Betina Hollstein · Wenzel Matiaske
Kai-Uwe Schnapp *Editors*

Networked Governance

New Research Perspectives

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Contents

Network*ed* Governance: Taking Networks Seriously

Betina Hollstein, Wenzel Matiaske, and Kai-Uwe Schnapp

Governance refers to the multitude of ways, mechanisms, and processes in which individuals, companies, organizations, societies, states, and supranational forms of organization arrive at and implement decisions. Governance in this abstract sense describes patterns of rules and mechanisms of social coordination and decision making in which a group of actors regulates its collective issues and interests (Mayntz 2009: 9). As a less abstract concept, governance is not just any mode of steering but a particular one, something done cooperatively in a network structure. The terms *governance* and *network*(*ed*) *governance* refer to a mechanism of reaching and implementing decisions whereby, instead of hierarchy and command or markets and prices, networks and cooperation are at work. Whereas government always entails a hierarchical component, governance does not even need to involve government or state actors (Fuster 1998: 68).

Governance research today faces ever more complex organizational forms that consist of different types of actors (e.g., individuals, states, IGOs, economic entities, NGOs), instruments (e.g., law, administrative decree, recommendations), and arenas from the local up to the global level. This increasingly questions theoretical models that focus primarily on markets and hierarchies as modes of

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governance. In this book, we seek to explore older as well as emergent forms of governance by combining theories and methods developed in social network analysis (SNA) and governance research. In so doing, the contributions assembled in this volume use concepts and methods of social network analysis to investigate governance processes.

This approach differs in important respects from the usage of the terms *network governance* or *governance networks* that has dominated the governance research literature so far. Starting in the 1990s, the terms *network* or *network organization* were increasingly used in the literature to capture the complexity and opacity of these newly emerging forms (Powell 1990; McPherson et al. 1992; van Waarden 1992; Alter and Hage 1993; Kobrin 1997; Keck et al. 1998; Uzzi 1999; Korzeniewicz and Smith 2001; Sassen 2001; Rohrschneider and Dalton 2002; Kern 2004; Hafner-Burton et al. 2009). In particular, two strands of governance theory arise from these contexts: network governance theory and nodal governance theory. Network governance theory has focused on formal governance networks, that is, public policy networks and issues pertaining to their management (meta-governance) and democracy (Torfing 2006, 2007). Nodal governance, on the other hand, has adopted a wider definition of governance to include various processes of networked governance that range from local security initiatives in South African townships to international trade agreements (Burris et al. 2005). Like network governance theory, nodal governance theory has scrutinized the normative implications of networked governance. Yet the latter has been more sensitive towards power inequalities (Burris et al. 2005). Whereas the theoretical and empirical foci differ, both approaches have in common that they have treated networks mainly as a metaphor and a theoretical notion rather than an empirical tool (Dupont 2006; Knox et al. 2006).

Only relatively recently have a number of researchers begun arguing that networks are not only suitable as a metaphor but also as a theoretical and empirical concept to describe distinct forms of governance (Wald and Jansen 2007; Lazer 2011; McClurg and Young 2011; Siegel 2011). In line with these theoretical considerations, a number of empirical studies have proven social network analysis to be a promising approach to understanding governance processes (Powell 1990; Windolf and Beyer 1996; Brandes et al. 1999; Brandes and Erlebach 2005; Agneessens and Roose 2008; Christopoulos and Quaglia 2009).

In this volume, we follow this line of thought. We argue that the analysis of their network structure is a prerequisite for a deeper understanding of what governance networks do and can achieve, why they achieve it, and what the social meaning of these networks is. Social action, interaction, and the formation of relationships—that is, social networks—make (wo)man a social animal. They are the very essence of society itself (Simmel 1908; Elias 1978). As Tilly puts it: "... transactions, interactions, social ties and conversations constitute the central stuff of social life" (Tilly 2004: 72). Neglecting this fact or simply giving it a metaphorical interpretation when analyzing governance networks risks forgoing major insights that one can gain when being attentive to the details of these structures and their analysis.

1 Social Networks and Social Network Research

Following J. Clyde Mitchell's classic definition, networks can be described as a "specific set of linkages between a defined set of social actors" (Mitchell 1969: 2) whereby both the linkages and the social actors can refer to quite different social entities. Actors can be organizations, political actors, households, or individuals. The linkages or relationships may refer to the exchange of information, resources, support, or to power relations. By way of formal and informal institutionalization of interaction, these relationships generate the very fabric of every organization, society, state, and supra-state. It is through this fabric that any type of social network, such as personal networks, informal networks within and between organizations, or power elites, emerges as a structure with a significant impact on its actors (Scott 2000; Scott and Carrington 2011). In contrast to most standard social science methodologies and theories, social network analysis does not attempt to explain differences among actors through their characteristics (attributes) but instead through the relations in which they are embedded (Wellman 1988; Wasserman and Faust 1994; Emirbayer 1997; Scott and Carrington 2011). In line with Georg Simmel's approach (Simmel 1908), social network analysis takes relations—rather than individuals and attributes—as the fundamental unit of social analysis (Wellman 1988; Hollstein 2001). With reference to Emirbayer (1997), Mische calls this the "anti-categorical imperative" of social network analysis (Mische 2011: 80). Going beyond even individual relationships, network research investigates the structure of the various relationships within a network (e.g., the formation of clusters or cliques) and the influence of structural properties of networks and social relations on social actors and social integration. This form of structural analysis "does not derive its power from the partial application of this concept or that measure. It is a comprehensive and paradigmatic way of taking social structure seriously by studying directly how patterns of ties allocate resources in a social system" (Wellman 1988: 20). Networks are made up of actors (nodes) and their interrelations (edges), which can be formally analyzed through the tools of social network analysis. For instance, information flow is a lot faster and norms are more effectively established in dense networks where a large number of people are acquainted with one another than in networks marked by a low density of relationships. At the individual level, dense networks provide more social support but also exert more social control (Coleman 1990). Another well-known structural property of networks is so-called structural holes (Burt 1992). Occupying such structural holes gives an entity privileged access to information, power, and influence (Padgett and Ansell 1993).

Moreno's sociometric studies in the 1930s and American community studies in the 1940s were early antecedents of contemporary network research in the social sciences. Interestingly, many of their first applications focused on governance issues, including the question of how to design and organize housing projects, schools, and prisons (Moreno 1936; Lundberg and Lawsing 1937). However, with the rise of computers, the focus of social network analysis partly shifted away from these substantial and applied questions toward methodological,

conceptual, and computational advances. The most important concepts developed in the 1970s and 1980s to describe social networks include cohesion, equivalence, centrality, and embeddedness (White et al. 1976; Freeman 1979; Wasserman and Faust 1994; Trappmann et al. 2005; Stegbauer and Häussling 2010). Although the field still profits very much from these developments, it has arguably hindered the integration of the fast-growing network paradigm and its scientific community into wider theoretical debates (Schnegg 2010).

Only in the 1990s, and strongly associated with the work of scholars like Ronald Burt and Harrison White, were major developments initiated that once again increased the value of social network analysis for the social sciences and humanities (Schnegg 2010). On the one hand, Burt and others argued that actors and their strategies had to be more rigorously included in the analysis of social phenomena (Granovetter 1985; Burt 1992). This perspective has enhanced our understanding of how people shape social structures creatively while acknowledging that those structures also constrain social action (hence, this is one part of network governance as governance of networks). On the other hand, a second major development is strongly associated with the work of Harrison White. He argued that social structures are always embedded in discourses that support or question them (White 1992, 2008). In doing so, he helped to overcome the gap between those social scientists who focus on social structures and those who search for culture and meaning (Hollstein 2001; Fuhse 2015). Both developments (re)link network research to larger theoretical debates in the social sciences (structure/agency, social structure/culture) and pave the way toward integrating the network paradigm into a wider theoretical context. The theoretical debate is also reflected in a significant increase in network studies that integrate quantitative and qualitative methods, that is to say, structural network data and the network perceptions and network practices of actors (Hollstein 2011; Dominguez and Hollstein 2014). The attractiveness of relational analysis (White 2008; Mützel and Fuhse 2010) is becoming more and more recognized theoretically and, as this volume will demonstrate, also offers fresh and fruitful perspectives on governance as a process of coordination.[1]

2 Organization of the Book

It is this contemporary analytical approach of social networks and social network analysis, which refers to an ensemble of specific concepts and methods used to collect and analyze sets of relational data (e.g., Wasserman and Faust 1994; Scott and Carrington 2011; Dominguez and Hollstein 2014), that provides the main thrust of this edited volume. As the volume will demonstrate, the basic assumption of social network research—namely, that an empirical analysis of social relations can provide a deeper understanding of the functioning, success, and failure of old as

[1]For a more extensive treatment of the history of social network analysis, see Freeman (2004), Schnegg (2010), Scott and Carrington (2011), Ward et al. (2011), and Carrington (2014).

well as new organizational forms and governance structures—has proven to be a fruitful approach in many research contexts. An analytical approach to social networks furthermore provides orientation for empirical research and helps to avoid widespread "normativisms" that frequently accompany the discovery of networks as new entities in economics, politics, and society.

We aim to advance *networked governance* as a more general research paradigm that focuses on processes of coordinating, reaching, and implementing decisions that take place in network(ed) (social) structures. By combining theories and methods developed in social network analysis and governance research, an international group of scholars from the fields of anthropology, economics, political science, and sociology has explored established as well as emergent forms of governance and explores processes and mechanisms of networked governance. The starting point for this book was a lecture series organized by the editors and held at the Center for Globalization and Governance (CGG) at the University of Hamburg in 2012 and 2013.[2] The contributions thus take into account the increasingly complex forms that governance takes, which consist of different types of actors, instruments and norms, as well as arenas from the local up to the global level. The topics addressed in this volume are the processes of coordinating, reaching, and implementing decisions that take place in network(ed) social structures, such as the governance of financial markets, environmental governance, and the governance of knowledge production, innovation, and politics. These processes are investigated and discussed from the viewpoints of sociologists, political scientists, and economists who are seeking to encourage the exchange of ideas, concepts, and approaches between different fields and disciplinary perspectives. The contributions to this edited volume all adhere to the basic assumption of social network research outlined above and sketch possible paths that research in this field might take in the future. The chapters address important questions and engage in cutting-edge debates in the different areas on which they focus, thereby making a substantial contribution to the field of networked governance.

The book consists of four parts. The articles in part I, *Networked governance: General issues*, represent disciplinary viewpoints brought together in this volume: political sciences (Christopoulos), sociology (Jansen), and economics and management research (Sydow). The authors discuss fundamental issues and questions relevant to networked governance: the question of how relations between (political) actors are associated to political outcomes (Christopoulos), the role of social networks and social capital in knowledge production (Jansen), and ways of managing (inter-organizational) networks (Sydow, Jansen). The contributions in part II, *Types, processes and limits of networked governance*, present studies that demonstrate the use and the potential of the social network approach when investigating governance in different societal arenas. These studies range from the macro to the micro level, such as the governance of financial markets (Mayntz), the coordination

[2]We are grateful to the School of Economics and Social Sciences at the University of Hamburg for their financial support of this event.

of action in heterogeneous "interstitial" communities (Korff, Oberg, and Powell), the network self-management of individuals at social networking sites (Grabher and König), and the social embeddedness of individual educational decisions (Heath, Fuller, and Johnston). The contributions in part III, *Methodological approaches*, present different ways to investigate networked governance processes: simulations (Pfeffer and Malik), stochastic actor-oriented models (Mohrenberg), experiments (Schwaninger, Neuhofer, and Kittel), and complex mixed-methods designs (Gluesing, Riopelle, and Wasson). At the same time, the chapters offer valuable insights into specific fields of research, such as policy diffusion (Mohrenberg), social exchange (Schwaninger, Neuhofer, and Kittel), and environmental governance (Gluesing, Riopelle, and Wasson). The volume closes with a chapter that sums up major results, draws conclusions, and assesses prospective lines of future research (Hollstein, Matiaske, Schnapp, and Schnegg).

To illustrate the wide spectrum of possible uses of the social network concept in investigating governance processes and, at the same time, to encourage the discussion of the (somewhat similar) theoretical and methodical problems across different subjects, the book includes studies from diverse areas of application. The contributions thus represent governance processes that take place in various arenas and network(ed) (social) structures, such as policy networks, international institutions, multi-stakeholder contexts, inter-organizational networks, heterogeneous interstitial communities, or personal networks. The network processes involved take place at different societal levels (from diffusion of policies to personal influence) and can take very different shapes—from reflexive relationship management to path dependency and network influences beyond the consciousness of the actors.

3 The Contributions

The first part of the book introduces the disciplinary perspectives assembled in this volume and discusses general issues. It starts with a contribution by *Dorothea Jansen* addressing fundamental concepts, questions, and discussions relevant to networked governance. By focusing on the governance of innovation, learning, and knowledge production, Jansen argues that networks are a more complex and sophisticated mechanism of coordination than either markets or organizations. Introducing the concept of social capital that is embedded in social networks, she demonstrates that a network approach can help to determine why and when which type of network structure and which network ties foster the process of knowledge production. She also tackles the question of governing networks by means of incentives or institutions and outlines a more macro-level interpretation of networks of knowledge production and innovation as a new governance form. The governance of networks and the question of whether and how (inter-organizational) networks can be managed is discussed by *Jörg Sydow*. On the basis of studies on the management of inter-firm networks, he conceptualizes managing inter-organizational networks from a structuration perspective that is able to capture the genesis and dynamics of these networks and their reliance on individual and

collective actors. As he argues, there is an inherent tension between emergent features of existing inter-organizational networks and the active governance of their network structure and performance. Path dependency and uncertainty mark the extreme ends of the continuum between which much of network management takes place. In the third chapter, which is devoted to general issues, *Dimitris Christopoulos* provides an overview of governance networks in politics with a focus on governance as the process as well as a product of political relations. He outlines key parameters for capturing network properties of and network influences on political action, political power, and decision making. In addition, he examines the mechanisms through which agent relations affect power and the impact this has on governance process and outcomes. Christopoulos argues that studies of governance networks should ideally combine analyses of interactions, resource transfers, asymmetric power relations, and the values of key political actors.

On the basis of case studies, the chapters in part II focus on certain types, processes, and mechanisms of networked governance in different societal arenas, ranging from the macro to the micro level. *Renate Mayntz* investigates international institutions of financial market regulation and their changes after the 2008 financial crisis. Applying a social network approach, she describes various aspects of the structure of the network that governs financial market regulation and its changes following the reform (tightened relations, expanded scope of the network). However, her contribution also demonstrates that in order to understand the effectiveness of a network and a type of governance system, the relationships between actors must be scrutinized carefully, for example, with regard to their nature and purpose. Taking into account the newly emerging and increasingly complex forms of governance, *Valeska Korff*, *Achim Oberg*, and *Walter Powell* discuss how networks coordinate and commit communities of individuals and organizations to common causes and agendas, and how disparate actors govern their behavior in the absence of clearly established rules and norms. In addition to other types of networks such as brokerage networks, social movements, and technology clusters, they introduce interstitial communities as a particular form of networked governance in which disparate actors (individuals, organizations) come together, convene, share ideas, and refine new practices. Whereas the former *join* actors in a given field, interstitial communities *create* such a field and open new developmental trajectories. A completely different form of decision making is presented in the subsequent chapter by *Sue Heath*, *Alison Fuller*, and *Brenda Johnston* on how personal networks govern individual educational decisions. Their case study illustrates different ways in which the decision to pursue higher education is influenced by one's personal network. With regard to networked governance understood as a process of arriving at *collective* decisions, this study clearly marks a border case. Nevertheless, the study nicely demonstrates the social embeddedness and complexity of what we usually consider an *individual* decision. Furthermore, in focusing on those who did not pursue higher education, the study questions the voluntary and conscious character of decisions and brings to the fore the significance of identities, norms, habits, and habitus (Bourdieu 1984) in understanding individual action. The last chapter of part II by *Gernot Grabher* and *Jonas König* is again concerned with

the management of networks—in this case, the management of personal relationships on social networking websites. Interestingly, the authors find a generic type of performativity, something they call reflexive relationship management: actors perceive and describe themselves and their actions through the vocabulary of social network theory. Not only do people describe themselves in this way, they also use knowledge from social network theory and evidence from network research to shape their own personal networks. Furthermore, Grabher and König show that the active governance of personal networks is an intentional activity that is carried out first and foremost to be able to produce other governance results with the help of the respective network.

Part III presents methodological approaches to the investigation of networked governance processes: *Jürgen Pfeffer* and *Momin Malik* provide an overview of the use of computer simulations for the investigation of social networks and governance processes. By reviewing classical studies on the evolution and dynamics of complex socio-economic systems, they discuss opportunities and limitations of simulations, with a special focus on agent-based models. In his chapter on policy diffusion, *Steffen Mohrenberg* presents another way to study network dynamics. As a method especially appropriate to probe into causal relations and questions of influence and selection, he focuses on stochastic actor-oriented models (SAOM) as developed by Tom Snijders and his group. In diffusion research, SAOMs can be used to better understand how beliefs spread in social networks and to show how decisions are formed as consequence of network structure, its evolution, and the diffusion of beliefs. *Manuel Schwaninger*, *Sabine Neuhofer*, and *Bernhard Kittel* focus on basic problems of network formation and social exchange in networks and review the use of experimental methods, especially laboratory experiments. They discuss the limitations of and prospects for laboratory research in the investigation of networked governance. Experimental research can help identify actors who shape networks as well as the effects of network structure on the ability of actors to further influence network structure. Finally, by integrating standard instruments of (quantitative) SNA with interpretative approaches, *Julia Gluesing*, *Ken Riopelle*, and *Christina Wasson* present not one method but rather a methodological toolbox for the analysis of networked political decision making. In their study on environmental governance within local multi-stakeholder contexts, they demonstrate how networks, policy content, and the collective construction of meaning inside networks can be analyzed to provide a deeper understanding of the processes in governance networks. In the final chapter, *Betina Hollstein*, *Wenzel Matiaske*, *Kai-Uwe Schnapp*, and *Michael Schnegg* relate this new research perspective on networked governance to network governance research as it has developed over the last decades. They present a classification of networks as institutions and discuss the relations between actors and networks. They sum up the major results of the contributions in this volume and advance *networked governance* as a more general research paradigm that focuses on the processes of coordinating, reaching, and implementing decisions that take place in network(ed) (social) structures.

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Part I

Networked Governance: General Issues

Networks, Social Capital, and Knowledge Production

Dorothea Jansen

1 Introduction

Knowledge, its use and production, is seen as the central resource within societies and organizations today. Modern societies are no longer characterized as industrial societies but as knowledge societies; modern economies are knowledge-based economies.[1] Social and economic development and performance depend on the capacity of individuals and organizations to continuously search for and exploit new knowledge (i.e., their capacity for innovation).

Thus, not just corporate R&D but the whole system of innovation, including higher education and the state-financed research system (Nelson 1987, 1993;

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[1] A knowledge-based economy is characterized by the fact that the competitive edge of firms has changed from price competition to continuous innovation and improvement (OECD 1998). Besides rapid changes in goods and services, it involves the creation and management of change becoming a mission in itself and knowledge transactions becoming more important and more numerous (Maskell 2000; Weingart 2001).

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Freeman 1988; Lundvall 1992, 2002), is evaluated from the point of view of its contribution to the production and diffusion of knowledge, industrial innovation, and the competitiveness of national or European industries. The central thesis underlying this chapter is that, today, innovative capacity and the production of knowledge increasingly depend on personal and organizational networks. New approaches to the theory of the firm claim that the superiority of organizations over markets owes to their advantage in creating and sharing knowledge (Kogut and Zander 1992, 1996; Nonaka and Takeuchi 1995; Spender 1996; Foss 1999; Nelson and Winter 1982). But, in fact, neither the firm or organization nor the market can stimulate and coordinate the production of knowledge satisfactorily. Networks can be expected to become an additional and dominant mechanism for balancing innovation and coordination.

First, I will deal with the concept of knowledge, types of knowledge, and the knowledge process as well as with related concepts such as innovation and learning. Second, I will elucidate the argument about networks being a more sophisticated mechanism of coordination than either markets or organizations. I will introduce a concept of social capital that is embedded in social structure or networks. A social network approach can help to find out why and when which type of network structures and which network ties promote the process of knowledge production and innovation at the meso level of organizations. A central result of this discussion is that there is a trade-off between the benefits from either cohesive, dense networks or sparse, far-reaching networks and weak ties bridging so-called structural holes. In section "Network Strategies, Competencies, and the Governance of Networks", I will tackle the question and review some empirical evidence as to which type of network structure under which conditions is better suited for the process of producing knowledge. I will present some arguments on why conditions of increasing interdependence and volatility render an innovative network strategy in R&D more important. I will then address the question of how the trade-off between dense networks and structural holes and between innovation-breeding incentives and trust-breeding institutions is solved in networks. Finally, I will outline a more macro-level interpretation of networks of knowledge production and innovation as a new governance form.

2 Knowledge, Innovation, and Learning

Knowledge is more than information or data.[2] Knowledge shapes mental models of reality for individuals and organizations. It is underpinned by experience, judgments, and values. It depends on perspectives and goals (Huseman and Goodman 1999: 107; Rehäuser and Krcmar 1996: 5; Venzin et al. 1998: 44ff.).

Knowledge comes in several types; it displays cognitive, economic, and social dimensions. There used to be a rather strict line of differentiation between technical

[2]Information is defined as data (signs + syntax) that are put into a context of a problem at hand. Knowledge is the goal-oriented integration of several informational elements (Steinmüller 1993: 236).

knowledge accumulated by crafts and professions and scientific knowledge developed by academic research. Technical work aims to produce functional artifacts and is governed by technical rules, that is, by inequalities and means–ends relations. Scientific activity, on the other hand, strives for truth, scientific laws, and equations. It accepts high uncertainties and an open timescale en route to new knowledge. Scientists prefer simple systems and reduce reality to models with few elements and relations. Technologists, by contrast, prefer less risky ways of developing new applications within a shorter timeframe. But technical knowledge is at the same time more complex and concatenated. It tries to represent a real-world phenomenon in all varieties and synthesizes all available pieces of knowledge (Sahal 1981; Rosenberg 1982; Pavitt 1991; Nelson and Rosenberg 1993; Faulkner 1994). Nelson (1989: 233) denotes this difference in terms of openness/generality versus the specificity of knowledge as "generity." Technology is specific in that it tries to take into account all those context variables that science ignores but are essential for the effective functioning of an artifact or process. The aim of this endeavor is of course to shield the artifact or process from potentially conflicting contexts, so that they can be operated by users who have no profound technological understanding (for instance, when driving a car or operating a PC).

The clear line between science and technology today has become blurred in the cognitive, social, and economic dimensions. Beginning in the nineteenth century in the areas of chemicals and electrical engineering, industry became more and more science-based. Among the science-based industries today are not just typical high-tech industries such as biotechnology and semiconductors but also traditional industries such as food processing, ceramics, and mechanical engineering as well as the service sector, for instance, transport and media. The interaction between science and technology is particularly intense in areas where a scientific breakthrough leads to a change in a technological paradigm (Dosi 1988). Interaction, whether in the cognitive or in the social sense, is not a one-way street. Technical problems raise serious scientific questions, and scientific knowledge gives rise to technical applications. In modern-day society all of this happens on an accelerated timescale. The time from discovery to commercial exploitation is growing shorter and shorter. At present, so-called strategic research, which produces the background knowledge required for the development of new technologies, is conducted not only in industry but also in public-sector science (Rosenberg 1990; Brooks 1994; Faulkner 1994; Gibbons et al. 1995; Schulz-Schaeffer et al. 1997; Jansen 1995a, 1996).

From an economic perspective, knowledge can be a public good, a private good, or a sort of collective asset of a group, an industrial sector, or a profession. Academic knowledge used to be a public good,[3] whereas technical knowledge

[3]Knowledge, and particularly fundamental scientific knowledge, used to be thought of as a pure public good. Since Arrow (1970), it is widely held that fundamental knowledge is not marketable since nobody can be excluded from its use. Once you know the "product," you can use this knowledge "for free" without having to pay for it. Moreover, knowledge does not diminish when it is used; the consumption of knowledge does not bear the characteristic of rivalry in consumption. This state of affairs used to legitimize public financing of basic research since otherwise basic

tended to be of a more private type, often protected by property rights (Schott 2001; Stiglitz 1999; Dasgupta and David 1994; Cowan et al. 2000). Some technical knowledge is of course of a more generic type, not specific to the products and processes of a particular firm. This knowledge pool is a collective asset of an industrial sector or of professional and trade associations; it is also developed by these industries or trades as well as technical colleges and similar research institutions. How to design a governance system that gives due credit to the use of commons of pre-existing knowledge is [still] an open question. Another problem is that property rights to knowledge, while stimulating innovation, pose the danger of monopolistic positions that might block further innovations.

In addition to property rights, the protection of private knowledge in the firm is to a great extent based on the cognitive characteristics of technical knowledge. Such knowledge is not only specific in such a way that it might not be of much value to other users (Nelson 1989) but is also tacit to a large degree (Polanyi 1962, 1966). Tacit or implicit knowledge is a sort of specific knowledge that is not explicated. Tacit knowledge is difficult to codify; it is personal and contextual and cannot be easily aggregated or transferred. Explicit and codified knowledge, by contrast, is easily communicated, and it is thus almost impossible to keep it private and secret.

With the advent of so-called strategic research, the ability to predict the economic characteristics of knowledge on the basis of the organizational home of its producer changed dramatically as did the correlation between the organizational homes of knowledge producers and the cognitive characteristics of this knowledge. Today, industrial research groups conduct basic research and publish their results in openly accessible literature, and academic groups patent their findings and sell them to companies. In summary, along with the strengthening of the interaction between science and technology has come a move towards interests in the specifics of an application and in its economic value on the part of academia, while industry has acknowledged the need to conduct fundamental research resulting in generic knowledge as a collective asset (Gibbons et al. 1995; Etzkowitz and Leydesdorff 1997, 2000; Nowotny et al. 2001) (Table 1).

Considering the social basis of knowledge, we have to take into account that knowledge can be of an individual or an organizational/collective type. In the case of individual knowledge, this type is stored in people's brains and bodily skills. The theory of the firm and theories of organizational learning have in the meantime conceded that organizations command knowledge, as well. They know at once

knowledge would be undersupplied. But this is not the whole story. Even knowledge as a public good cannot really be taken from the shelf and put to new applications without further investments by the user. And its potential value can only be recognized if a firm is involved in the knowledge process and knowledge community producing this new knowledge. This is one of the causes of the increasing importance of non-market processes. The necessity to ensure this absorptive capacity to some extent lowers the temptation for free-riding on the knowledge investments of other actors. To make use of their knowledge, you must invest in its "absorption" and thereby you (inadvertently) contribute to the collective knowledge pool. This underlies the growing activities of industry in basic research.

Table 1 Explicit and implicit knowledge at the individual and collective level

Knowledge is	Individual	Social (group, organization)
Explicit/Codified	Conscious concepts	Objectified stories, missions, rules, manuals, etc.
Implicit/Tacit	Automatic skills	Collective genres (how things are done around here)

Adapted from Spender (1996: 52) and Cook and Brown (1999: 391), see also Lam (2000) and Collins (1993)

Table 2 Types of knowledge and knowledge conversion

	End point	
Starting point	Implicit	Explicit
Implicit	Socialization	Externalization
Explicit	Internalization	Combination

Nonaka and Takeuchi (1995: 62)

more and less than what their members know.[4] The difference between individual and organizational knowledge is mostly due to tacit organizational knowledge. The latter is embedded knowledge. It consists of shared metaphors and norms as well as of knowledge about communicative and collaborative practices in an organization over and above encoded, explicit knowledge such as official rules, blueprints, and manuals (Lam 2000; Nahapiet and Ghoshal 1998; Venzin et al. 1998) (Table 2).

Nonaka and Takeuchi (1995) and Nonaka et al. (1998) analyzed the organization of knowledge by cross-tabulating the two types of knowledge according to their starting and end points. The process of codifying implicit knowledge via dialogue and reflection is called *externalization*. *Socialization* involves an interactive process of transferring implicit knowledge from one individual or group to another. *Internalization* refers to applying explicit knowledge to new contexts. This learning by doing yields new contextual, implicit knowledge at an operational level. Finally, *combination* puts pieces of explicit knowledge together.[5] The process of externalization in particular is highlighted as a process of creating new knowledge for the corporation.

The advantage of codifying implicit knowledge to turn it into explicit knowledge is very much debated. Mueller and Dyerson (1999) pointed to the risk that educated employees who know explicitly instead of implicitly about the technology of the firm might leave. This would not only entail a loss of investment in human capital but also knowledge drain. Kogut and Zander (1992) identified a paradox of

[4]Hedberg (1981), Nelson (1977, 1982), Argyris and Schön (1978), March and Olsen (1976), Levitt and March (1988), Simon (1991), Dodgson (1993), Cohen and Sproull (1995).

[5]Combining knowledge of a codified type but also using tacit knowledge will yield concatenated knowledge, which is typical of scientific instrumentation and technical engineering. This type of knowledge is produced in application contexts (transdisciplinary knowledge). This type of research is of a more applied type and can build bridges between basic and applied research (Jansen 1995a; de Solla Price 1984). It is typical of the so-called mode 2 of knowledge production (Gibbons et al. 1995).

replication: "Whereas the advantage of reducing costs of intra- or inter-firm technology transfer encourages codification of knowledge, such codification runs the risk of encouraging imitation" (390).

On the other hand, the fact that much knowledge necessarily remains tacit and embedded in the social routines of communication and collaboration will always make it difficult to take away knowledge from an organization.[6] Knowledge is a largely intangible asset. The capacity of a firm to use its knowledge and combine and process different pieces of knowledge is thus a core competence that is not only difficult to measure precisely but also difficult to imitate (Winter 1987; Hamel and Heene 1994; Henderson and Cockburn 1994; Zander and Kogut 1995; Venzin et al. 1998; Barney 1991).

Besides types of knowledge, we also have to distinguish between knowledge and knowing (Cook and Brown 1999). Knowledge is something you possess. Knowing is something you do using knowledge of several types. You possess the tacit skill of riding a bike and/or the explicit knowledge of how to stay upright even if you are not riding at the moment. In many cases, using knowledge means adapting knowledge, creating new knowledge (i.e., learning).[7]

A connection can be drawn between this insight and the inflation of types of learning in the literature, such as learning by doing, using, interacting, or imitating.[8] The general thrust of the argument is that the application and transfer of either explicit or implicit knowledge involves learning and innovation. The contexts are always different, for instance, when implementing a new machine into an existing production flow, when reengineering the product of a competitor, or when using new kinds of instruments in scientific research. And this is the reason for the creation of new knowledge.

Knowledge can be created by different types of inquiries. Following Argyris and Schön (1978), I distinguish between single- and double-loop learning. Single-loop learning is adaptive learning, an incremental change in routines and concepts. It very often yields tacit knowledge, which is localized and context dependent. Double-loop learning extends not just to an action as such but to the premises of action, to the concepts and routines themselves. Thus, it tends to create knowledge of a more explicit type. These two types of learning are echoed by two types of innovation and two types of science. Incremental innovation follows the established path of a technological paradigm, a dominant design (Dosi 1988; Anderson and

[6]See Buskens and Yamaguchi (1999: 303) on the longer diffusion times in transit models compared to contagion models. In transit models, a resource actually travels within a network (e.g., a scientist with particular tacit knowledge), whereas in contagion models, a resource is duplicated by any transfer that stays with the transmitter and the receiver (such as explicit knowledge). Also the effect of local density (i.e., social closure) on trapping information in a special corner of the network is more severe in the transit model.

[7]Thus, Cook and Brown redefined the spiral of knowledge by insisting that knowledge is not converted but new knowledge created.

[8]von Hippel (1988), Rosenberg (1982), Lundvall (1988, 1992), Johnson and Lundvall (1991), Dodgson (1993).

Tushman 1990). Radical innovation establishes a new technological paradigm. The everyday business of routine science is spelling out the details of an established scientific paradigm. Revolutionary science, by contrast, means discarding the old paradigm, seeing things anew, a change of gestalt (Kuhn 1962/1976). Single-loop learning can be trapped in local maxima. Double-loop learning devalues established capital of all sorts; it is creative destruction (Schumpeter 1934, first published 1911, 2000).

Finally, there is the form of deutero-learning (i.e., reflexive learning). It involves establishing the capacity for creativity, innovation, and change management on a permanent basis. It means changing concepts and identities and choosing deliberately between them not only in times of crisis but constantly. It means putting one's identities and core competencies up for debate, to be willing to intentionally create a challenging and even destructive environment. Since even science is mostly routine, evolutionary science, neither individuals nor organizations can accomplish this easily. Of utmost importance for this capacity is the loosening of the boundaries of the organization by personal and organizational networks that transcend its boundaries.[9] These networks of an organization constitute social capital that can be converted into absorptive capacity, scientific discoveries, and inventions and innovations (Jansen 1996).[10]

3 Production of Knowledge by Organizations, Markets, or Networks?

There are several arguments for expecting better performance in the production of new and still uncertain knowledge by networks of organizations rather than by any single organization or organizations in a market. Since Schumpeter, innovation has been seen as something that happens at the margins, in connecting and combining ideas, markets, designs, or materials that have yet remained unconnected (Schumpeter 1934). Several organizational forms such as the functionally differentiated form, the divisional form, the matrix form, or project groups derive their rationale from the idea that combinations of differences are productive. This applies even more so to the combination of organizations into networks.

Organizations themselves suffer from a built-in resistance to change (Jansen 2002b). From an economic perspective, organizations are mechanisms to guard against opportunism via hierarchy and exploit economies of scale by specialization

[9]See Jansen (1997, 2000b) concerning the capacity of organizations to evaluate and choose between learning strategies and learning environments.

[10]Innovation used to be defined as the first marketing of a new product or the first introduction of a new process. It was preceded by the stage of "invention" (i.e., making a design for a product/process by applying several types of knowledge) and followed by the diffusion of the new product/process. Nowadays, these stages are no longer neatly differentiated. Many feedback loops have to be acknowledged (Kline and Rosenberg 1986; Brooks 1994; OECD Oslo Manual 1992; Schumpeter 1934).

(Williamson 1991; Chandler 1977). Organizations are well designed for the exploitation of existing knowledge and competencies and less well equipped for the creation of new knowledge. From the perspective of sociological institutionalism, organizations are instruments for the reduction of uncertainty; they establish routine ways of doing things. They are governed not just by efficiency and effectiveness but are also required to sustain collective identities and legitimacy (March and Olsen 1989; Powell and DiMaggio 1991). The need to maintain organizational identity imposes constraints on the possibilities for variation and innovation within an organization. Organizational ecology even posits that the structural inertia of organizations makes change of any kind impossible. According to this view, change and innovation can only come about through the death of old populations and the birth of new organizations/disciplines/industries (Hannan and Freeman 1984). If organizations change at all or new organizations come into existence, this is seen as an effect of competition in markets (Hayek 1979: 94; Nelson 1987, 1988 on markets and the production of variety).

But markets are poor instruments for coordination. They are restricted to a single guiding mechanism (prices) and imply a very restricted conception of relations (arm's-length and short-term). The idea of the market puts a great deal of emphasis on selection by competition and tends to neglect the preselection processes within organizations. It could well be that organizations could be more successful in adapting to market competition if preselection was performed by networks rather than by an organization on its own. Moreover, the process of intentional generation of variations and new ideas has not been examined sufficiently. Markets alone are too weak a mechanism to ensure that organizations adopt innovations. Besides self-learning under competitive pressure, there are several other mechanisms that are supported by networks: imitating or even collaborating with rivals, collaborating with customers and subcontractors, setting of standards among an industrial group, or the birth of new businesses via joint ventures.

Networks of organizations can make use of the special qualities of organizations. These are specialization, economies of scale, a focus on core competencies, the establishment of a collective identity, and the reduction of uncertainty. Networks of organizations can also make use of the qualities of networks: variety, a mix of collaboration and competition, loose coupling, and differentiation and co-specialization within a structure. These advantages have resulted in a steep increase in corporate alliances and small business networks, particularly in R&D and joint ventures in new technologies since the 1980s (Jansen 1995b; Hagedoorn et al. 2000; Hagedoorn 2002, 2003; Todeva and Knoke 2002; Noteboom 2003). At the same time, inter-organizational collaboration and networks have become buzzwords in universities and state-financed research organizations (Etzkowitz and Leydesdorff 1997, 2000; Nowotny et al. 2001). Thus it may well be worthwhile to take a deeper look at the relation between knowledge production and networks.

The main producers of new knowledge today are not individual researchers or entrepreneurial inventors but research groups collaborating within and across organizations. These groups are embedded in different types of organizations (academic, government, industry), disciplines, and industrial sectors. They interact

with other organizations and groups from diverse settings such as funding agencies, customers like the military or hospitals, or production engineers.

New knowledge—and especially basic innovations and new paradigms—emerge mostly at the margins of disciplines, organizations, and sectors.[11] Such knowledge is produced by combination and exchange. This is why embeddedness in a knowledge community via research contacts, the flow of information, knowledge, materials, instrumentation, and people engaged in research collaborations can be treated as a kind of social capital.

I define those aspects of a network structure[12] that open or constrain opportunities for action for individual or corporate actors as social capital (Jansen 1996, 2000a; Bourdieu 1983; Coleman 1988, 1990; Lin et al. 2001). Social capital can be converted into other forms of capital. It can help with market entry, inspire an idea for a new product, or help in overcoming problems of collective action. But an overdose of embeddedness in so-called strong ties can also hamper innovation and produce too much confidence in established routines and products (Burt 1999; Kern 1998; Glasmeier 1991; Werle 1990; Grabher 1990; Anderson and Tushman 1990; Jansen 2002a).

The benefits of social capital are information/knowledge, trust in and enforcement of norms, brokerage positions that yield structural autonomy and entrepreneurial profits, and finally social influence that comes from the legitimacy and reputation attributed by other relevant actors. The benefits accrue to individual and corporate actors, to groups of actors within a social structure, for instance, to an industrial sector or to a whole network.

Different benefits from social capital are based on different social ties and structural configurations. Structures and positions that are beneficial in one regard (e.g., entrepreneurial profits) can be detrimental to other goals (e.g., sustaining

[11] von Hippel (1987, 1988), Tushman and Nadler (1986), Blackler et al. (1998), Gibbons et al. (1995), Knorr et al. (1980), Lemaine et al. (1976), Mulkay (1972), Schumpeter (1934, 1946), Tushman and Anderson (1986), Henderson and Clark (1990), Henderson and Cockburn (1994), Nahapiet and Ghoshal (1998), Alchian and Demsetz (1972) on co-specialized assets, Crane (1972) on invisible colleges.

[12] Networks in a methodological sense consist of a set of nodes (actors, events, ideas) and the edges/relations that they define (e.g., information flow, influence, membership). From a technical point of view, a market is thus a special kind of "network." Nevertheless, the term *network* as used in the literature usually denotes an entity different from a market. It starts from a different conception of man as embedded in social structures and thereby less under-socialized than *homo economicus* and ends in a critique of equilibrium theory, which assumes that prices tell us all we need to know and that transactions with each and every market partner are a viable option for any market participant irrespective of constraints in time, place, matching opportunities, etc. (Baker 1984; Granovetter 1985; White 1988; Podolny 2001). Part of the arguments of new institutional economics and its analysis of networks as hybrid governance structures (Williamson 1991) are therefore matched by sociological network theory (for the differences, see Jansen 1996, 2002a). At the same time, social network analysis provides an analytical tool that is able to tackle all sorts of structures. Thus we need not presuppose that a structure is hierarchical (organizational structure) or atomistic (pure market). Rather, this issue can be dealt with as an empirical question in the analysis.

social influence). The level of analysis is also important. Structures and positions that yield high benefits to one actor may be to the disadvantage of a group or the network as a whole. And benefits to an actor may depend on his or her personal network, the person's position in a group within the network, or on properties of the network as a whole. Thus social capital partly displays some features associated with private goods and others typical of collective goods. This also comes to the fore when we try to invest in social capital. We never fully own our social capital because it depends on relations and indirect relations to other actors who also have a say in this.

As for the structural basis of social capital, the main differentiation is between so-called strong and trusted ties in densely knit networks and so-called weak ties in sparse, extended networks. The latter yield information and structural autonomy for brokers. These brokers can bridge so-called structural holes and thereby combine diverse information/knowledge, transfer knowledge, or extract arbitrage profits from their unconnected partners. Dense networks, by contrast, promote collaboration, the exchange and production of tacit knowledge, trust and shared norms, and collective action of all sorts.

Tie strength and network structure need not be directly associated: bridging relations need not be weak, and cliquish relations between a group of actors need not be strong. In the tradition of Simmel's formal sociology, Burt's (1992) theory of structural holes claims that the structural pattern is most important. Thus he expects closed networks to impose constraints upon actors and brokerage positions in which ego's partners are not linked with one another, regardless of tie strength, to give rise to entrepreneurial opportunities.

The central question now is which type of tie and which type of network are more successful in innovation and knowledge production in the long run. What is the role of norm- and trust-breeding cliquish relations in knowledge production? Will they bring about stability at the cost of innovation and learning capacities? How important are weak ties? What is the role of unconstrained brokerage positions in the knowledge process? What is the effect of brokerage between cliques? Since network structures and ties that prove to be functional in the exchange of codified and public knowledge may not be functional in the transfer and creation of implicit or proprietary knowledge, the ultimate question will probably be how to balance both types of ties and closed and open networks in an overall innovation network. And what does the acceleration of the knowledge process and intense feedback between basic research, technical application, and markets imply for network structures?

4 Network Strategies, Competencies, and the Governance of Networks

When evaluating the opportunities for knowledge production in networks, we have to distinguish between two problems. The first is a cognitive problem. How might the fundamental uncertainty in search processes be managed given the bounded

rationality and local intelligence of humans (March and Simon 1958)? How could an intentionally rational search come to terms with the trade-off between exploiting existing knowledge, competencies, and machinery and exploring alternative opportunities? The second problem is a motivational one: How to construct a system of incentives and institutions that will guard against opportunistic behavior in networks. Which type of network structure, which positions in networks, which type of tie can successfully deal with these problems?

4.1 Stability and Dynamics of Knowledge and Competencies

The problem of how to manage the trade-off between exploitation of existing knowledge and exploration of new knowledge boils down to whether to engage in a local or long-distance search. The typical routines of people and organizations are of course local search and incremental innovation processes (Nelson and Winter 1982; Simon 1991).

Evidence from complexity science and network analysis show that there is a relation between pre-existing network structures and size as well as between the returns from an innovative and a conservative local strategy. The general mechanism underlying this evidence is the effect of size, interdependency, differentiation, and speed on volatility. The larger the markets/networks, the more structuration and differentiation evolves because of the bounded rationality of humans. Growing markets/networks give rise to dense regions of cliques and structural holes between them. Trading within cliques reduces risk. But since large networks cannot be fully connected, the gaps that inadvertently come into existence produce volatility, for instance, in financial markets (Baker 1984). Simulation studies show that in addition to network size, shorter transmission times and more differentiation in networks produce more volatility (Baker and Iyer 1992). This devalues existing knowledge and competencies.

The stronger the interdependencies between agents in models of complex adaptive systems, the more it pays to innovate (Levinthal and Warglien 1999: 347f). Introducing interdependence between agents striving for fitness means that clear fitness landscapes with a single peak turn into rugged landscape with several peaks. In a single-peak environment, no matter what strategy agents opt for, whether it be incremental change or wide-ranging exploration, they will sooner or later reach the peak. By contrast, in a rugged landscape, a strategy of incremental change will trap them in local maxima. Reaching a higher peak via short leaps requires traversing a valley of decreased fitness.

In real life, interdependencies between actors and organizations increase with the acceleration of communication and production processes. Globalization, the World Wide Web, and improved information and communication technologies all strengthen interdependencies.

Although necessary because of increased speed and interdependence, wide-ranging changes (long leaps) are naturally very dangerous. Most of them will come with a loss of fitness. It makes for a good compromise between incremental and radical strategies of learning to put together expertise, ideas, or artifacts that have proven to be instrumental in different contexts. Levinthal and Warglien (1999) used these insights for organizational design and pointed to new forms of innovation and product design as examples (see also Kline 1985; Wheelwright and Clark 1993; Blackler et al. 1998; Sutton and Hargadon 1996 on wisdom vs. creativity). Therefore, to confine oneself to new combinations of "existing solutions" is probably a well-adapted strategy in a rugged fitness landscape (i.e., a rapidly developing field of science and technology).[13] This ensures a balance between exploration and exploitation.

This balance used to be guaranteed by cognitive and normative standards of science and technology: by the scientific paradigms that guided academic research and by the technological paradigms, learning curves, and vested interests in production machinery and skills that guided technological innovation. An even more heterogeneous mix of viable partial solutions and the exploration of new combinations could be a promising route to new knowledge. Since adherence to a specific "solution" is tightly coupled with an organization, more variety and innovation can be expected from collaboration between different organizations than from collaboration within an organization. There is evidence that the scientific performance of research groups is enhanced by organizational heterogeneity in their collaboration network and by the number of different disciplines in the research groups (Jansen 2000a). Innovativeness in terms of the patent output of a technological alliance is higher when the partners come from different technology clusters (Stuart and Podolny 1999).[14] Thus collaboration with partners from outside the established technological or disciplinary position of an organization and across different institutional settings is a strategy to overcome the boundaries of local search routines within an organization.

However, the dissimilarity and heterogeneity of organizations and ideas can very well be too large for successful collaboration and transfer. For the successful co-evolution of collaboration networks and semantic networks, a balance between similarity guaranteeing understanding and dissimilarity to enable learning and innovation is necessary (Contractor and Grant 1996; Carley 1999). The business literature on strategic alliances, joint ventures, and mergers is full of evidence on the advantage of common characteristics and mutual understanding for the successful implementation of an alliance and particularly for learning and innovation (Todeva and Knoke 2002: 363 ff.; Stuart 1998: 692f.).

[13] See the idea of solutions looking for problems in Cohen et al. (1972) on the garbage can model of decision making, which seems to me an inspiring organizational model for highly creative organizations.

[14] Innovativeness of a patent is measured as non-overlap in patent citations with citers of previous patents of the firm. Technological clusters are established via patent-citation analysis.

The transfer of knowledge and collaborative production of new knowledge and combinations depends on the absorptive capacity of an organization (Cohen and Levinthal 1990). To a large degree, this depends on its own research and development activities. Only those whose work comes close to a specific scientific or technical idea or artifact can understand its usefulness and conditions. The transfer of tacit knowledge in particular requires proximity and intense interaction. Thus actors need to exhibit a certain degree of similarity and nearness (Hansen 1999; Lundvall 1992).[15]

In an environment characterized by the globalization of knowledge and increased interdependence, organizational actors must do both: collaborate trustfully in structures marked by strong ties that allow for the transfer of tacit knowledge and innovate by searching for structural holes and new combinations. The type of interdependence involved here changes from sequential or outcome interdependence to pooled or task interdependence. Sequential interdependence can be dealt with by arm's-length relations between organizations in an atomistic market. Pooled interdependence has traditionally been the realm of organizations but will become the realm of networks. This requires that the second problem mentioned above—namely, the establishment of a governance structure that prevents opportunistic behavior between network partners—can be addressed satisfactorily.

The paradox of collaboration and innovation is manifest in its motivational consequences. Dense and stable collaboration in cliques is a precondition for agency, for learning and innovation. But the incentives to break away from established collaborations and underlying norms and institutions increases with the degree to which these rules and institutions are taken for granted. The value of a collaborative position decreases as the number of collaborators increases. Instead, the potential value of a new brokerage position grows. And new brokers in turn will produce even more volatility and destroy old competencies and collaborations (Burt 1997; Beckert 1999).

4.2 Incentives and Institutions Governing Networks

Inter-organizational networks show strong tendencies towards homophily and stability. In-depth studies of collaboration patterns (Uzzi 1997) and longitudinal quantitative samples of alliance formation in several industries (Gulati 1995; Gulati

[15]Other mechanisms are of a more symbolic kind. Action and especially risk-taking action and learning depend upon building bridges between heterogeneous organizations and their "solutions." Successful innovation needs visions of new solutions and confidence in their viability. Representations of collective innovation goals and strategies can thus have a coordinating effect. They focus the awareness of the collaborating partners and turn a confusing variety of opportunities into clearer paths to follow. Even misrepresentations of opportunities can have positive consequences in that they help overcome puzzlement and helplessness when confronted with a turbulent and overly complex environment (Levinthal and Warglien 1999; Lundvall 1992).

and Gargiulo 1999; Keister 2001; Todeva and Knoke 2002) have found network formation to be guided by prior experience with partners or partners of partners. The mechanism behind this strategy is the reduction of uncertainty in the choice between potential partners. Complementarity of assets and trustworthiness are less in doubt for firms that are known from previous alliances. Trust is accumulated, collective norms and understanding grow so that the capacity of joint problem solving and returns from collaboration increase over time. Exercising voice—for instance, overtly addressing mishaps and problems in the relation to a partner—is easier in networks than in markets.

Similarity of actors as well as personal familiarity are vehicles for the reduction of uncertainty. They breed trust, lower transaction costs, and facilitate coordination. Strong and embedded ties tend to be associated with successful cooperation and high returns to an actor in the form of stability, profitability, successful innovations, and access to tacit knowledge and funding. There is ample evidence that dense networks and strong ties represent social capital for organizations.[16] But while strong ties involve smooth relations, rich information, and high yields, high-performing organizations also continue to maintain a set of weak ties in order to optimize access to information and bargaining power (Uzzi 1996, 1997, 1999; Baker 1990). Research collaboration via strong ties and the cultivation of information windows via extended weak ties are strategies of high-performing organizations to enlarge their absorptive capacity (Jansen 1996; Hansen 1999). The search for complementarity reduces the effect of familiarity on tie formation. The probability of another tie increases with the number of previous ties, but this effect eventually diminishes and finally turns negative (Gulati 1995).

Studies of trust and conditional cooperation (Sabel 1994; Ostrom 1990) in these early stages of the evolution of a network are based on direct relations, personal experience, and one's own sanctioning capacity and direct ties. The structure is more or less governed by direct reciprocity. But over time the reliance of actors on their previous relations for their choice of partners decreases. Third-party relations and role relations and positions become more important for the choice of partners and for bolstering confidence that opportunistic behavior will be effectively prevented or sanctioned (Lazega 2000; Buskens and Raub 2002). The network itself becomes an informational device for the choice of potential partners. Network position and prominence are a partial substitute for personal experience with

[16]See Uzzi (1996, 1997) on embedded strong ties in supplier–contractor networks and their positive effect on stability and knowledge transfer; Talmud and Mesch (1997) on the positive effect of local cluster cohesion on the stability of an industry (i.e., turnover in the top ten of the industry); Ingram and Roberts (2000) on the positive effect of cohesion and friendship between competitors on the occupancy rates and profitability in the Sydney hotel industry. See Uzzi (1999) on better access to capital as well as lower interest rates for small and medium-sized firms via strong ties and Baker (1990) on the prevalent strategy of embedding ties to banks; see Hansen (1999) on the benefits of strong ties for the transfer of complex and tacit knowledge and R&D project progress within an organization. Most of these studies analyzed local networks around a focal actor (ego-network analysis).

partners (similar to the price mechanisms in markets but with greater information density).

This also means that network position becomes an asset to an organization. This social capital can be converted into several resources, especially into intellectual capital, research opportunities, and organizational autonomy. Network capital is more valuable the less marketable the products and performance of an organization and the more complex, implicit, and less visible its knowledge. Occupying a certain network position signals a history as a potentially interesting and trustworthy research partner. It attracts interesting partners and thus allows an organization to respond in a timely manner to newly emerging technological trends. Since global competition sets a premium on first movers, timely access and implementation of new technology through networks is important.[17]

Network positions have been measured in several ways. Centrality and prestige indices are important measures of the stratification of actors in networks.[18] Some indices of centrality (betweenness, Bonacich power) bear a relation to the concept of structural holes, which up until now has rarely been measured directly. A strong effect of these variables on innovation performance would indicate that networks are governed by brokerage incentives. They could come from profits extracted either from creativity and information or in the form of arbitrage profits from unconnected partners. Prestige indices, on the other hand, measure status hierarchies. A prestigious position lends esteem and influence to an actor. It derives from professional or hierarchical authority and legitimacy. A strong effect of prestige on innovation performance would indicate that networks are governed by some sort of institutionalized systemic trust and norms of fair collaborative behavior. An actor at the apex of this stratified structure might figure as a kind of generalized trustee that is honored for professional authority. Such an actor

[17]Although networks and positions in networks do become visible, the network of an organization is largely an intangible resource. It comprises formal and informal ties, indirect ties, network positions, and characteristics of the whole network at the organizational as well as the member level. Networks are difficult to describe, imitate, or substitute, and thus networking capacity becomes a strategic asset of an organization in global competition (Galaskiewicz and Zaheer 1999; Nahapiet and Ghoshal 1998; Maskell 2000).

[18]Centrality of an actor is an aggregate measure of the actor's embeddedness in symmetric ties. The simplest index counts the number of ties of an actor (degree or outdegree) in relation to possible ties. More sophisticated indices will also take into account indirect ties and weight them with their path distance. An open question is how long a path may be in order to effectively transfer public or tacit knowledge, social influence, or goods and services. The most sophisticated type of centrality index weights the impact of each actor who is connected to ego with her or his own centrality in the overall network (Bonacich centrality).

Prestige of an actor is an aggregate index of her or his embeddedness in asymmetric ties. Prestige or prominence is based on the ties pointing to an actor. Centrality in asymmetric networks is defined on the basis of the outward ties of an actor. The most simple prestige index is a count of the ties to an actor (indegree). There are also several ways to weight the impact of direct and indirect ties for the calculation of an actor's prestige (Jansen 2003, Chaps. 6 and 7). Prestige scores, and particularly their deviation from equivalent centrality scores, measure the influence and legitimacy of an actor (provided the relation is positive).

would guard against opportunistic behavior in networks by means of oversight, informal control, and sanctions.

In the following paragraphs, we will discuss some evidence on whether it is power and profit incentives or trust and legitimate norms of fair behavior that govern success in networks. A more macro-level approach to the question of network governance that deals with the roles and position of the network as a whole is presented in the final section of this chapter.

There is ample evidence of the positive effect of a central and/or prestigious position in a network on an actor's performance. But since many studies relied only on symmetric data (e.g., on alliance formation), a clear distinction between the partly concurring hypotheses on power or influence governing networks is not possible. Powell et al. (1999, 1996) and Smith-Doerr et al. (1999) offered evidence that the centrality of a start-up in an alliance network has a positive effect on the number of patents, non-operative income and research funds, sales, and number of employees. Patents attract minority investments and non-operative incomes, while a central position prevents a firm from being acquired.

Over and above the position in a stratified network, patents and patent citations become additional signals that attract new partners. Patents are thus not just intellectual property rights. In high-technology industries, they are not so much used to keep rivals out of an area. Rather, they are chips for bargaining over the terms in inter-organizational collaborative research. Also, they signal the inclination of an organization to contribute to the knowledge pool (Jansen 1996; Smith-Doerr et al. 1999). Stuart (1998, 1999) and Podolny et al. (1996) reported a similar finding on factors influencing technological exchange alliances in the semiconductor industry. The higher an actor's prestige in the patent-citation network, the more likely she or he is to become a partner in a technological alliance, especially in the role of obtaining a license or otherwise receiving technology.[19] In the very strongly stratified semiconductor industry, a highly reputed actor who obtains a license legitimizes the technology of the partner. Since the effect on the issuance of a license is not significant, Stuart (1999) concluded that what is sought is not primarily knowledge and competence but legitimacy.

For British research groups in an emerging interdisciplinary field, I demonstrated a strong correlation between the type and degree of embeddedness of a research group and its performance (Jansen 2000a). Centrality concepts that account for some of the ideas of structural holes are better able to explain the level of performance by the position in the research network, whereas prestige-based indices (indegree centrality) do better at explaining scientific contact networks.[20]

[19]High prestige in patent-citation networks had a positive influence on growth rates, too. This effect was larger for firms with a small technological overlap to their competitors than for those with a large overlap.

[20]Betweenness-centrality in the research network has a larger effect on performance than in contact networks (beta = 0.86 versus 0.51). Betweenness measures the bridging capacity of an actor between two actors who are not directly connected. Indegree prestige is the best predictor in the contact network (0.65) and only slightly worse than betweenness in the research network

Nevertheless, indegree prestige was almost as good a predictor as betweenness-prestige in explaining performance.

Ahuja (2000) reported a positive effect of technological alliances on innovative success measured by number of patents in the world's chemical industry. The number of direct ties (degree centrality) and several kinds of indirect ties had a positive influence on the subsequent patent output of a firm. The larger the number of direct ties, the smaller the additional benefit of indirect ties became and vice versa. Thus Burt's (1992) argument on network efficiency is corroborated. Ahuja's study is one of the rare ones that tested the effect of structural holes on performance directly. His data showed that structural holes lower the innovative output of a firm. Innovation, by contrast, seems to need embedded ties.[21]

In summary, the positive effect of both centrality and prestige on the innovative performance of an actor is strongly confirmed. A position that can reach all parts of a network via short paths or that has access to other actors with high centrality scores is instrumental to the knowledge-generation process. Closed cliques in which each member can get in touch every other member are not reported. Actors do differ in their centrality. But the relation between centrality measures and network cohesion on the one side and structural holes on the other is far from clear. Differences in actor centrality are associated with brokerage positions in a network, but it is not necessarily the best broker in the best position who achieves the highest centrality score. Thus the impact of centrality scores on performance can only be taken as a hint that some structural holes that produce differentiation in actors' centrality scores are beneficial to the brokers. What cannot be concluded is that cliquish ties are absent in these cases or that they have a negative impact.[22] On

(0.73). The Bonacich power index, which was constructed for negatively connected networks of competition for ties, also shows a significantly higher effect on performance for the research network than for the contact network (0.70 versus 0.56). In this index, the power of ego is larger the less power those who are ego's contacts have. To take this one step further, ego's power is enhanced if his or her contacts face other strong actors. The rationale behind negatively connected networks is that a resource can be given to just one actor (e.g., confidential information, a job, a marital relationship, or a partner position in a research project). This produces competition for ties. See Cook et al. (1983), Cook and Yamagishi (1992), Markovsky et al. (1988), Szmatka and Willer (1995) on power in negatively connected networks.

[21]Evidence of a positive effect of structural holes mostly comes from studies of managers' networks (Burt 1992; Burt et al. 2000; Gargiulo and Benassi 2000; Podolny and Baron 1997; Gabbay and Zuckerman 1998). Perhaps structural holes are more profitable for them than for organizations or groups. Collectivities are more dependent on the establishment of their collective identity, whereas the identity of individuals seems to be given by their body and its clear boundaries. And the need for a legitimate identity is better dealt with by a trust-building strategy than by a brokerage strategy.

[22]An analysis at the level of whole industries showed that the stability of an industry is positively related to the existence of structural holes *and* local cohesive cliques. But an increase in local densities leads to corporate instability (Talmud and Mesch 1997). It increases competition, devalues existing collaborations, and increases the incentives to search for new opportunities.

the contrary, the strong impact of indegree prestige (Jansen 2000a) and the finding of Powell et al. (1999: footnote 7) that Bonacich centrality for positively connected networks works better in their model than betweenness-centrality point to the importance of positively connected influence networks. They deliver legitimacy and support but do not offer entrepreneurial opportunities for exploitation. This is also in line with Ahuja's data. There is another important finding: direct ties (degree/indegree scores) are much more important to performance than indirect ties as measured in several ways (Ahuja 2000; Jansen 2000a). This is an indirect corroboration of the thesis that the transfer, combination, or production of knowledge requires direct interaction and probably also strong ties. The important role of direct interaction and some cluster stability for the transfer of knowledge and the co-operative network regime has also been shown by simulation studies. Cohen et al. (2001) demonstrated that the establishment of a cooperative regime depends on structural and local characteristics in a network of adaptive agents. A stable role structure supports the building of reputation and increases the degree of cooperation significantly compared to a random network. Local stability in the sense of stable interactive pairs is almost good in triggering collaboration as long as the percentage of new random partners stays below 30%. This can be taken as an indication of the relative balance that has to be maintained between a strong-tie vs. weak-tie strategy for building social capital. Another simulation study by Krackhardt (1997) dealt explicitly with the relation between stability in groupings and the diffusion of an innovation. He arrived at the counter-intuitive result that the mother site of an innovation has the best chance of spreading it to surrounding groups when the exchange rate of group members between the sites is rather low, at between 0.08 and 0.16. Lower rates result in a split between concurring promoters and traditionalists, whereas higher rates end up barring the innovation. The reason is that the agents need some like-minded partners in a group to stay with the innovation. Too much turnover undermines this need for stability. Another counter-intuitive result was that the mother site does better when it is positioned at the end of the chain of five groups than in the middle. Again the mechanism behind this is the need for stability to harness the innovative idea.

5 A Macro-Level Perspective on Network Governance: Center, Periphery, and the Sources of Innovation

Despite how far the structural analysis of scientific and technological networks has advanced by now, all such analyses display a center–periphery structure. This means that the more central actors tend to interact strongly with one another, whereas actors from the periphery have more ties upward than to their own

group.[23] The most peripheral actor groups might even be unconnected among themselves. As Schott (2001) in his analysis of global knowledge networks noted, the attraction of the center produces even more inwardness among the US scientific community than could be expected from its performance. Thus, bandwagon effects of this sort and the scarcity of time and money for collaboration in effect prevent a network from becoming a totally connected clique and transform disparate horizontal structures into stratified ones. Homophily based on personal relations is replaced by mobility aspirations based on status groups.

As for the question of how a balance between sparse and wide-ranging networks and dense cliquish structures can be maintained, what can be concluded from this typical network structure? The prevalence of this type of structure in science and technology networks shows that dense regions with strong stratification and differentiation do coexist. Dense relations connect actors who are structurally equivalent or connect peripheral positions to the center. What is missing are relations between the peripheral groups. This means that the center is in a position to exploit structural holes between the various peripheral groups of actors. Centrality and prestige, which were shown to be instrumental in the access to and production of knowledge at the actor level, are highest for the actors in the center who enjoy a brokerage position.

But this does not mean that dense relations and cliquishness are detrimental on the whole. After all, there are dense regions, and even the center itself tends to be cliquish. The pre-conditions of learning and absorptive capacity and the overcoming of uncertainty suggest that cliquish relations are necessary for knowledge production. The argument in favor of a certain amount of cliquishness can also be strengthened by evidence of the positive effect of strong ties if they are accompanied by some weak-tie relations.

For asymmetric network data, we can take this interpretation one step further. The role image usually displays reciprocal relations between the center and its various periphery groups. The ties from the periphery that give the center its prestigious position are reciprocated by the center. This differentiates a center–periphery structure from a hierarchical structure. And it could denote a difference in the use of structural holes. Brokers can be more or less honest. Reciprocity in relations tends to be associated with a sense of equity. From the point of view of the concept of Simmelian ties, the idea of an unconstrained entrepreneurial center position is still debatable. As Krackhardt (1999) posited, Simmelian ties that embed one actor in two cliques are even more constraining to that actor than if that actor were embedded in one single clique. An actor in this position is under the control of two potentially conflicting norm systems. This might give rise to double-bind situations. Concerning the typical center–periphery structure of knowledge

[23]See Gulati and Gargiulo's (1999) study of industrial networks (automotive, industrial automation, and new materials) and Stuart (1999) on alliance formation in semiconductors across prestige differences in patent-citation networks. For typical patterns found in science networks, see Jansen (1995c), Shrum and Wuthnow (1988), Hargens et al. (1980) and Mullins et al. (1977).

production networks, it is the center actor who might well be the only common member of two cliques connecting actors from periphery 1 and periphery 2. Center actors are highly visible, and reputation effects are strong for them. By being a member of two or more cliques, they are subject to different normative and cognitive expectations from various peripheries, for instance, different application perspectives and diverging standards of what makes a reputation or constitutes fair credit. If they nevertheless are the most innovative actors, this is more likely to be an effect of their capacity to integrate cliques, normative standards, and information than of their capacity to exploit partners. A conclusive test of this idea presupposes further analysis at the actor but not the position level.[24]

Images structures can also be inspected for information about competitive pressures in the system. These pressures are largest between those actors who share the same position—this is so because they are structurally equivalent. An obvious answer to this pressure is collaboration with one another. Density[25] within a technological niche leads to joint ventures in order to prevent duplication, set standards, or even to engage in collusion. But it also diminishes the value of high status as a predictor of growth rates (Podolny et al. 1996).[26]

Concerning the question of whether innovations come from the periphery (i.e., from low-status actors or from the prestigious center actors), the empirical evidence is inconclusive. In a study on investment banks and the financing of new ventures, Podolny and Castellucci (1999) reported that high-status banks were subject to less competitive pressures. They had a range of attractive opportunities and could choose low-risk projects—without an innovative effect. And that is exactly what they did. But semiconductor firms with high prestige were more likely than low-prestige firms to evade technological niche density by forming alliances with partners from other technological areas (Stuart 1998). Innovations have been observed to spread sooner when coming from center positions with high legitimacy (Valente 1995; Strang and Soule 1998). On the other hand, there is evidence that peripheral actors are more inclined to engage in innovation even though they are less successful (Stevenson and Greenberg 2000).

[24]In the British case study mentioned above (Jansen 1995c, 2000a), central positions in the emerging center–periphery structure tended to support high-quality research. High-performing blocks in that structure were characterized by the combination of several disciplines in the research groups and by organizational heterogeneity in the composition of their positions. Their exposure to different norm systems via relations to different peripheries did not harm the scientific performance of the members of the center position. But it did harm their forcefulness in science-policy terms. This has been explained by their lower internal centralization and larger heterogeneity (Jansen 1995c). Overlapping and contradictory Simmelian ties may be a concurring explanation.

[25]Density in the sense of niche theory is not the same as network density! Membership in the same technological niche is not derived from dense ties between actors but from the structural equivalence of actors (i.e., identical or similar relations to other actors, such as in a production chain).

[26]See also Burt (1997) on the devaluation of structural-hole-bridging positions by the existence of competing bridges. Ingram and Roberts (2000) also reported a strong tendency to choose competitors for collaboration in trying to manage hotel capacities.

In summary, center actors enjoy a high reputation, which makes them less susceptible to the temptation to opportunistically exploit collaboration partners. Highly reputed actors have much more to lose if they get caught cheating than lowly reputed actors. Their position yields high profits from the existing network, and this explains their good performance. They have a vital role in guarding the cooperative regime of a network. Their surplus revenues from networks could be understood as a sort of balance for proper behavior and sanctioning costs. While they are also in a good position for innovative strategies, they may become self-sufficient. By contrast, actors from the periphery are less visible and under less pressure to conform to established norms and routines. They are therefore more susceptible to opportunistic strategies but often do not enjoy a productive network position. Relative encapsulation can be a fertile ground for innovation. But their structural position and lack of legitimacy and reputation are obstacles to the diffusion process.

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Managing Inter-organizational Networks: Governance and Practices Between Path Dependence and Uncertainty

Jörg Sydow

1 Introduction

Inter-organizational networks such as *StarAlliance*, or the network of automotive suppliers managed by *Toyota,* for example, as well as regional networks of small- and medium-size enterprises represent not only social but also polycentric systems. The attribute of polycentrism in the field of management and organizational research is anything but extraordinary. The core idea is that a system marked as polycentric cannot be managed (solely) from one centre but via several, in some cases even many operational and decision-making centres. Its management relies on a form of "networked governance" that on the one hand unburdens central coordination in whatever form while on the other hand throws up additional management problems, particularly in networks such as the one mentioned which are controlled strategically by one or more focal enterprises. It is also vital how this particular form of network governance is imbued with life in practical terms, in other words is put into practice.

Based upon earlier studies on the management of inter-firm networks (cf. Sydow and Windeler 1998, 2000; Windeler 2001), I will conceptualize 'managing inter-organizational networks' from a structuration perspective that considers not only the overall governance or 'network architecture' but also the genesis and dynamics

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of this organizational form (Ahuja et al. 2012) as well as the reliance of its continuing existence on reproduction or transformation by individual and/or collective agents (Giddens 1984). The level to be addressed by management plays a major role in this. Two contrasting concepts, path dependence and uncertainty, will be introduced as extreme points between which much of network management takes place in reality. I will conclude with a summary that places network management as 'reflexive structuration' between necessity and impossibility—and raises questions that should be addressed by future research on network governance and practices.

2 Network Management: Concepts and Levels

To some people, the term "network management" seems paradoxical. Not infrequently, the term "network" or "network relationships", connecting individual or collective actors with one another, is associated with emerging or evolving phenomena, in other words networks tend to develop beyond any systematic management. Networks as an organizational form of economic activity become interesting for management theory, however, only when they can be influenced, managed and controlled even if they constitute polycentric systems. The paradox of network management between emergence and engineering (Doz et al. 2000), on closer examination, turns out to be a pseudo-paradox: it is here that the (network) perspective on organizational realities is confused with the organizational form itself. The latter always implies that it is an outcome of management, even if management and organization theory took a somewhat oversimplified approach to this central question *before* the reception of social theories such as Luhmann's (1995) new system theory or Giddens' structuration theory. Against this theoretical background it is typically a matter of intervening in the *more or less* autonomous dynamics of a social system and of influencing the direction of development in more than just a very selective fashion. *Network* management, then, is the endeavor to reduce differences that arise between a desired and an emerging system state. This is done through management interventions, particularly with regard to interorganizational networks at the level of a "whole network" (Provan et al. 2007). But such interventions have also to consider "the management of individual organizations that are integrated into the network" (Sydow and Windeler 2000: 3). The organizational and interorganizational interventions themselves will here—in the spirit of a terminology inspired by the theory of structuration—be considered as management *practices* and thus be conceived as recurring managerial activities that are enabled and constrained by structures and reproduce or transform these very structures (Giddens 1984). Network management practices, hence, ensure the reproduction or transformation, i.e. the stabilization or change, of network governance.

Besides the network as a whole and the individual hierarchical organizations, there are yet further levels of relevance in terms of management, ranging from the individual through to society (Sydow et al. 2016: 15-17). In this spectrum of a multi-level analysis, organizational research and, building upon that, also network research points to the immense importance of "organizational fields" (DiMaggio

and Powell 1983). Such a field encompasses "those organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products" (DiMaggio and Powell 1983: 143). In addition to the organizational actors themselves, technologies, regulations and indeed practices characterize such a field (Leblebici et al. 1991; Windeler and Sydow 2001). These field characteristics are, on the one hand, conditions for organizational action, including the management of organizations and inter-organizational networks, yet on the other hand are also the result of such. Thus, inter-organizational networks may be embedded in more or less networked organizational fields, the former being the case in regional clusters such as, for example, that of optical technologies in Berlin-Brandenburg (Sydow et al. 2010, 2016: 130-139). Such embedding has considerable consequences for network management, which, on the one hand, is oriented toward the development of networks in regional clusters. On the other hand, the management can and should relate to the cluster as a networked context.

What level should now be primarily targeted by network management? Viewed from a network perspective, and in the language of formal network analysis (Wassermann and Faust, 1994), what are important are the 'knots' (organizations) and the 'ties' (relationships between the organizations). If, however, networks are regarded as an organizational form of economic activity characterized by long-term, rather reciprocal relationships and by a dominance of cooperation over competition, the systemic character of networks becomes evident. Windeler (2001: 200–282) accentuates this systemic character as an outcome of reflexive structuration processes in which individual and/or collective actors—i.e. individuals and/or organizations—relate more or less intentionally, by means of social practices, to structures of the system (as well as other levels) and reproduce or transform them. The author further points out, with reference to Luhmann (1995), that the actors constitute the 'environment' for the system and also remain in this position in the process of system reproduction or transformation. One example of the systemic character of inter-organizational networks is the creation of a network identity as result of corresponding structuration processes (Rometsch and Sydow 2006). It would, however, need to be examined empirically whether such an identity actually exists in the initially mentioned cases of *StarAlliance* and *Toyota* and, as such, complements the more 'outwardly' oriented images through an 'inside view'. Yet if networks can more or less have a systemic character, it makes sense to devise network management as a management of a social system. As a result, the focus of managing shifts toward strengthening the systemic character of the network if not, even, toward only then establishing and using this systemic character for management purposes.

3 Network Management as Reflexive Structuration

Network management, as already indicated, serves to reduce differences between the actual and striven-for system state. That state may, for example, concern the extent of the formal rules or of the factual culture of trust in the network. Individuals and/or organizations, in most cases individuals on behalf of

organizations, intervene in the more or less autonomous dynamic of a system and influence the direction of development in more than just a selective manner, at least in case of success. For this purpose, the actors relate with the help of their practices to the prevailing structures of the network. In the theory of structuration these are, firstly, the rules of signification and legitimation and, secondly, resources of domination (Giddens 1984; Sydow and Windeler 1998). These structures which, in networks, include formal network rules as well as the level of trust to be found in the network, enable and constrain the actors' attempts to influence these structures, while the respective actions and the corresponding management practices help, for their part, to reproduce or transform the structures of the network.

Besides the network structures themselves, there are the structures of individual organizations, such as the resources of a focal company such as *Daimler*, that are available for network cooperation, as well as of those of the organizational field, for instance the distribution of networks in a particular industry or region such as the automotive cluster in the Stuttgart area in Germany (e.g., Kaiser 2007) or the biotech industry in and around San Francisco and San Diego in California or Boston, Massachusetts (Padgett and Powell 2012).

The respective rules and resources on these different levels support (or possibly constrain) the managing attempts of the individual and collective actors. In the example of *Daimler* or of *StarAlliance* with their network partners (large system suppliers in the first case, leading national airlines in the second case) the organizational resources of the firms, in addition to the rules agreed within the network, are likely to be of utmost importance for network management. Regional networks of small-and medium-size enterprises, by contrast, will have to manage with very limited organizational resources and, therefore not infrequently, rely on public sector funding for their networking activities.

Inter-organizational networks *may,* as a result of recurring efforts to manage organizational, network and field structures, be "highly reflexively regulated social systems" (Windeler 2001: 225) and, in that respect, be very similar to organizations. The actual extent of system reflexivity, however, depends not only on the reflexivity of the actors but also on the reflexivity institutionalized in the social system. By establishing a "network administrative organization" (Human and Provan 2000), for example, networks may succeed in monitoring themselves more closely and in supporting the managing actors in their influencing attempts. But the creation of such institutions can also backfire, causing a systemic blindness, because the majority of the network members will erroneously feel freed of the responsibilities of network management in view of such an institution. Reflexivity is urgently required, however, particularly where inter-organizational networks are concerned, if management between path dependence, on the one hand, and uncertainty, on the other, is to succeed.

4 Path Dependence: Beyond Persistencies

Inter-organizational networks can become inflexible and develop persistencies, rigidities or inertias over the course of time. This statement may come as a surprise because networks are actually ascribed a strategic flexibility, seen as an important

reason for their spread in the last couple of decades (cf. Powell 1990; Sydow 1992: 110–118). But such networks may indeed become rigid in the course of time, not least due to the fact that they include more or less inert organizations (Walker et al. 1997). In addition to the structural inertia rooted in the member organizations, networks potentially exhibit a kind of relational inertia, rooted in the quality of the inter-organizational relations (Baker et al. 1998; Maurer and Ebers 2006; Burger and Sydow 2014). The binding effect of relation-specific investments or the emergence of inter-organizational routines comes to mind in this connection, for example.

Under certain circumstances, such persistencies are caused by organizational path dependences and are then particularly difficult, perhaps impossible, to overcome. In such a case, persistencies obstruct effective network management and, in extreme cases, only allow further pursuit of the development path that has already been selected. A development is referred to as "path-dependent" if it is set in motion by one or more contingent events (so-called *triggering events*) and subsequently (from a so-called *critical juncture* onward) is positively intensified such that the options for action are constrained ever more greatly. A path-dependent development leads, at least potentially, to a *lock-in* which, although may well still be efficient in the short term, must however already be regarded as problematic from a strategic viewpoint (Sydow et al. 2009).

Coordination, complementarity, learning and expectation effects in particular are thought to be the central drivers of a path-dependent development of inter-organizational networks—similar to those in the case of organizations. While coordination effects in networks can result from improved routines in inter-organizational cooperation, complementarity effects may have their roots in structural fits (e.g. fit of various such routines) and the possibly ensuing synergies (Kremser and Schreyögg 2016). And while learning effects ensue from repeated applications of the more or less identical routines and perhaps lead to accompanying improvements of precisely those inter-organizational routines, expectation effects lead to a strengthening of preferences that pave the way for a certain development of the network. Alone or together (Dobusch and Schüßler 2013), these self-reinforcing effects strengthen a path-dependent network development and, in extreme cases, reduce network management to a pursuit of the network development path already selected. No network management within the meaning of a reflexive structuration will provide a way out of this dilemma, either. Correspondingly, it could be speculated that *Toyota's* long-term approach of not only improving vertical relationships in its supplier network but also of intensifying horizontal relationships between its suppliers (Dyer and Singh 1998; Wilhelm 2011) can no longer so easily be reversed. Whether this was indeed a case of path-dependent network development that goes beyond general persistencies or relational inertia would, however, have to be examined more closely.

Network management, understood here as reflexive structuration, must nevertheless take account of these persistencies and path dependences if it is not to be doomed to failure from the outset or network development to rely on "evolution" or "emergence". More details on this later.

5 Uncertainty: Beyond Risk

Genuine uncertainty forms, so to speak, an opposite pole to complete path dependence and the quasi-determinism of network development that is to be noted in a lock-in situation. Such a situation would reduce any effort of reflexive network management to the pursuit of the path already selected and offer the actors a corresponding "certainty". Uncertainty, by contrast, implies the inability to provide an accurate prediction, points to the incompleteness of knowledge of alternative courses of action, and even includes the unexpected as "the unknown unknown". With this in mind, uncertainty should be differentiated from risk, the latter being regarded in essence as calculable ("the known unknown"), i.e. as measurable and assessable in terms of probabilities (Knight 1921). So-called residual risk is also, strictly speaking, a genuine uncertainty as it simply cannot be calculated. Since not only the (calculable) risks but also particularly the (incalculable) uncertainties have increased in the past few years, if not decades, management—including network management—takes place increasingly in a "risk society" (Beck 1986), which actually would have deserved to be referred to as the "uncertainty society".

Differentiating between (exogenous) environmental uncertainty and endogenous system uncertainty, as broadly applied in management research, is helpful also in connection with the management of networks. While the former directly comes to mind, the latter denotes less the system-specific perception and processing of environmental uncertainty through either the organization or the network than the fact that also organization- or network-endogenous sources of uncertainty (e.g. relational uncertainties or those resulting from personnel or partner behavior) need to be taken into account (Beckmann et al. 2004; Sydow et al. 2013). Also helpful in this context is the differentiation made by Milliken (1987), which is much cited in management and organizational research and provides a further distinction regarding perceived environmental uncertainty. This author differentiates, firstly, regarding perceived environmental uncertainty in the above-mentioned sense of the unpredictability of events (*state uncertainty*); secondly, regarding the ability or inability of an actor to predict the influence of environmental uncertainty on its own system (*effect uncertainty*); and, thirdly, regarding the uncertainty associated with the complexity of possible responses (*response uncertainty*). All three types of uncertainty are also relevant in the context of network management, which to a considerable degree simply focuses on endogenizing environmental uncertainty, in other words on transforming the environmental uncertainty of individual organizations into network uncertainty (Sydow et al. 2013). This is the case for instance when, in connection with searching for new transaction partners, the uncertainty of finding a suitable one at all is replaced by relational uncertainty which, in network form, persists through a solely local search or focus on a continuation of an existing business relation (Li and Rowley 2002).

Exogenous environmental and endogenous system uncertainty is, like the corresponding risks, tied to the knowledge of individual and collective actors, for example organizations or, in selected cases, also inter-organizational networks. This applies even when authors such as Milliken (1987) focus mainly on how

individuals perceive and respond to environmental uncertainty. Of relevance in this connection is individual or collective knowledge concerning requirements for and consequences of action, as well as the (more or less causal) mechanisms linking the two (Giddens 1984). In addition, there is the difficulty that actions, not infrequently, are doubly contingent, in other words dependent not only on the individual or collective actor him- or herself (and his/her knowledge) but also on the actions of other actors (Parsons and Shils 1951; Beckert 1996). As is well known, any action under the condition of double contingency is possible only if corresponding expectations can be formed with some degree of reliability. These expectations, however, often remain genuinely uncertain in the reality of inter-organizational networks whose functioning relies on the interaction with others.

Also, it would be fundamentally naive to assume that additional knowledge would always, anywhere, lead to a reduction of uncertainty or to a better calculability of the risks. Often enough, additional knowledge, individual or collective, produces additional uncertainties. An example that springs to mind is the diagnosis of a fault in a supply chain that indicates deeper-lying problems. Such uncertainties can also—this being a final important point—be co-produced by organizations and, perhaps increasingly, also by inter-organizational networks (Beck and Holzer 2007). One example of the co-production of uncertainty by inter-organizational networks is supply chains or production networks in the food industry which are globalized with the aid of networking and thus exposed to new uncertainties. Some of these additional uncertainties stem from their focus on organic products and corresponding certifications (e.g. Raynolds 2004). Another example is the uncertainties to which global supply chains are exposed as a consequence of work disruptions (e.g. destruction of factories, strike activities by the workers) (Sydow and Frenkel 2013).

Network management, here once again understood as reflexive structuration, has to focus on these various types and levels of uncertainty. "Reflexive monitoring" (Giddens 1984) that takes account of these types and levels and thus prepares the system to handle the uncertainties more appropriately may be helpful. What ought to be even more practical than very strongly focused monitoring in cases of extreme uncertainty is an open, rather undirected search for weak signals or, rather, unfocused monitoring of the environment and system (Schreyögg and Steinmann 1987; Stark 2009). Such monitoring creates an often necessary, but rarely actually adequate basis for dealing practically with the uncertainty.

Management of environmental and systemic uncertainty that builds upon such monitoring and in no way ends in a reduction of uncertainty cannot, in a network context, relate to either an extension of the network of relations or lead to a deepening of existing relations. What is more, it can also be geared to the re-orientation of very specific practices of network management (e.g. for selecting and integrating partners; cf. Beckmann et al. 2004). Such practices for handling environment- and system-related uncertainty should be examined more intensively and complement the network research, which until now has focused on governance solutions to problems of uncertainty (Sydow et al. 2013).

In spite of this plea for more research into the practical handling of uncertainties in inter-organizational networks and—not least of all, based upon this—for more reflexivity in the practice of network management, it is important that a multitude of social mechanisms ensure that individual and collective actions are at all possible in view of ubiquitous uncertainty. This must be borne in mind time and again when it comes to increasing the reflexivity of action—as is often necessary in the case of network contexts. These mechanisms include (1) tradition, habit and routine; (2) norms, institutions and conventions, (3) organizational and inter-organizational structures; and (4) power of various kinds; with the structures mentioned as they reduce uncertainties, in particular in the case of path dependences (Beckert 1996). Added to this, though, is also the reduction of or coping with contingencies, for example by having a sense of reciprocity or emotional energy, two social mechanisms that are also important, especially in inter-organizational networks.

6 Network Management Between Necessity and Impossibility

Regardless of whether we now live in a "society of networks" (Raab and Kenis 2009) or not, regardless also of how the relationship between society and inter-organizational networks is to be understood at all: managing such inter-organizational systems between path dependence on the one hand and uncertainty on the other, is not only possible but also absolutely necessary if differences between a desired and an emerging system state are to be identified and the system state suitably adapted. Simply focusing in this case on network control in the sense of classical business management that developed in times of a "society of organizations" (Perrow 1991) would clearly fall too short, even though it seems an obvious recommendation from an application-oriented viewpoint. The focus of such a conventional management approach, after all, remains on calculable risk instead of uncertainty, on instruments rather than on practices (including how to deal with the former), and is also based on a concept that is (overly) optimistic with regard to controlling the development of social systems.

Management, including that of inter-organizational networks, is necessarily contingent, i.e. is always possible in other, although not infinite, ways. Organizational path dependence in the context of such complex systems takes place between the also-always-otherwise-possible (Luhmann 1995) on the one hand, and the process characterized by increasing necessity or constraint on the other. Path dependence, if not devised all too deterministically (Sydow et al. 2009), is also contingent to a certain extent; and this is the case not only at the beginning of the process (triggering event) but also over its course (path shaping, possibly even path-breaking activities). This structurationist understanding has real consequences, not least also for the management of social systems, such as inter-organizational networks. When processes, because of their dynamism and path dependence, are all the more difficult to manage (the later the stage) and in the end—in lock-ins—are no longer manageable at all, then that implies the necessity for earliest possible

intervention. This leads to a not-yet-no-longer problem: at the outset we do not yet know enough to manage properly—not enough of the current circumstances, not enough of the actions, the inaction and the moves of the other, and nothing of unintended consequences and previous processes; later we are no longer able to take a (different) course of action (Ortmann 2013).

Such considerations of the more differentiated kind and, building upon them in managing inter-organizational networks, ask for more reality-oriented concepts of management requiring a deep foundation in social theory. Social theories, not only system theory and structuration theory used here more intensively as a basis, but also complexity theory (Stacey 2010) for example, are originally suited to understanding organizations and inter-organizational networks as *social systems*. These theories also meet the claim of being able to help conceptualize network management located *between* planning and emergence, between voluntarism and determinism, or between freedom and constraint. These social theories are all, ultimately, able to highlight uncertainty as a condition for and consequence of managing systems and nevertheless take path dependences into account. Appropriate network management, on the basis of increasing individual and—in organizations as in networks—also institutionalized reflexivity, requires less reducing contingency in the practical handling of uncertainty but, invariably, preserving contingency and thus of maintaining possibilities—particularly in view of a lack of certainties and the need for creative, new solutions. This applies in inter-organizational networks with regard to the development of trust and reciprocity as it does in the sense of considering the interests of others in one's own actions. Structures, not least due to their constraining effect, enable network management that (also) focuses on the management of contingencies and aims at the development of trust, reciprocity and cooperation without losing sight of control, self-interest and competition. Network management conceived this way differs significantly from traditional approaches which, like network control and supply chain management, clearly rely by and large on the reduction of contingency. Despite or precisely because of these fundamental and also basically different theoretical insights, there is in this respect an extensive need for further research into network management between necessity and impossibility.

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Governance Networks in Politics

Dimitris Christopoulos

1 Introduction to Theory

Do the networks of political actors cause governance or are such networks a mere epiphenomenon of political action? In this chapter we will review the extant scholarship and outline the key parameters to the empirical challenge of capturing the effect of political actions and the theoretical challenge of associating these to debates on structure and agency as these relate to relational properties of political action, political power and decision making.

Political systems entail a combination of norms and rules that guide agent interactions. The product of these interactions determine the allocation of political, social and economic resources. Relations between agents are instrumental as they reflect the presence of intangibles such as reputation and power while often also mirror the exchange of tangible resource transfers. Sets of these relations (i.e. networks) act as conduits to agent power. And power is channeled to the attainment of governance outcomes. Since networks reflect the power of agents, and since it is the exercise of their power that generates governance outcomes, the study of networks becomes indispensable to comprehending political governance. Traditional social science makes the simplifying assumption that actor interdependence can be captured as an actor attribute. This has been reinforced by an inherent limitation of frequentist statistics, which require independent observations for the attainment of unbiased statistical tests. By comparison the analysis of networks makes actor interdependence the point of departure. In that respect actors' impact on outcomes is mediated by the pattern of interaction between others. These

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patterns of interaction create socio-political structure that often lies beyond the direct influence of individual agents.[1]

Governance networks are produced by the actions and interactions of stakeholders who collectively shape a political domain. Critically, a governance system is constrained by its regulatory regime, while the latter can itself be shaped by governance outputs.[2] We are concerned here with governance as a process as well as the product of political relations. The governance of networks, i.e. the study of manipulation of network structure to achieve certain outcomes, is beyond our scope. In this chapter political governance networks are defined to entail all information that pertains to the relations between political actors as they are associated to political outcomes. This is distinct from a heuristic understanding of political networks (Rhodes 1996) and follows the epistemological insights of relational sociology (Freeman 1978; Coleman 1986; White et al. 1976; Friedkin 1998) and policy network analysis (Lauman and Pappi 1973; Knoke 1990; Knoke et al. 1996; Pappi and Henning 1998; Knoke 2011; Christopoulos et al. forthcoming).

Definitions of governance networks abound in all fields of the social sciences, with politics, management, sociology and policy studies offering multiple and often contradictory versions, premised on a wide range of background assumptions (Biermann et al. 2009; Kohler-Koch and Rittberger 2006; Ostrom 2010; Rhodes 1996; Newig et al. 2010; Provan and Kenis 2008;Treib et al. 2007; Young et al. 2008). Governance has been employed to analyze modes of decision making, resource exchange, organizational modes, policy formulation, policy implementation, information dissemination, agent coordination and collective action. Governance has also been used to describe government efficiency, for instance in the evaluation of state executives (Fukuyama 2013). Epistemological and disciplinary boundaries offer a wide scope for divergence in the way the term is employed to describe political process and outcome.

The realization that all forms of interaction between agents can be defined with reference to their network properties has led to the proliferation of the use of networks as a descriptor of non-hierarchical political coordination (Börzel and Heard-Leuréote 2009), a state of interaction that exists somewhere between idealized markets and hierarchies (Treib et al. 2007) and which can be said to pertain to politics, polity and policy (ibid.). Theorizing governance networks is complicated by whether network agents are individuals or organizations and the unit of analysis is the relation(s) agents have or the architecture of the network (Jones et al. 1997). In other words, whether the analysis concentrates on the interaction between agents or the pattern of these interactions. Both approaches identify mechanisms that have the potential to affect political outcomes as they shape opportunities and constraints for agents.

[1]To put this in context, a relational structure of only a 150 individuals is considered to be beyond the cognitive capacity of the average human agent (Dunbar 1992; Gamble et al. 2014).

[2]In this context stakeholders are all actors, individual or organizational, that have a legitimate claim of representation within this domain. A regulatory regime refers to the explicit and implicit rules and regulations that determine governance scope.

Furthermore, human agents engage in multiple relations at the same time (McPherson et al. 2001), while processes of collective action are rarely sequential (Diani and McAdam 2003). Those two combined constitute a particular quality to political action. They also represent a constraint since sequential coordination is inefficient or unfeasible due to task complexity (Jones et al. 1997), and therefore agents have no choice but to coordinate concurrently through their multiple relations. This implies that the quality of their relations and the architecture of network topology, what Granovetter (1985) termed their embeddedness, determines their effectiveness at achieving their goals. It also determines the efficiency with which they can attain these goals. In short, governance processes are intertwined, overlaid, or even entrained in multiple implicit or explicit relational associations between agents. Dealing with the organized complexity of political systems has been attempted via multimodal analysis of different types of political entities (Frank et al. 2012; Lubell 2013; Neal 2014; Christopoulos et al. 2014). But generally the field is limited to one-mode analysis of political agents.

There are multiple challenges employing network analysis to understand political governance. First of all, influence is not only exercised by prominent key actors[3] but by all actors connected to a network. Second, is that political power does not have to be exercised to be present or indeed it does not have to be exercised for actors to be aware of it. Third, is that capturing exchange relations at a specific point in time could be missing the relevance of underlying power.[4] Fourth, the degree to which a single mode network captures this latent power depends on how well it reflects the full range of multiplex relations tying agents to one another. Therefore a validity limitation, and potential source of predictive error, lies in our capacity to capture all pertinent relations between actors. Finally, as complex systems, political networks do not evolve linearly but can be subject to exponential growth and tipping point dynamics (see Folke et al. 2005; Miller and Page 2007).

At the same time a single-minded focus on network prominence alone (e.g. on the most central actors or prominent brokers) can overlook the currency of political exchange, the political capital of agents. A definition of political capital by Sørensen and Torfing (2003) distinguishes endowment capital, empowerment capital and political identity as aspects of political capital. Relations obviously affect the way endowment and empowerment political capital are evaluated within a political system. Capturing the changes in the stock of political capital within a political system and understanding the mechanisms through which it is leveraged via political networks is therefore instrumental to understanding political governance process and outcome.

[3]Key actors, some of which could be deemed to be elite within a specific governance domain, can be identified by status, by authority or network advantage, by their position or their actions. In network analysis, they are often located by their possession of tangible assetsor access to intangible assets or their pivotal role in specific political actions.

[4]At the same time the dearth of reliable measurements to political power makes an analysis of actor relations an indispensable proxy.

Table 1 Theories of tie formation and cohesion in modeling political action

	Social capital	Social homogeneity
Flow	Capitalization: information advantage	Contagion: dissemination of innovations
Coordination/Bond	Cooperation: trust relations	Convergence: adherence to group norms

Note: Amended from a classification by Borgatti and Foster (2003) and Borgatti and Halgin (2011)

It should also be appreciated that network models entail limitations that mitigate against an unbridled use of network analysis to interpret political network interactions. First, is the difficulty of analyzing political conflict in tandem with political support and collaboration (but see Smith et al. 2014). This reflects the fact negative ties comprise a different type of relation that poses a theoretical and a computational challenge in their concurrent analysis to positive ties. Second, and related, is whether the absence of a tie implies an actor choice (and therefore similar to a negative tie), reflects indifference (or neutrality) or is due to an agent limitation such as their cognitive capacity or network horizon. Third, is the realization that some network advantage dissipates fast, in what has been termed bridge decay (Burt 2002). Fourth, is a concern with volatility, since networks of power and influence can evolve suddenly (cf. complexity). So, verifying the degree to which a network of power relations acts as a cause to political outcomes constitutes a challenge both for data collection and data analysis.

Challenges are also related to the nature of the phenomena examined and the fact that data do not constitute independent observations. The lack of independence in the data constrain the use of classic statistical tests of significance. A number of techniques have been developed that employ simulation and permutation procedures which create tests of significance on measures of association for network data while controlling for network dependence or actor attributes (see Robins et al. 2012). As Borgatti and Halgin (2011) expound, most theorizing has been grounded on serendipitous access to information as implied by "weak ties" theory (Granovetter 1985), or on agents strategizing their brokerage positions as implied in the assumptions of the "structural holes" theory (Burt 2005). These theories are premised on either a flow or a bond model (Table 1). Power however is an intangible agent asset that does not necessarily flow nor does it necessarily constitute a bond. Alternative models such as principal agent theory (Eisenhardt 1989), provide convincing models of agents mediating for principals without assuming a permanent transfer of power from the principal to the agent. Models of collective action in particular (Ostrom 1990) recognize that political agents can have different preferences, incentives or information from those they represent. This insight can be extended beyond representation politics to all political transactions between agents. The implication is that political networks (as conduits of power transfers) can act as principal-agent transaction systems. Propinquity to power is associated with positions of structural privilege (i.e. centrality and brokerage), while actor preferences and incentives are affected by network topology and an actors' position within network structure.

Table 1 provides an overview of flow and bond models crosstabulated with theories of social capital and social homogeneity. For instance, the combination of assumptions on social homogeneity with a flow model produces an interpretation for the dissemination of innovations that is based on contagion dynamics (top right quadrant). Assumptions on the importance of social capital with bond models of networks imply that trust relations underlie cooperation (bottom left quadrant). Similarly, information advantage is associated to capitalizing on network flows in contexts where social capital is relevant (top left quadrant); while strong bonds associated with strong social homogeneity processes lead to convergence through an adherence to community norms (bottom right quadrant). This classification does not imply that the behavior of political agents can be neatly pigeonholed. Or that the dimensions to agent behaviors can be neatly aggregated. But it is the case that making an assumption on what drives the creation of ties coupled with theories of cohesion, implies different governance processes and possible outcomes. This in turn could be helpful to those seeking to identify relational mechanisms to governance outcomes.

The rest of this chapter deals with more narrowly defined networks of political governance and examines how power is mediated by networks and its impact on governance process and outcomes.

2 Networks and Political Power

A key interest of political science is whether actor relations, and therefore a network of relations, affect the power of actors. Classic elite theory (Lenski 1980; Pareto 1991; Weber 1968; Mills 1956) had theorized an affirmative answer premised on the most elemental network level, the dyad. The formal consideration of triadic relations, as exemplified in the work of Simmel ([1908] 1950) for instance, did not enter the lexicon of political science until the 1990s. This fosters interest on the structure of political relations between actors beyond the dyadic level (see, Feld 1981). Relations of influence, information, affinity or power can be examined in tandem with the actions of agents. For this reason networks have been theorized as the meso-level of analysis (Monge and Contractor 2003). A focus on networks can be seen to integrate structure and agency since a network model incorporates structural constraints (relational topology) to actor behavior (their relational choices). A relational account can model institutional structure as a hierarchical constraint and agent predisposition (i.e. their psychology or preferences) as an actor attribute. The key departure is to offer models of political agency while not excising actor interdependence for methodological reasons, but considering it as an integral aspect of the analysis of agent power.

In this context it is essential to recognize that relations could be of many different types, they could be the conduits for the transfer of tangible resources as well as the channel through which intangibles such as trust is conveyed. It is reasonable to assume that multiple networks overlay different relations within a

set of political actors. But it is often the most visible relation that is analyzed, the one deemed most pertinent to a specific political outcome. And although ideally, models of political agency would require overlaying multiple relations in complex models of agency, in practice this is rarely the case.[5]

But what do we gain from employing network analysis in examining relations of power and the governance outcomes they generate? At the level of an individual actor, their networks: (a) determine opportunities for coalition building; (b) can ameliorate shocks from institutional transformation; (c) facilitate the sourcing and allocation of resources; (d) determine the dissemination of information; (e) signal their connectivity to valuable alters; and (f) potentially ameliorate the risks associated with political action as this will be mitigated by their ties. At the group level, network structure can determine: (a) the opportunities for establishing coalitions, (b) the prevalence of a core-periphery, (c) the dissemination of innovations and (d) the potential for conflict. Overall, relational structure provides information on the distribution of power, hierarchy, coherence, reciprocity and closure. It can allow us to deduce the prevalence of trust, brokerage and leadership opportunities for actors within political structure. It can further allow us to make inferences on the degree of stability of political systems and the potential impact from change.

In the policy literature influential work by Rhodes (1996) has claimed that "governance refers to self-organizing, interorganizational networks" (ibid: 660). This heuristic use of policy networks is often employed to describe complex systems of decision making assumed to be distinct from hierarchical decision making structures (Börzel and Heard-Leuréote 2009). There are a number of assumptions that underline this approach. First is that private and public actors form informal negotiating systems, while such voluntary systems are collectively binding. They suggest the process of governance is affected by networks by claiming that there is "governance in networks rather than governance by networks" (ibid: 140). Further to that, there is an assumption of an increased role of private actors and of more efficient and effective policy making systems (ibid: 141). This is linked to the presumed flexibility of networks, their capacity to provide access to multiple resources, the socialization function they play and that they facilitate valuable informal relations between private and public actors (ibid).[6] Grounding an analysis of networks on case studies of policy making cannot address the fundamental issue of whether networks are the outcome or the cause of the interaction between agents. Inevitably perhaps, heuristic networks become "aggregative institutions that can exchange and negotiate with public officials" (ibid). The assumptions behind this definition have been the subject of a critique by Dowding (1995) and Christopoulos (2008) among others, who consider that the use of a

[5]In datasets with the requisite wealth of information the biggest challenge is determining the relative weight between different types of relations in eliciting specific outcomes.

[6]An influential analysis by Sørensen and Torfing (2003) finds that networks possess capacity to engender compliance and reduce resistance to policy implementation.

network as mere metaphor, cannot provide a substantive insight or a theoretically grounded understanding of policy making. The use of networks as a heuristic devise lacks concern with the instrumental notion of a network boundary and with accounting for essential constraints to agents, such as their network horizon or the cost of maintaining relations (ibid). Similarly network structure is presumed diffuse and dense to the point where all actors are directly and reciprocally connected to one another, which is patently not true in most cases (ibid).

A promising stream of work that dates back to the 1970's (Laumann and Pappi 1973) has offered a valuable interpretation of the policy process by conducting a formal analysis of relations and focusing on the interactions between actors. The recognition that decisions are influenced by processes beyond formal institutions of government or elite interaction owes a lot to this literature. Political networks are defined by Knoke (2011) to be a bounded set of actors and the set of relations that connect them. Political actors are not only individuals but can also be formal or informal organizations, such as political parties, legislatures, interest groups or corporate actors. The network boundary for such actors is the policy domain premised on a common understanding by all participants of the importance of the preferences of others (ibid.). A policy domain in that respect constitutes a policy subsystem

> "identified by specifying a substantively defined criterion of mutual relevance or common orientation among a set of consequential actors concerned with formulating, advocating, and selecting courses of action (i.e. policy options) that are intended to resolve the delimited substantive problems in question" (Laumann and Knoke 1987: 265).

This definition alludes to political actors sharing a common discourse and potentially having a common understanding of feasible political outcomes. Considering organizational actors, Knoke (2011) classifies five basic types of interorganizational relations, each of which is likely to have a distinct network structure: (a) resource exchange, (b) information transmission, (c) power relations, (d) boundary penetration and (e) sentimental attachments. Coalitions form around a specific policy event, such as a legislative bill, regulatory order, or court case ruling and the networks between organizations are predictive of the likely coalitions and therefore of the policy outcomes.[7]

Anthropomorphizing organizations may be a convenient mental heuristic but should be conducted with caution to assumptions of organizational agency. This is particularly pertinent on applying theories that have been developed in sociology, and evidenced on human agents, such as reciprocity, transitivity or brokerage. However, beyond an awareness of the underlying assumptions to any theoretical

[7]In this context the term meta-governance has been employed to account for "the reflexive coordination and organization of the framework conditions under which governance takes place" (Christopoulos et al. 2012: 306). Governance in that respect advances an understanding of regulatory regimes as the negotiated outcome between competing political demands and values (see Kooiman and Jentoft 2009). See also Sørensen and Torfing (2009).

claims, organizations can be presumed not to be schizoid in their behavior (i.e. different inter-organizational departments to have different agendas) but instead to be rational utility maximizers. Unlike human agents that often employ mental heuristics when deciding on a course of action (Kahneman 2011) or have an ambiguous memory of their social interactions (Bernard et al. 1984) organizations can be assumed to be making well appraised decisions on their relations with other organizations which can be recalled with relative accuracy. Furthermore, such choices are likely to be stable and directly reflect organizational interests. Fortuitously for social scientists, few organizational relations can be considered to lie beyond the legitimate interests of researchers or to be possible to conceal.[8] So, the network analysis of corporate, governmental or non-governmental organizations often provide unique insights underlying interests in policy making (Christopoulos and Quaglia 2009), policy contest (Knoke et al. 1996; Johnson and Orbach 2002 and agenda setting (Ingold and Varone 2012). We next look at how network parameters can affect governance decisions.

3 Governance Networks and Decision Making

The most intuitively obvious measure of network privilege is centrality. And there is extensive literature on the relationship between centrality and agent power starting with the work of Laumann and Pappi (1973) and developed in the work of Krackhardt (1990) among others. The most obvious measure of such centrality is degree centrality, which is the number of alters a focal agent is connected to, either by sending ties (outdegree) or receiving ties (indegree) from others. These measures have an obvious theoretical association to the influence and popularity of agents. One of the types of centrality of particular interest to political relations is derived by considering that relational power of an agent is conditioned by the relational power of their alters. Formalized by Bonacich (1987) this measure employs a uniform weight to the number of alter relations.[9] This Bonacich power measure is constrained by this computational uniformity as alters are considered to either have a positive impact on ones' centrality when they are central themselves or a focal agent is considered to control their weakly connected alters. Beyond its limitations the measure advances a theoretically interesting point. The centrality of an agent's alters reflects on their structure of opportunities and ultimately their power. What is true for human agents is also confirmed for organizations as agents. Knoke et al. (1996) suggest that "describing the network densities, indegrees, and outdegrees among different types of organizations gives an initial overview of . . .

[8]Which points to a major ethical concern in researching human agents, where not only the anonymity of the study participants but also their alters can be compromised, since they are invariably not approached for providing informed consent (Klodvahl 2005).

[9]See Christopoulos and Ingold (2015) for a methodology employing a range of centrality and brokerage measures to policy analysis.

power structure dimensions" (ibid: 198). The source and distribution of power can also be detected with reference to betweeness centrality, a measure that combines information on local and global network structure, by calculating the times an agent is on the shortest geodesic between other actors. Other advantageous positions that have an apparent impact on actor power are boundary spanning positions (Ibarra 1993; Burt 1992, 2005) and network positions that sideline hierarchies and prestigious groups (Brass and Krackhardt 2012). It is also apparent that individual actor power relates to the social capital of an agent. This is true for all measures of centrality and brokerage discussed above, as well as, measures that capture network density, the heterogeneity and the compositional quality of an actor's network (Borgatti et al. 1998).

But what do sociometrics reveal about governance networks? Ansell and Gash (2008) in a meta analysis construct a model of collaborative governance that incorporates (a) background conditions, (b) the governance process, (c) institutional design and (d) leadership as instrumental in the production of governance outcomes. The background conditions are determined by power, resource and knowledge asymmetries. The process depends on trust and a shared understanding between participants. Facilitative leadership is a reference to actor agency, closer to what Christopoulos (2006) has termed political entrepreneurship and Christopoulos and Ingold (2015) have termed exceptional agency.

More broadly, governance networks can describe processes of political decision making and policy implementation that reflect the negotiation and power relations between actors. This is about politics, broadly construed. And in all political action we find evidence of power inequalities and asymmetries.[10] At the same time policy space is shaped by the degree of leadership and political entrepreneurship of key actors (Christopoulos and Ingold 2015). And while mapping of veto points and other constraints is instrumental for comprehending institutional complexity (Tsebelis 2002) agent interactions, theorized as networks, reflect the efficiency of exchange, levels of trust and reciprocity in political space.

An area of direct interest to political analysis is whether network topology affects decision making and equity among agents. Broadly, the pattern of interactions determines the degree of centralization for a network. Centralization is an elemental statistical measure of network structure, reflecting hierarchy. Determining whether the control of such interactions lies with the interacting agents or is mandated externally can offer a classification to governance networks.[11] In Table 2 a schematic depiction of the implications of this classification to network topology are presented.

[10]Steven Lukes (2005) suggests that more important than an account of who holds power, is "compliance to domination" (ibid, 109) and the recognition that actors may not be aware of their "real" interests (ibid, 146). Such 'false consciousness' is further affected by the perceptional filters imposed by relational structure. In juxtaposition see also the classic definition of power by Parsons (1963).

[11]Further dimensions to the same classification is whether these rules of behavior and decision making are implicit or explicit; the degree of relational and structural embeddedness; and the prevalence of agency.

Table 2 Governance network topology: impact of centralization and rules of interaction

	Rules of interaction	
Centralization	Internal	External
High	**Hierarchical** network dominated by few actors with high centrality or high brokerage roles, where key agents are popular and leadership prevalent	**Mandated network**, typical of goal oriented networks assigned with allocative decisions and where decisional authority coincides with centrality
Low	**Equitable** distribution of power, ties and relational positions that limit decision making efficiency, anticipate the prevalence of structural holes	**Consensus building network**, can facilitate information diffusion and is more suited to policy implementation than decision making

Variations to network structure and rules are of particular interest to decision making. The existence of self-regulated and internal rules of interaction depict a "democratic" exchange where differences in relational power reflect agent popularity and appeal (bottom left quadrant). High levels of relational power and centralization are associated with efficient decision making (top left and right quadrants). Low levels of centralization in mandated networks can facilitate policy implementation (bottom right quadrant). Another interesting difference is that although mandated networks appear to be stable, they are less likely to evolve smoothly and their change is therefore likely to resemble punctuated equilibria as theorized by Baumgartner and Jones (2002) and critically examined in Cairney and Heikkila (2014).[12]

There are multiple dimensions that are subsumed to the classification in Table 2. These include agency related factors such as the distribution of power or agent skill. And they can be associated to both relations and rules of political exchange. Neither does this classification allows for a nuanced picture of constraints and opportunities offered by network structure, such as taking account of core-periphery effects. Nevertheless, even an elemental classification, such as the one in Table 2, can help us make predictions of likely outcomes to the governance process with two basic types of information from policy space: levels of centralization and rules of interaction. In tie models (those focusing on the interaction between actors) recognizing that a policy space has low centralization and actors are capable of self-regulation would lead to a prediction of high levels of reciprocity and transitivity, prevalence of strong tie dynamics and political governance that is characterized by high levels of political brokerage. In such a policy space we would expect to see political entrepreneurs active (Christopoulos 2006).

Studies of governance networks, ideally, combine an analysis of the interaction, resource transfers, asymmetric power relations and values of key political actors.

[12]Cairney (2013) has looked at how "providing new theories that compete with the old" implies a theoretical synthesis while discovering their complementarity (ibid: 7). An alternative approach would be to verify the compatibility of multiple theoretical streams within an explanatory model by considering whether the underlying assumptions of these theories are compatible.

While, the larger the scale of a governance system, the more likely for it to be fragmented. Fragmentation can be also associated to the emergence of divergent discourses across a wide governance space and the variations in intangible assets, such as authority and legitimacy, which actors develop within different clusters. Fundamentally, this is also associated to the networks of agents. A key property of networks of human agents is their high levels of clustering (Scott 2013). This finding has been extended to our understanding of policy networks (Christopoulos 2008) which are known to develop governance structures fragmented by silos of knowledge, while common norms emerge in densely tied clusters. Divergent norms have to be reconciled for political agents to be able to efficiently reach political settlements. Fragmentation in governance structures can also be linked to the different and often overlapping competences that local, regional, national and supranational government institutions have. These can be understood as systems of multi-level governance (Keating 1997). At the same time the distribution of competences between different government levels has been seen to act as a check on the sustainability of governance arrangements (Mauerhofer 2013).[13] In other words, sustainable governance would depend on optimizing the distribution of competences among different levels. Our insights from the analysis of political networks permit us the prediction that sustainable governance would also depend on the degree of clustering among political agents and prevalence of ties between groups with divergent norms.

A nuanced view of structure (represented by regulatory regimes) and agency (evident in the actions and interaction of stakeholders within a governance system) would promote an understanding of the interdependence of structure and agency as suggested in the work of Jessop (2002) who proposes that structure and agency logically entail one another. An analysis of agency would therefore entail an analysis of structure and vice versa.[14] The dynamic interplay of resources and cultural schemas that produces social structure (Sewell 1992) can be seen as the context that generates governance. Capturing individual and collective agency and situating it within the confines of regulatory structure would promote a comprehensive view of political governance. One where governance process and outcomes are directly associated within our models. Although such an aim is within our methodological competence, no such examples are cited in the literature.

[13]Fundamentally, competence has to be construed beyond reference to legislative and regulatory authority to entail governance legitimacy.

[14]Giddens (1984) and Mouzelis (1995) have suggested that there is a duality of structure, since structure is both the means and the outcome of human action. We do perceive governance networks as both the means and the outcome of political action but obviously their analysis would need to take account of "specific time-horizons and spatial scales of action" (Jessop 2005: 53).

4 Conclusions

In this chapter we have examined the mechanisms through which agent relations affect agent power and the impact this has on governance process and outcomes. These mechanisms are not universally recognized or fully understood. The importance of relational limitations (i.e. the cost of relations, maximum number of relations that can be maintained, the cognitive limitations of political agents, their comprehension of network topology, and their network horizon) are rarely integrated in social science. Obviously aspects beyond relations can also skew the interaction between political agents, as they affect their ability and willingness to transact with other political actors. These aspects include institutional boundaries; rules and regulations; state borders; identity, beliefs and affiliations.[15] Networks can be seen as causal to political outcomes or as the outcome of political process. The iterative process between network causes and network outcomes pose a challenge beyond classic predictive models.

Fundamentally, in political systems with broadly equitable distribution of power it is not direct control but often indirect influence that determines political outcomes. Therefore, aggregating individual preferences cannot safely predict political outcomes but mapping the interactions between actors does reflect their power relations. In governance systems, where stakeholders and decision makers are well recognized, the ability to project power is a good predictor to political outcomes and processes. *Governance as the product* of political exchange is affected by the quality of the interaction between political agents, what Jones et al. (1997) and Robins et al. (2011) have termed governance embeddedness. For instance, the degree to which political agents reciprocate relations equitably, whether there is transitivity (is a friend of a friend a friend?), and whether relations are predominantly hierarchical. *Governance as a process* is affected by the pattern of exchange between political actors. For instance, the degree to which there is a strong core-periphery, the multiplicity of clusters, prevalence of brokers or the skewness in the distribution of ties affects the way politics happens (Christopoulos and Ingold 2015). I have sought to demonstrate here that both governance process and governance outcomes are affected by the networks of political agents, often in ways that can only be comprehended by analyzing the pattern of their relations.

Future research in the field is likely to involve the use of mixed methods in cross-validating network with agent attribute data; the triangulation of qualitative and quantitative analysis (Lewis 2011); a focus on longitudinal studies to decipher evolution (Desmarais and Cranmer 2012); the analysis of multimodal networks to attain higher levels of content validity (Christopoulos et al. 2014); and insights on complexity (Stein et al. 2011) to account for non-linear changes to network structure. Finally, the use of ERGMs, simulation and permutation tests, Bayesian analysis and longitudinal time series models will improve on our predictive models of political action.

[15]Beliefs, identity and norms are termed a 'macroculture' by Jones et al. (1997).

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Part II

Types, Processes and Limits of Networked Governance

International Institutions of Financial Market Regulation: An Example of Network Governance?

Renate Mayntz

The public regulation of financial markets developed together with the modern nation state. For centuries, the main object of political intervention into the economy had been neither finance nor production, but trade. In the middle ages, sovereign rulers minted money, and independent cities established markets and enacted market orders. The rules of the *lex mercatoria* were a form of self-regulation carried by groups of merchants (Benson 1998). When the state claimed the task to govern the economy, the main objects of financial regulation were banks, trans-border capital movements, credit giving, and interest. Since the 1930s, modern transatlantic states have had centralized and formalized regulatory systems, as well as a legal framework covering all key areas of the banking investment (Busch 2009, 225). Regulation was extended to exchanges, securities, and insurance. Three distinct sectors developed that were regulated by separate legal acts, and supervised by special agencies: banking, securities, and insurance. After the First World War, several crises induced changes, both organizational and substantive, in financial regulation on the national level (Goodhart 2007). In the US, for example, investment banking was separated from commercial banking in 1933 by the Glass-Steagall Act, and in 1934 a new supervisory agency, the Securities and Exchange Commission SEC was established. The time between the two world wars saw relatively strict regulation; exchange rates and even interest to be paid were fixed by governments.

Towards the end of World War II, the Bretton Woods institutions—IMF, World Bank, and GATT (later WTO)—were established with the purpose of stabilizing the international economy and remove trade barriers. The so-called Washington Consensus was the basis of the "embedded liberalism" (Ruggie 1982) that characterized the 1950s and 60s. After the Second World War, both trade and industrial production in the Western World increasingly transcended national

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boundaries; the rise of transnational corporations and the increase in foreign direct investments are indicators of this development. In the wake of the expansion and internationalization of markets and the rise of transnational corporations, financial markets also expanded, and became internationalized. Both developments have been greatly facilitated by developments in information and communication technologies. Until the 1970s, nothing much changed with respect to financial regulation. After WWII, there was much rhetoric about free trade, but in fact most governments tried to shield their domestic financial markets from competition with protectionist measures. The financial industry continued to be regulated nationally. Banks were instrumentalized by governments for fiscal policy, and in many countries also for industrial policy.

The post-war settlement remained more or less stable until the 1970s. The two oil crises, and massive unemployment in the 70s motivated further liberalization of capital markets in order to remove barriers to international trade (Busch 2009, 28). Following the breakdown of the Bretton Woods system in the 1970s, Western states started to deregulate capital markets. There were no fixed exchange rates, no restrictions on credit and loan, and no barriers to capital movement. Especially the USA and later on Great Britain pushed the process of deregulation, but the European Union soon followed suit. Deregulation opened domestic financial markets to foreign competition, reinforcing the development of a financial system transcending national borders that had already started with the international expansion of the productive economy (Braithwaite and Drahos 2000, 101–103). Starting in the late 1970s, the structure of the financial system underwent important changes. The size of banks grew, and their activities were increasingly diversified, turning them into multi-functional financial institutions. The boundaries between the three sectors of banking, securities, and insurance eroded (Kaufman 2009, Chaps. 8–11). In response, the separate supervisory authorities for banks, securities, and insurance were merged in some countries to form an integrated financial supervisor, such as the German Bundesanstalt für Finanzdienstleistungen BaFin and the British Financial Services Authority FSA. Banks engaged increasingly in proprietary trading, and created complex financial instruments (e.g. collateralized debt obligations CDO, credit default swaps CDS), pursuing the "originate-and-distribute" strategy instead of the classical strategy "originate-and-hold". At the same time there were changes in the field of investors, where the weight of big corporate investors (pension funds, investment funds) came to dominate the dispersed mass of small investors. With these changes, the role of rating agencies became ever more important. Figure 1 gives an impression of the intensity of cross-border relations (cross-border claims among banks in given geographical regions) that had developed by 2006.

Parallel to the development of the complex, international financial system, and spurred by crises such as the bankruptcy of the German Herstatt bank and the Asian crisis, international bodies with standardization and coordination functions started to be established in the 1970s (Lütz 2009). Up to that point there was only one important international body dealing with issues of financial stability, the Bank for International Settlement BIS, founded in 1930, originally for the settlement of German reparation payments. The Committee for Payment and Settlement Systems CPSS and the Financial Stability Institute FSI are spin-offs from the BIS. The first

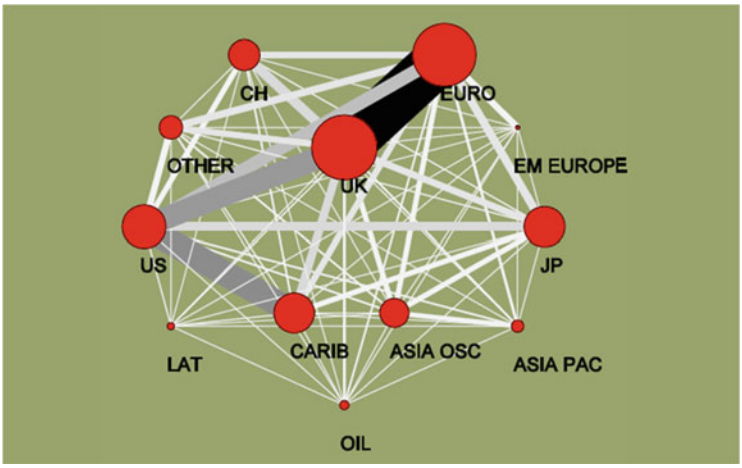

Fig. 1 Cross-border claims in the International Banking System.[1] *Source*: McGuire and Tarashev (2008, 184)

international standardization organization newly founded after World War II was the International Accounting Standards Committee IASB established in 1973, followed in 1974 by the Basel Committee for Banking Supervision. The BCBS was to define capital requirements for banks, and rules for the cooperation of national supervisors, and in this sense had regulatory rather than standard setting functions. In 1983 the International Organization of Securities Commissions IOSCO was established, to try and harmonize the rules for dealing with securities. After banking and securities, the insurance sector, too, became the object of international standardization: in 1996 the International Association of Insurance Supervisors IAIS was established. The international standard setters were to be loosely coordinated by the Joint Forum. Already in 1990, the G7 established the Financial Stability Forum FSF that was to deal with issues of global financial stability. In 1999 the finance ministers of the G7, who were increasingly concerned with questions of financial stability, set up the G20, a forum where the finance ministers and central bank governors of the 20 largest market economies meet in order to safeguard the stability of the international financial system.

[1]The size of each *red circle* is proportional to the outstanding stock of cross-border claims of reporting banks located in the particular geographical region. *ASIA OSC* Hong Kong SAR, Macao SAR and Singapore; *ASIA PAC* China, India, Indonesia, Korea, Malaysia, Pakistan, the Philippines, Taiwan (China) and Thailand; *CARIB* Aruba, the Bahamas, Bermuda, the Cayman Islands, the Netherlands Antilles and Panama; *CH* Switzerland; *EM EUROPE* Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Slovenia, Turkey and Ukraine; *EURO* euro area countries; *JP* Japan; *LAT* Argentina, Brazil, Chile, Colombia, Mexico and Peru; *OIL* OPEC member states (excluding Indonesia) plus Russia; *OTHER* Australia, Canada, Denmark, New Zealand, Norway and Sweden; *UK* the United Kingdom plus the offshore centres Guernsey, the Isle of Man and Jersey; US the United States.

At the turn of the century, these were the major international institutions concerned with regulating and coordinating the global financial system—a loosely knit, functionally fragmented set of bodies with partly overlapping mandates, bodies in which delegates from national finance ministries, central banks, and supervisory agencies played a major role. Some of these bodies were truly international, others like the BCBS and the FSB had a restricted membership and were initially dominated by the developed Western countries. Different from the Bretton Woods institutions, these financial governance institutions had not been conferred decision making competences by their member states; the rules and norms they developed had only the character of recommendations and were not supported by sanctions. As a consequence, such international standards as did exist before 2007/2008 were frequently disregarded by their addressees, or adopted formally but not complied with. At the regional level of the European Union, the Committees of European Banking Supervisors, of European Securities Regulators, and of European Insurance and Occupational Pensions Supervisors had a similarly limited mandate, focusing on coordination. Figure 2 gives an impression of the overall structure of financial market governance around the turn of the century.

When the financial crisis of 2007/2008 erupted and was widely attributed to regulatory deficits, agencies at all political levels started initiatives to reform financial market governance, in order to prevent the recurrence of similar crises in the future. At the international level, the different standard setting organizations, the FSF and the G20 became core actors; they were surrounded by a wider circle of international bodies playing only a secondary role in the reform process. These

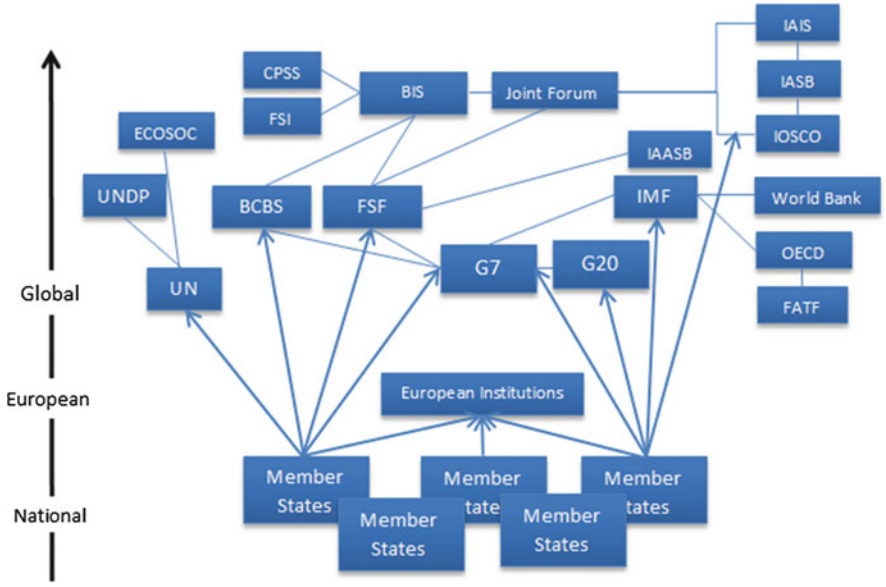

Fig. 2 Structure of financial market governance (before the crisis). *Source:* MPIfG

included the United Nations, the OECD, and the Financial Action Task Force FATF (created to combat money laundering). The IMF played a secondary role at first, but gradually became a more important actor, especially as the financial crisis morphed into a sovereign debt crisis. The reforms triggered by the financial crisis involved both the regulatory substance—rules, norms, and standards—and the structure of financial governance. In this chapter, we are only dealing with the latter.

The structure of financial market governance changed most, though unevenly, at the national, and least at the international level. No new international bodies were created, but the relative weight of several institutions changed, and where it had been formerly limited, their membership base was extended. The Basel Committee BCBS became an active reform agent early on, defining stricter capital requirements and leverage ratios for banks. The most significant change concerned the G20, and the FSF. Before the crisis, the G20 meetings of finance ministers and central bank governors, who often did not attend in person, were low key gatherings that had little impact. Though nothing but an informal forum, the G20 was best suited to initiate, and try to coordinate regulatory financial market reforms, for one thing because of its relatively broad representative basis, and secondly because its mandate was neither too narrow, as that of the standard setting bodies, nor too wide, as that of the IMF. Recognizing this, the heads of the G20 governments started to meet in much publicized summits, partly replacing the former G7 meetings. They also decided to transform the FSF into a kind of in official G20 staff and secretariat, now called Financial Stability Board (FSB). Figure 3 gives a rough view of the international structure of financial market governance as it looked after the crisis.

Though no new institutions were created in response to the financial crisis, the membership basis of the major existing institutions was significantly broadened. Whereas before the crisis, only 12 countries were members of the FSF, while IOSCO, CPSS and BCBS counted 13 members each, after the crisis the FSB, that

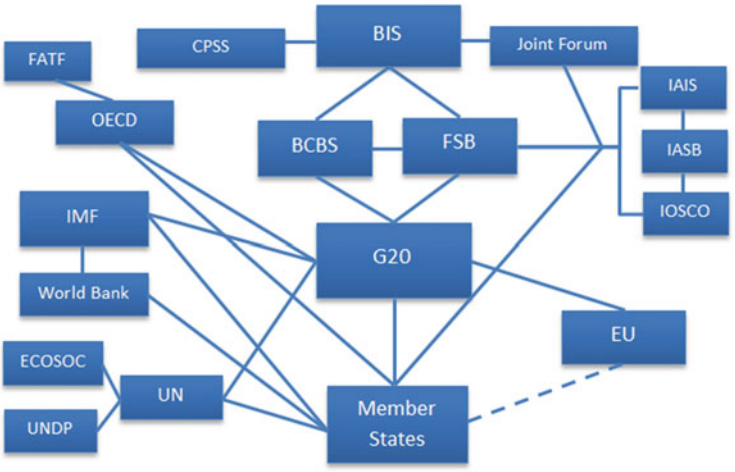

Fig. 3 International structure of financial market governance (after the crisis). *Source*: MPIfG

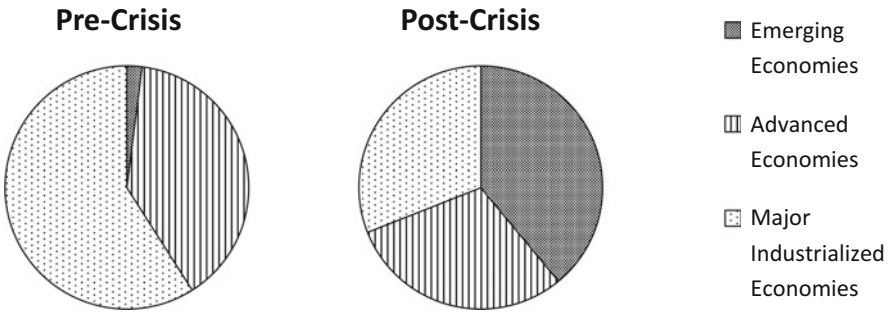

Fig. 4 Economic representation in the financial governance network. *Source:* Mohr (2013, 12)

had taken the place of the FSF, counted 24 members, while the membership of IOSCO, CPSS and BCBS had risen to 30, 23 and 27, respectively (Network analysis by Mohr 2013). Involving more countries, the network of financial market governance thus expanded geographically to include even a significant number of developing countries (See Fig. 4).

The FSB became the focal international coordinator and monitor of the reform initiatives started by the G20, both in its summits as in the meetings of finance ministers and central bank governors preceding them (Mayntz 2013). As Fig. 5 shows, the FSB has both national and international members; its chair and staff are appointed by the G20, and it is located at, and attached to the BIS in Geneva. The internal structure of the FSB reflects the network character of international financial regulation. This is also pointed out by Helleiner (2010, 3), according to whom the FSB "is designed to act more as a loose network of these various national and international officials than a substantial inter-governmental institution along the lines of the IMF, World Bank or WTO." In his survey of the international financial architecture, Pan (2010, 248) similarly puts the FSB into the category of "trans-governmental networks", along with IOSCO and the BCBS.

An important change in the multi-level financial governance structure took place at the regional level, when the three European committees already mentioned were transformed into agencies with at least limited decision making powers. In addition, a European Risk Board was created (Quaglia 2012). The European Union made its views about necessary regulatory reforms known to the G20, both at its summits and its regular meetings. In the course of time, the Council, Commission, and Parliament of the EU together developed both independent reform initiatives, as well as translating international reform recommendations into directives, subsequently to be written into law by EU member parliaments. This happened, for instance, with "Basel III", the capital requirements reform proposed by the Basel Committee BCBS. The basically bottom-up process of regulatory policy-making was thus complemented by a top-down process of implementation.

A network analysis, performed by Natalie Mohr using the NodeXL program, highlights some features of the network of actors involved in some way in financial

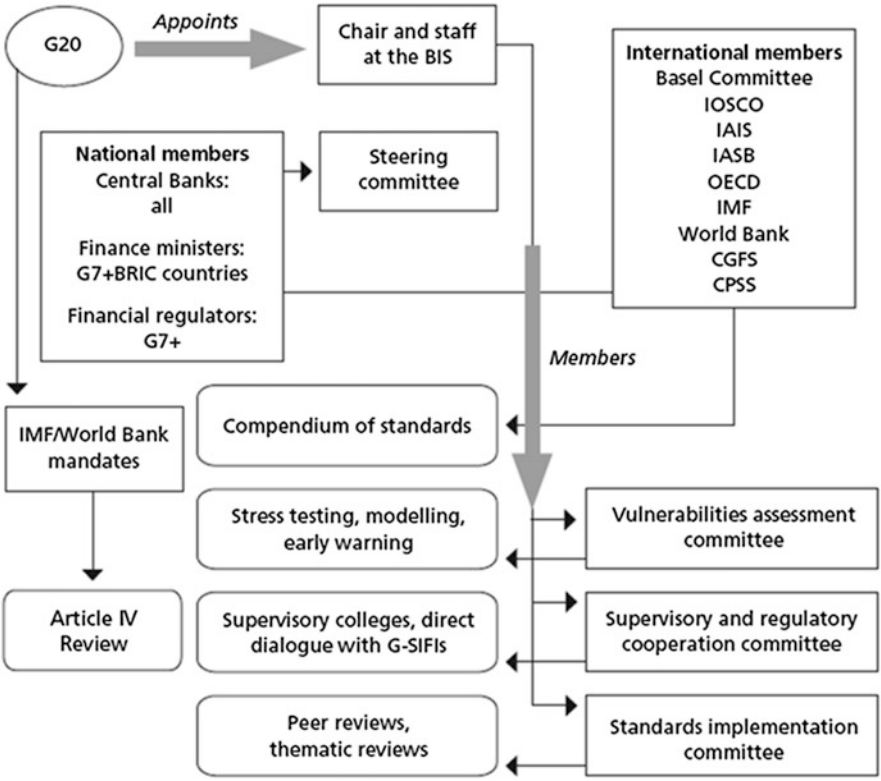

Fig. 5 Regulatory structure of the financial stability board. *Source*: Donelly (2012, 269)

market regulation. The analysis is based on a data collection exercise by Heide Haas at the MPIfG from April to September 2011. In total 68 international and regional (mainly European) institutions, involved in some way in financial market regulation, were identified. Of these, 46 are public and 22 private entities. According to the information from internet sites 229 linkages between the various entities were registered; 46 are formal membership relations, while in 183 cases organization A has observer status in organization B.

The network in Fig. 6 shows only linkages through formal membership. The focal position of the FSB is clearly evident. If only standard setters and supervisory agencies linked by formal membership are considered (Fig. 7), the dominance of public actors in the reform process is evident; this reflects the politicization of regulatory reform after the financial crisis and is a turn-around from the previous neo-liberal policy. A full picture of the relations between all bodies involved, public as well as private, and linked through observer status as well as by formal membership, is given in Fig. 8. Here organizations like the World Bank, which did not play an important role in the process of regulatory reform, appear prominent due to the

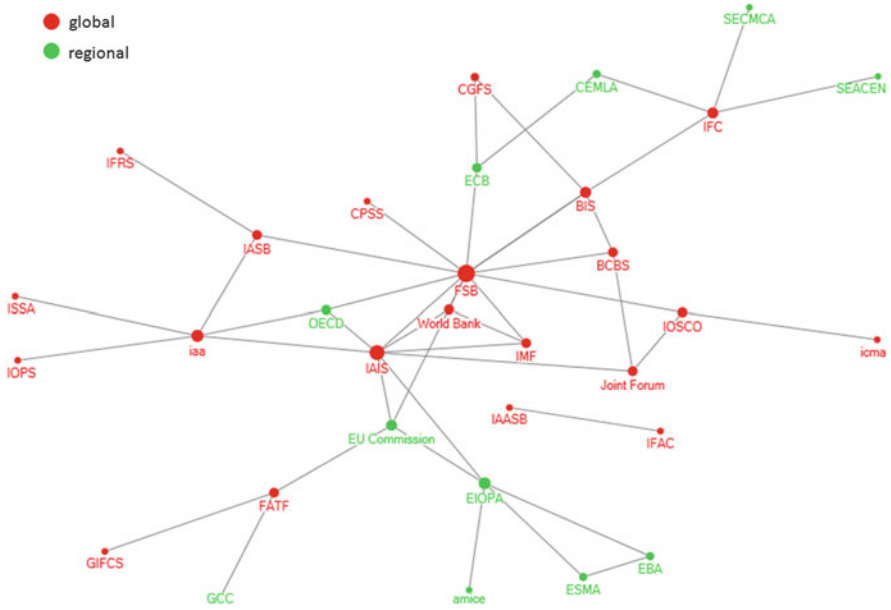

Fig. 6 Financial governance network of actors with formal memberships. *Source*: MPIFG

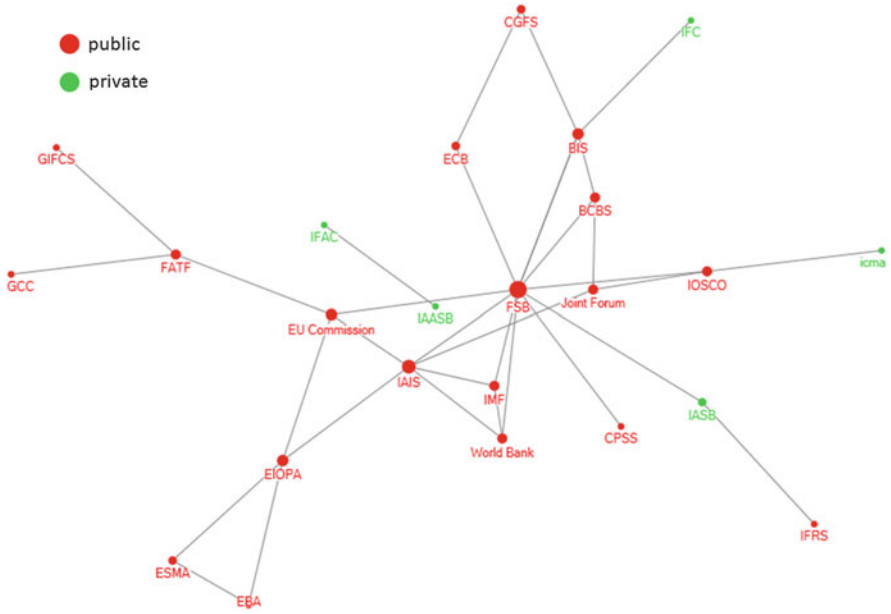

Fig. 7 Financial governance network of supervisors/standard-setters with formal memberships. *Source*: MPIfG

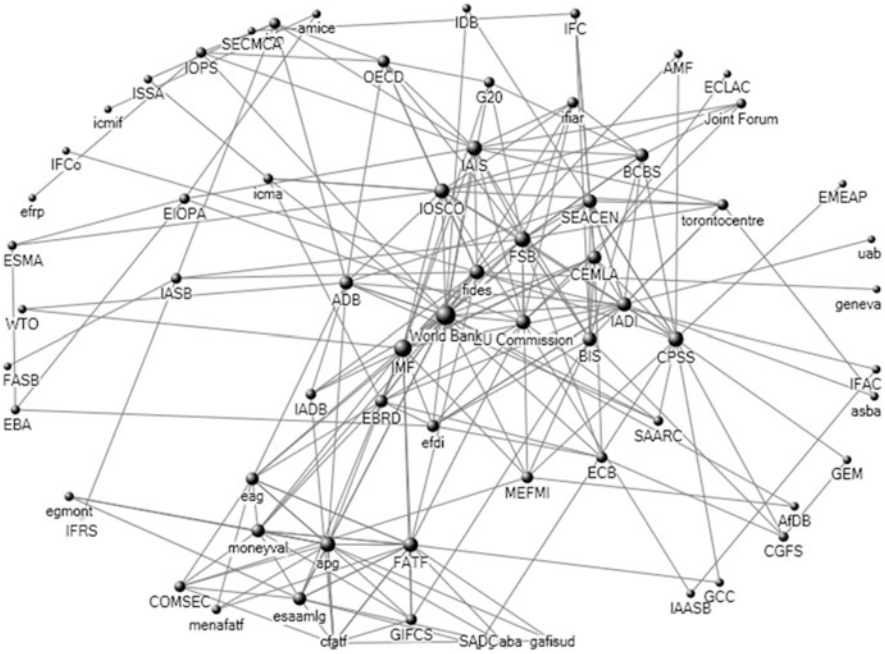

Fig. 8 Financial governance network of all actors with formal membership or observer status. *Source*: MPIfG

large number of members and observers. Clearly only a sub-set of the institutions in Fig. 8 play a role in the process of regulatory reform.

What can we conclude from this analysis with regard to the structure, and the effectiveness of the governance network of financial market regulation and its reform? As Davies (2011) correctly observed, network analysis can lead to misinterpretations, overemphasizing the network character of social reality. One obvious conclusion is that this is network, rather than hierarchical governance. There has been, and there is still no central supra-national agent that could impose a coherent regulatory reform following a well-considered master plan, even though the formation of such an institution has occasionally been advocated. But the financial crisis, and the ambitious reform plans of the period following the acute crisis, have had the double effect of tightening relations among heterogeneous institutions, and expanding the scope of the network through their greater inclusiveness.

Can this kind of "network governance" result in greater control of financial markets, and an international convergence of regulation, countering the universal temptation of regulatory arbitrage? The fact that all institutions involved with some aspect of regulatory reform are linked, either by formal membership or at least through observer status, does not mean that they cooperate closely. Regulatory reform is carried on by actors with different and partly overlapping mandates,

targeting different components of the financial system. In such a setting, it is obviously difficult to fashion non-contradictory, mutually reinforcing reforms.

The crucial problem, however, is the ability of representatives to commit those they represent in negotiations to abide by the resulting rules. To what extent do those, whose representatives have participated in the formulation of a new rule or standard, feel committed to comply with it? This is indeed questionable, not least because in democratic states, finance ministries, central banks, and national supervisory agencies whose heads or representatives have agreed to a new rule in international negotiations, are subject to decisions taken by government and the parliament. Possibly in recognition of this fact, only the FSB formally demands compliance with rules adopted by its plenary from the countries that are its members; but whether this happens in fact still depends on the goodwill of the member governments. The Basel Committee and IOSCO do not commit their member institutions to comply with any rules or standards they produce. The BCBS even points out explicitly that its standards have only the character of recommendations and need to be adopted, and written into law by its member jurisdictions.

To formulate recommendations or non-binding standards that have a good chance of being adopted and complied with by its addressees at the national level impacts strongly on the process of negotiation in international institutions. In fact, not only the implementation of, but already the ability to agree on a new rule or standard becomes problematic. If agreement is precarious, a decision costs more time. Substantively decisions must be pragmatic, trying to satisfy as far as possible the different interests represented at the negotiating table. Inevitably, this means making compromises, or to agree on the level of the lowest common denominator. This happened, for instance, in the formulation of new capital standards by the Basel Committee, which turned out not much higher than those already in effect, and are judged to be insufficient to make banks resilient to external shocks.

Clearly the international network of financial market regulation does not produce "network governance" in the ideological sense of "good governance", but nor is it "part of the hegemonic strategy of neoliberalism—the visionary, utopian and profoundly flawed regulative ideal of late capitalism" (Davies 2011, VII). Its effectiveness is strictly limited by the sovereign powers of the states that must implement reforms demanded by the G20 and devised by international standard setters. The international network of financial market regulatory reform reflects the fragmented structure of the international power system.

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Governing the Crossroads: Interstitial Communities and the Fate of Nonprofit Evaluation

Valeska P. Korff, Achim Oberg, and Walter W. Powell

1 Introduction

Networks are ubiquitous in social, economic, and political life. From job market referrals to the development of new technologies, ideas flow through friendship networks, work teams, and professional communities. Few public policies are made and implemented by individual agencies, instead the integration of private and civic stakeholders in the co-production of public services—both locally and globally—has become standard practice (Ansell and Gash 2008). Research-intensive industries form "clusters", seeking to replicate the innovative capacity of inter-firm networks that emerged in the 1980s in biotechnology (Powell et al. 2005). Universities now routinely engage in academic entrepreneurship, leaving the ivory tower behind for cooperation with the private sector, particularly in the life sciences (Colyvas and Powell 2007). The rise and ubiquity of *Wikipedia* as a primary information source underscores the contributions of loosely connected, open online communities. Open-innovation practices were a potent factor in the development of software and are becoming a favored source of innovation generally (Chesbrough 2003; Dahlander and Frederiksen 2012). Building on and simultaneously nurturing their members' capacity, expertise, and creativity, networks generate collective and individual benefits beyond the scope of any single participant. But do networks also coordinate and commit communities of individuals and organizations to common

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causes and agendas? How do disparate actors govern their behavior in the absence of clearly established rules and norms? This volume explores ideas and approaches to the concept of networked governance. Our contribution to this discussion is the idea of an *interstitial community*, a common forum where disparate participants come together and convene, share ideas, proselytize preferred approaches, and refine new practices.

We characterize interstitial communities as different from other strategies to exert influence in the context of networked social structures. Brokers that serve as a connection across structural holes can capitalize on their position by controlling and utilizing the flow of information, which is not readily available to others in different domains (Burt 1992, 2004). Social movements frame issues and demands as a basis to mobilize and gain legitimacy and power to represent collective interests against the status quo (McAdam et al. 1996). Research-intensive industries form linkages and inter-firm networks to share and advance new ideas and promising leads; when such ties "thicken" high-tech clusters emerge (Powell et al. 2005). These varied forms of collective action all, in their distinctive manners, lead to the mobilization of ideas and interests. We contribute to this diverse literature with a conceptualization that places more emphasis on cultural and spatial dimensions. By culture we focus on the creation of a common language and shared discourse. With regards to spatial aspects, we look at how porous borders between established domains are conduits, which can lead to the development of a new community at the *interstice* between spheres.

An interstice is a space between contexts, a versatile environment that is partly one thing and partly another. Less a demarcated area than an open concourse, participants can join and leave debates, form ties, and initiate interactions, without signing on to a common platform or agreement on standardized practices. Through such engagement, mutual recognition occurs, ideas and practices are exchanged, and boundary-crossing ties formed. As a result, frontiers may be bridged, turning the interstice into a permeable structure through which ideas and approaches can travel. One may think of the interstice as a basin or reservoir: a confluence of ideas and policies from various origins as well as a repository that feeds innovative recombinations back into established fields. An interstice featuring tributaries and outflows—like a network of streams—can be a prolific space. Combining cultural diversity with relational integration, an interstice is a borderland in which connections may be forged and new discourses developed.

Organizations that enter an interstitial space have the opportunity to partake in these relational and cultural exchanges, driving network formation and cultural innovation across different spheres. Our central argument in this chapter is that these interstitial communities are collectives that perform bridging functions, bringing together disparate constituencies in a form of networked governance that combines cultural and relational influences. The spatial topography that results from an interstitial position at the heart of both networks and discourse affords an opportunity to translate ideas and practices and develop new ones.

1.1 The Debate on Nonprofit Performance Evaluation

Interstitial communities are a particular form of networked governance that build on and use distinctive relational and cultural features. These elements, we contend, differentiate such communities from brokers, technology clusters, social movements, or other forms of influence in networked social structures. To empirically explore and illustrate our conceptualization, we examine the burgeoning field of nonprofit performance evaluation as an illustrative case. Over the last decades, the social sector has faced immense pressures to document its impact, resulting in efforts to integrate scientific and managerial discourses with civic ideals in order to assess the performance of nonprofit organizations. Around these efforts, an open and active arena of debate has emerged in which cultural content and new relationships have been forged. All manner of participants—from governments to donors and philanthropists to business leader and foundations—have evinced concern over how to gauge and document the effectiveness of charitable activity. The philosopher Singer (2015) adds another voice as he champions his movement for effective altruism, and praises nonprofit rating services such as Give Well. These disparate voices and pressures provide a rich empirical setting to study how this debate has reshaped the social sector, both in its pattern of relationships and language of assessment.

We draw on a research project that analyzed the relational structures and discourse among organizations involved in this debate, which includes 369 participants obtained through webcrawler sample selection. Those involved are a quite heterogeneous group: nonprofits, foundations, consultancies, national and transnational government bodies, select corporations, academic centers, social movements, and even single person blogs (Powell et al. 2017). In creating the sample, we defined a threshold that each entity was drawn in by five or more weblinks to other members. We regard weblinks as a form of mutual recognition, similar to co-citation networks in the world of science or friendship networks on Facebook. The connections suggest a densely integrated community. For each participant, we identified their orientation toward the domains of science, management, and civil society on the basis of discourse specific keyword occurrences in their publicly accessible representation on the worldwide web. This linguistic mapping of the entire content of their webpages, in some cases more than thousands of pages, allows us to assign each participant a position in a three-dimensional space spanned by the three axes of civil society, management, and science. This space can be represented as an equilateral triangle where the corners mark a cultural orientation position with 100% of the occurrences of keywords belonging to only one domain, the center being a space in which cultural content from all three domains is equally blended. By marking each member's position on the triangular plane based on its percentage of references to the three discourses, we create an image (Fig. 1a) depicting the cultural topography of nonprofit performance evaluation. In a second step (Fig. 1b), relations among participants in the debate—in our case hyperlinks—are layered on top, thus producing a visualization of both the cultural and relational structure of the debate on nonprofit performance evaluation.

(For more detail on our novel methods and for information on how the images were generated, see Korff et al. 2015).

The figures have several important features. Figure 1a has different shadings to denote the linguistic positioning of the organizations within the four communities (the interstitial community in white). Figure 1b captures weblink relations, with node size reflecting the number of references. As Fig. 1a suggests, at the crossroads between the domains of science, management, and civil society, organizations have come together to draw on diverse discourses to synthesize and re-combine concepts in a joint, if not necessarily consciously collective, effort to create new evaluative metrics of social performance. In this versatile and open debate, we observe a community at the interstice between science, management, and civil society that is

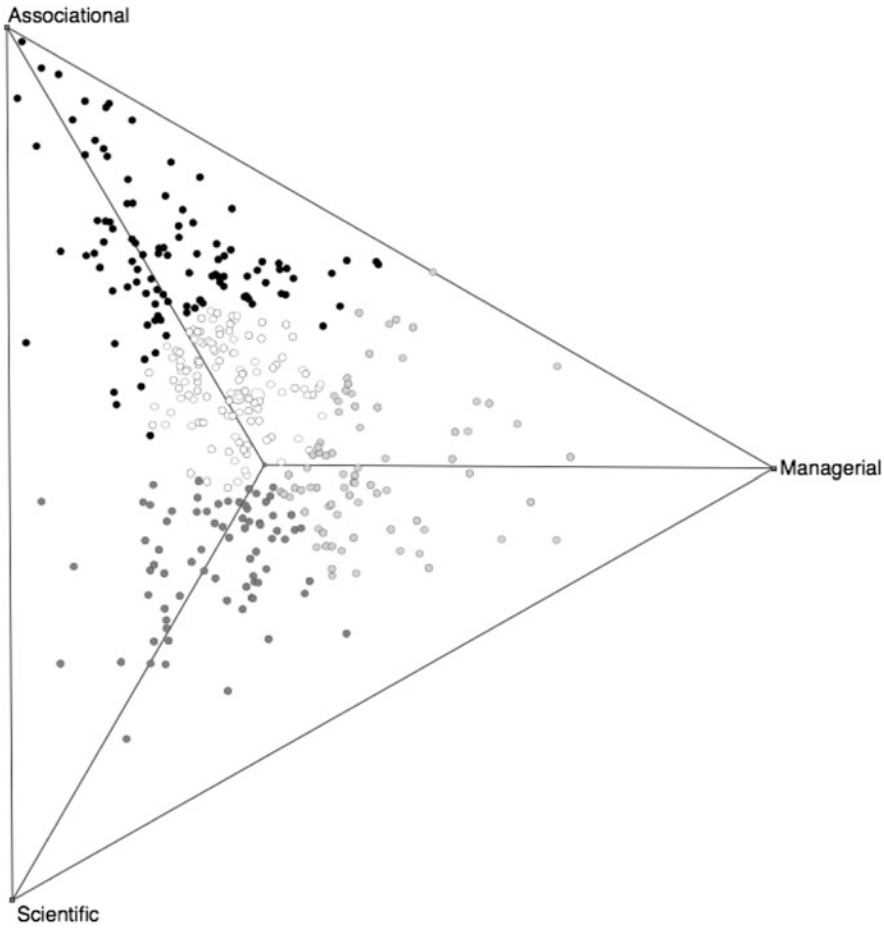

Fig. 1 (**a**) Cultural topography of nonprofit performance evaluation. (**b**) Cultural and relational topography of nonprofit performance evaluation

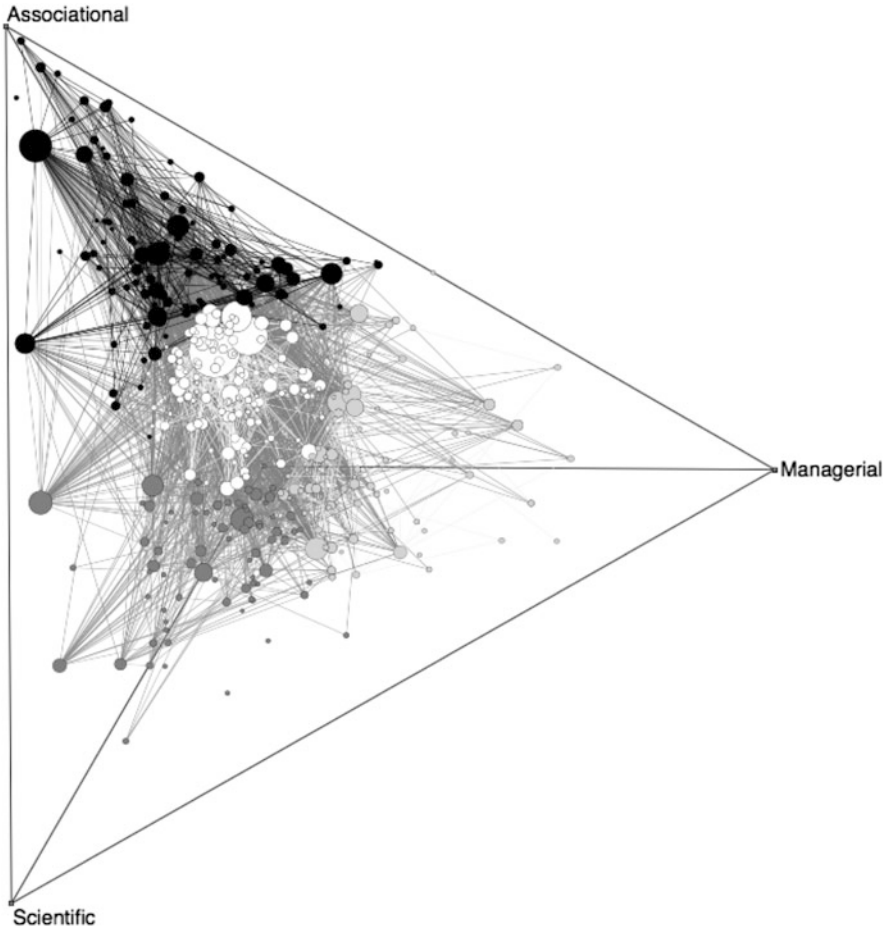

Fig. 1 (continued)

creating new relations and discourses. Figure 1b illustrates that there are central actors in each community, but the interstitial community has the largest number of these entities. In the following section, we differentiate this interstitial community from other forms of networked governance, both conceptually and empirically. We do so with close-ups and pullouts from the above visualization to illustrate the manifestation of diverse forms of networked governance in the context of this debate on nonprofit performance evaluation. Our effort shows how different participants pursue divergent strategies to try to influence this new world of social impact assessment.

2 Forms of Networked Governance

Our goal is to suggest and visualize notable distinctions among various types of network governance. With the proliferation of different types of interorganizational connections came a parallel ambition to understand and possibly influence the formation of relational structures: the origin of the rise of *network governance*. As a concept, network governance may take many forms. The literature on 'whole networks' and 'innovation clusters' emphasizes joint decision-making and coordination as a means to implement specific tasks and generate benefits for members (e.g. Klijn 2005; Kenis et al. 2009). Particularly in the context of open innovation, there is a growing focus on how new ideas and products occur in distributed communities where geographically-dispersed, but like-minded people are working at technological frontiers (Murray and O'Mahony 2007; Dahlander and Frederiksen 2012). In other streams, network governance involves collective mobilization. The literature on social movements elaborates how social cohesion can be utilized in order to affect institutional change by means of collective action (Diani and McAdam 2003; Diani and Baldassarri 2007). Research on brokerage emphasizes structural position as central to acquiring influence and identifies people or organizations in particularly advantageous positions (Ibarra et al. 2005).

These distinct theorizations offer differing perspectives on how both individuals and organizations participate in network-related activities, the goals they pursue by doing so, and the accounts that give meaning to their endeavors. We take these dimensions—actors, a basis for engagement, goals, and discourse—as building blocks to conceptualize interstitial communities. We then contrast them with other modes of governance, specifically brokerage, social movements, and technology clusters (see Table 1).

Table 1 Forms of networked governance

	Brokerage	Social movements	Technology clusters	Interstitial communities
Actors	Individuals or small groups	Small or large collectives of like-minded people	Diverse types of formal organizations and resource providers	Diverse types of organizations involved in organizational change
Basis for engagement	Opportunity, arbitrage	Common political beliefs	Technological complementarities	Convening
Goals	Benefit from bringing disconnected parties together	Political reform, transformation	Innovation in products, job creation	Field creation
Discourse	Entrepreneurial	Ideological, grievances	Science and technology based	Polyglot, creole

2.1 Brokerage

Brokers are typically individuals or a select group of organizations that are in particularly advantageous network positions in so far as they span structural holes, and are thus able to control the flow of information and resources between separate parties. A broker reaps benefits from uniting two or more disconnected parties (Burt 1992). Such gains can be financial, reputational, or political. Brokers bring parties together to derive benefits; brokerage can generate rewards both with regard to the provision of information as well as the facilitation of contacts. As such, brokerage is based on a fundamentally entrepreneurial meaning system or discourse: opportunities deriving from network position are a basis to garner forms of profit. Brokerage can, however, exceed individual benefit and contribute to the collective good by facilitating the re-combination of diverse and even incompatible ideas (Hargadon and Sutton 1997). Particularly in contexts characterized by high levels of ambiguity, brokers engage in integration or nexus work, actively selecting, rejecting, and synthesizing disparate contributions into coherent wholes (Long Lingo and O'Mahoney 2010). From this perspective, the broker, although considered to be concerned predominantly with relational power, becomes an active participant in processes of meaning construction and innovation. In our sample, three organizations stand out as brokers, both in terms of their location and their activities. We highlight them below in Fig. 2, showing their respective positions astride two domains.

Two organizations are positioned at the juncture of management and civil society. Bridgespan, with a moniker that captures its location between the worlds of business and nonprofits, was co-founded by a former managing director of the for-profit consultancy Bain and a Harvard Business School professor in 1999. They have built an organization, with more than 170 employees today, that is an adviser, consultancy, and resource for medium and large mission-driven nonprofits. On its webpage, Bridgespan states that it values performance and results, and that it works with clients and listens to them and learns from them as it transfers and implements managerial reforms and strategies. The organization straddles these two domains and is a conduit, becoming in a short time the leading nonprofit consulting firm. Tactical Philanthropy, was a blog site from 2006 to 2012, authored by Sean Stannard-Stockton. At its peak, the blog site played host to a debate about effective philanthropy and chronicled what its author termed "the second great wave of philanthropy". The blog site attracted more than 25,000 monthly readers. The blog site is no longer active, but the 6-year archive still attracts thousands of visitors monthly. Today, Stannard-Stockton is a broker par excellence, serving as a director of investments and overseer of philanthropic services at Ensemble Capital Management, a wealth management firm that advises the wealthy of the San Francisco Bay Area about their philanthropic investments. A differently positioned broker, the Center for Effective Philanthropy, with offices in San Francisco and Cambridge MA, sits between the spheres of science and management. The center provides advisory services and research tools to enable foundation funders to "achieve greater impact". With a combination of assessment tools, applied research and

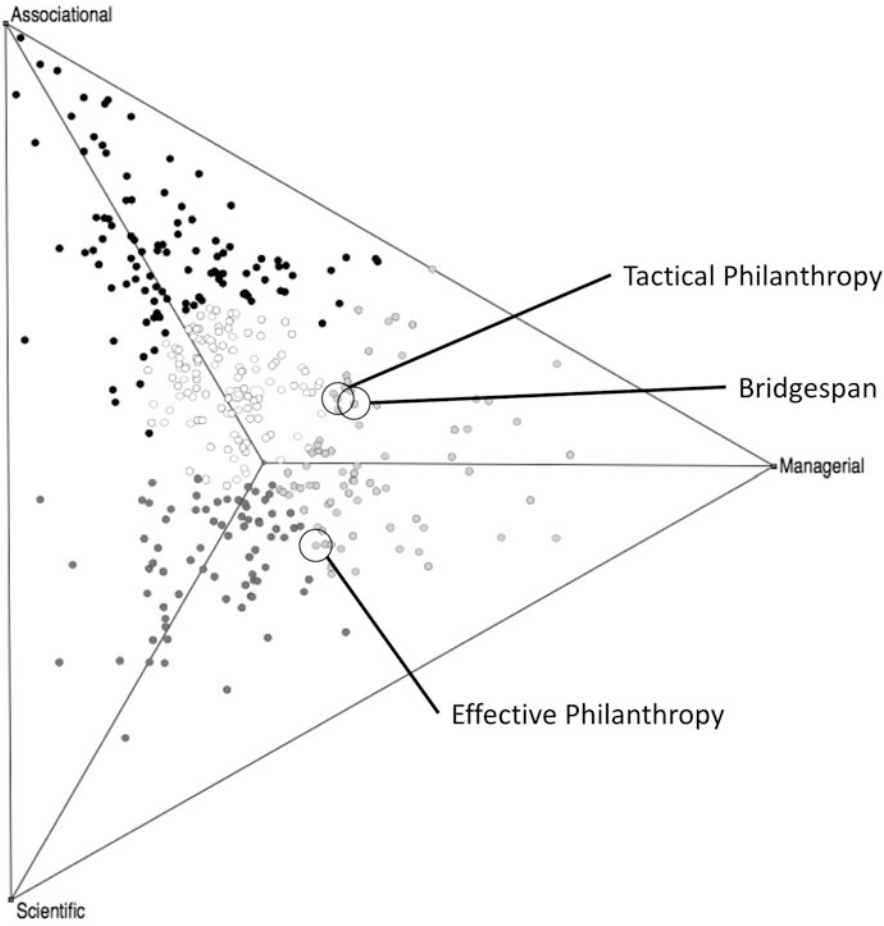

Fig. 2 Brokers

programs, the Center represent itself as a data-driven adviser to leading foundations.

Each of these brokers is providing services that bridge communities that were formerly separate. Their respective distinctive positions place them at the forefront of efforts to define social impact. At the same time, each runs an enterprise or business that is sustained by these brokering efforts. Indeed, all three have prospered as the field of evaluation has mushroomed.

2.2 Social Movements

In contrast to brokers, social movements are composed of multiple like-minded individuals united by a shared political vision. Such a "movement frame" is a

highly potent integrative device: social movements portray issues and demands in a cohesive format as a basis to mobilize and obtain the legitimacy to represent collective interests (McAdam et al. 1996). Discourse is central to such framing as it specifies the grievances against which a movement is directed and provides the rallying cry for formulating demands, strategies, and objectives. Such discursive action facilitates the creation of a common identity: multiple expressions are channeled into one unified voice. People join because they identify with the specified political beliefs, purposefully assuming membership and forming ties to other movement participants. A striking example in our sample is Kiva, one of the first crowd-funded, micro-finance organizations, founded in San Francisco in 2005 to connect people through lending to alleviate global poverty. Today, Kiva has attracted more than one million lenders worldwide and raised more than a half billion dollars to finance female-run, green, and educational businesses. True to its movement roots, Kiva does not collect any interest on the loans it facilitates, nor do its lenders make any money. Similarly, Charity Water, founded in 2006, is "on a mission to bring clean drinking water to every person on the planet". Like Kiva, it uses crowd-funding, and funds individuals, a tactic that is, admittedly, quite challenging when it comes to a public infrastructure like water. As of early 2015, Charity Water had attracted more than 300,000 donors for more than 16,000 projects in 24 countries. Both organizations reflect a new movement—crowd-sourced campaigns that go straight to help individuals, transparency about operations, and no desire to make a return off of their efforts, but a direct attempt to change lives of the recipients of aid.

The call for better performance of social service providers and higher "social return on investment" in nonprofit organizations also has a strong social movement flavor. An examination of the language of the managerial domain reveals that this semantic space is not only inhabited by for-profit organizations, such as consultancies, that offer their services to nonprofits. We also find several highly visible nonprofits that, despite their status as civil society organizations, draw on the discourse of management. Teach for America and the Grameen Bank, both champion the themes of leadership, effectiveness, and individual responsibility that are pervasive in this community. Many websites of organizations in the management sector sparkle with catchy phrases—"a passion for performance," "money and meaning," and "investment for social change"—reflecting the use of language as a framing device. Managerial concepts and terminology are combined with civic values to promote ideals around market-based solutions, notions of turning good intentions into profitability, and ambitions to uphold clear performance standards. The charity evaluator Give Well is perhaps the signature of the "effective philanthropy" movement, as its methodology of evaluation enables, in its words, potential donors to achieve "real change for your dollar". Proselytizing to shape public perception and mobilizing by providing resources based on adherence to performance standards are an important part of the mission of the nonprofits in the managerial domain. "Smart", "tactical" and "effective" philanthropy are not just buzzwords, but visions—movement frames—around which to rally. Figure 3 locates Kiva, Charity Water, Teach for America and Give Well in the overall

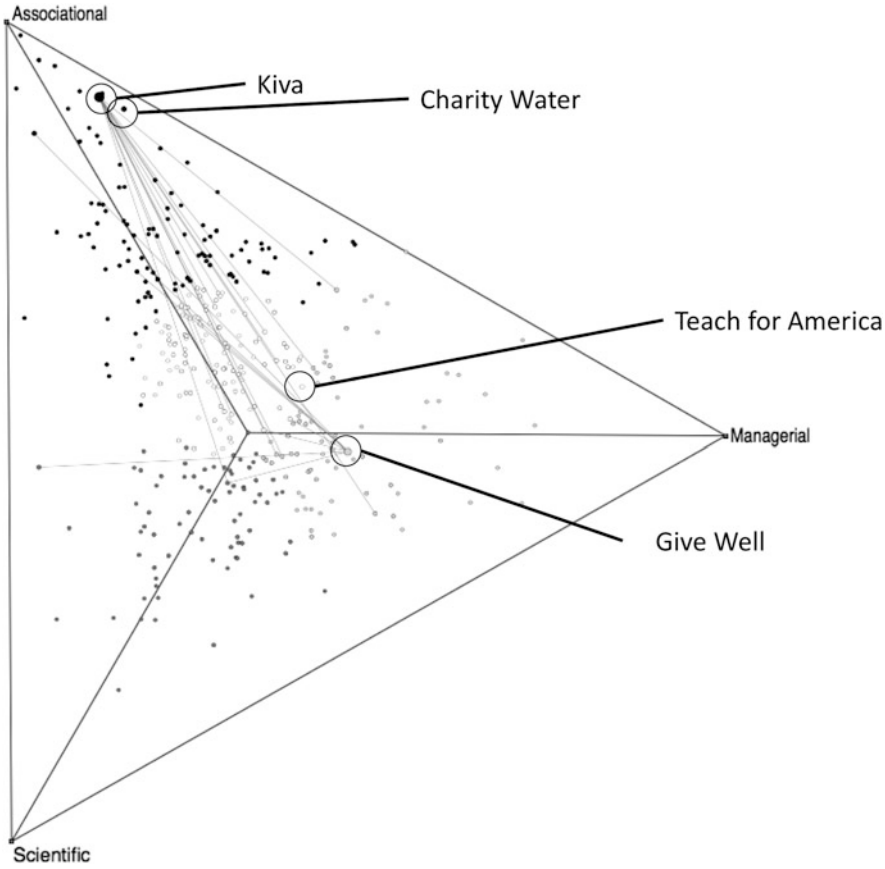

Fig. 3 Social movements

network and depicts their web references to the full sample. The pattern suggests the efforts of each organization to build relations outside their immediate locales. Such efforts at enrollment typify social movement-like mobilization.

2.3 Technology Innovation Clusters

Studies of the growth of science and technology-based industries have demonstrated that networks of learning among firms, institutes and universities are the locus of innovation (Allen 1983; Powell et al. 1996). Innovation in these fields seldom arises from solitary individuals or organizations, but from a process of building on the ideas of others (Fleming 2001; Katila and Ahuja 2002). Such cumulative processes of knowledge creation require that ideas be shared rather than hoarded. As the economist Marshall (1890, 1920) famously said of nineteenth

century industrial districts, it is as if "the secrets of industry are in the air". In districts or clusters, the sharing of information across organizational boundaries becomes commonplace (Saxenian 1994). The existence of loosely connected, but not centrally coordinated, groups of participants are integral elements in creating a favorable context for cumulative innovation (Foray 1991; Murray and O'Mahony 2007).

New ideas and products are often developed in distributed communities where geographically-dispersed, but like-minded people are working at technical frontiers. But there are also many efforts underway to purposefully create such interconnected communities or "clusters". These open networks are meant to leverage the complementarities of their members in expertise and resources, and facilitate mutually beneficial cooperation between competitors, resource providers, and entrepreneurial-minded research agencies with the goal to develop new technologies and products.

Digital technologies and online communications now play an important role in the formation of such clusters (Dahlander et al. 2008). This is especially the case in the context of nonprofit performance evaluation, where donors' reliance on the internet as an information source has been met by the emergence of nonprofit rating services. Agencies like Charity Navigator, Philanthropedia, Give Well, or the Better Business Bureau's Wise Giving Alliance developed Web-based rating services that judge and rank nonprofits on administrative overhead, effective allocation of funds, accountability and transparency. The data underlying these rankings are drawn from multiple sources. Where initially the emphasis was on the use of audit reports, tax forms, and other publicly accessible financial information, more recent responses to calls for the integration of "qualitative" metrics include the use of expert reviews and crowdsourcing along the lines of Yelp, Zagat, and other consumer rankings (Lowell et al. 2005).

The idea to provide reliable and comparable information to support decision-making with regard to donation allocation is not new. Since 1918, beginning with the National Charities Information Bureau's effort to prevent abuses in fundraising for war relief agencies, various initiatives have been conceived to assess the worthiness of charitable organizations. The precursor of the BBB's Wise Giving Alliance dates back to 1945 and entailed a straight-forward differentiation between organizations that meet core quality standards and those that do not (Gordon et al. 2009). Charity Navigator, the largest rating agency in terms of charities evaluated, provides detailed accounts and visual representations, using various data to compute a general score based on which one to four stars are attributed. Most of these rankings are available online. These various rating services are united by the goal to make the performance and donation 'worthiness' of nonprofits measurable, as well as by a common use of technologies to make big data and crowdsourcing accessible to this endeavor. In the scientific community, we see a parallel effort underway. A cluster of organizations, portrayed below in Fig. 4, are involved in a common effort to measure the impact and effectiveness of US school and health care reform efforts

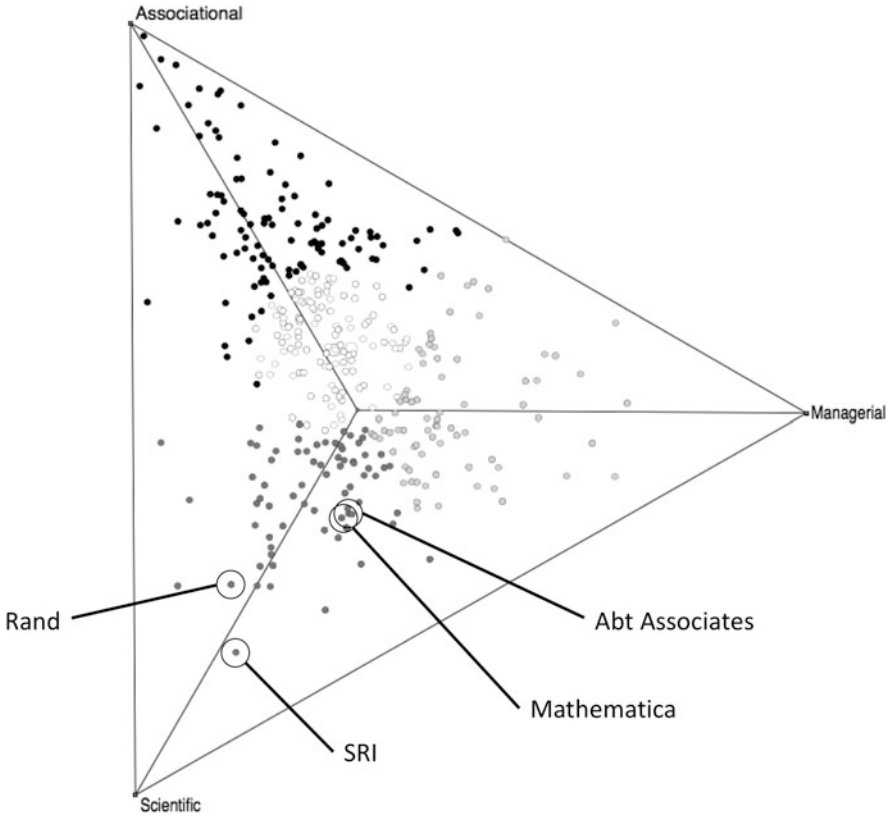

Fig. 4 Technology clusters

and other social policies. They are shaping the contemporary debate about impact evaluation, field-based experiments, and research design. Included in this group are Abt Associates, American Evaluation Association (AEA), Mathematica, Rand, and SRI. These groups have their origins in the academy but are notable for their emphasis on usable knowledge and deep engagement with the messy world of policy and implementation. As we see, these organizations are tightly clustered spatially, indicating that they speak a common language of measurement, statistics, and field studies.

2.4 Interstitial Communities

Interstitial communities share features with, but are also distinct from, other forms of network governance. The contrast is perhaps most pronounced with regard to brokers. Although interstitial communities also connect different communities, they do not constitute individual bridges spanning structural holes, but form a

collectivity that in its entirety constructs multiple pathways across domain boundaries. As such, no individual interstitial organization can leverage its network position for great benefit. Instead, interstitial communities form collective entities, in which relational bridging capacity is combined with the discursive skill to speak to diverse audiences. Being polyglot enables interstitials to draw on multiple discourses and recombine as well as translate concepts across arenas, thus building cultural bridges.

Social movements are possibly more cohesive than interstitial communities. Whereas movement activism is typically based on strong identification with the respective ideology, membership in interstitial communities is not necessarily purposive or entails deep attachment. Discourse also plays a crucial role for interstitial communities both as a bridging function and to create cohesion, but it does not serve a comparable role as a framing device through which a common identity is created. Whereas social movements seek to affect political and social change, interstitial communities engage in open exchange and interaction to formulate ideas and establish new relational structures. Through such convening efforts, different perspectives are brought together. In contrast to social movements, interstitial communities are not a unitary collective actor. Instead of speaking with a single voice, interstitials form a chorus, maybe even a cacophony, given the absence of a harmonizing conductor.

Innovation clusters, finally, have strong internal connectivity and orient themselves to others as a magnet of attention. This is different for interstitial communities, which—in order to span domains—are at the same time internally as well as externally oriented. One ambition of interstitial communities is to develop a new "interlanguage", while successful tech clusters expect outsiders to learn their language. Nonetheless, we observe the closest similarity to innovation clusters in so far as both forms consist of communities of independent organizations united by common interests. The potential of such communities has long been recognized, both within organizations as well as across organizational boundaries in various domains, from science to technology (Brown and Duguid 1991; Knorr-Cetina 1999). For interstitial communities, innovation is, however, not a stated objective, but arises from the interactions among diverse organizations that are able to speak multiple discourses.

In sum, interstitial communities represent a distinctive form of networked governance different from brokers, social movements, and innovation clusters in that their influence derives from a combination of cultural and relational centrality. Spatial power is derived from positioning at the heart of both networks and discourses, which affords the creation of new ideas, metrics, and language.

As discussions about nonprofit performance evaluation have become louder, the interstice between the domains of science, civil society, and management has become densely populated. Of the 369 organizations in our sample, 119 exhibit a cultural orientation that positions them in between all three discourses. Among these interstitials we find the full diversity of our sample. No organizational form, type or feature is either dominant or absent. The interstice is home to nonprofits and for-profits, US-based and international, old and young, large and small, liberal and

conservative organizations alike. These organizations are generalists, although their audience is clearly the nonprofit community, donors, and governments. Community-building is an important topic, both with regard to neighborhood transformations as done by the Harlem Childrens Zone, as well by efforts of "meta-organizations" and associations to promote interorganizational cooperation (Ahrne and Brunsson 2008). There are also those that engage in efforts to create novel organizational models, such as the nonprofit venture capital fund Acumen, KIPP (a charter school network), Ashoka, Benetech (a nonprofit tech company providing access to the world's libraries for the blind), Social Venture Partners, and the Skoll Foundation. Together these organizations—not only despite, but because of their differences—are able to bring together and recombine ideas and practices from diverse worlds. They are also important producers and carriers of evaluative practices. Through their interactions, they are shaping the creation of performance metrics for the social sector.

In sum, three dimensions underlie the bridging capacity by which an interstitial community draws together disparate members and exerts influence over structure and content of a social system: (1) a common cultural orientation as expressed in a shared language, (2) internal integration as a community of like-minded organizations, and (3) external ties with the adjoining established domains. We discuss each dimension in turn.

The Power of a Common Language Language has a direct communicative aspect as well as a strong integrative function. It reflects taken-for-granted understandings and procedures for generating and evaluating action, and creates cohesion by establishing a common ground (Mills 1940). At the same time, language excludes those unwilling or unable to converse in the shared vocabulary, thereby creating borders demarcating social worlds. Language does not exist as an abstract construct however; it is ultimately a matter of practice. By drawing on a particular discourse, membership in a community and its associated norms and beliefs is expressed. Language use in this sense becomes a structuring device, a means by which groups are formed and differentiated from one another. Language thus can be used to either reinforce or reconcile differences.

An interstice that serves as a semantic space between established domains is a home to organizations who express themselves in a language that is not distinctive to any one "older" discourse, but instead is composed of polyglot terms, or a pidgin or "interlanguage" that allows communication across cultural boundaries (Galison 1997). Given this linguistic versatility, interstitials have, irrespective of their origin, the capacity to transcend the discourse of any one particular group and speak to organizations of various orientations. The capacity to converse across cultural boundaries allows drawing on a more diverse and extensive pool of ideas, concepts, and practices, while at the same time opening the potential to broadcast, convince, and proselytize (Powell et al. 2017). Organizations that can speak to diverse audiences have a broader reach—both outgoing and incoming—than their monolingual peers, whose scope is limited to those in their linguistic vicinity.

A shared language that reflects all three discourses is a key feature of the interstitial community that we observe in the debate on nonprofit evaluation. The websites of the various interstitial organizations feature a distinctive vocabulary: translator, navigator, interpreter, catalyst, expositor, mobilizer, change agent. Themes of field-building, architecture, and agenda-setting are common, all signs of efforts to create a new language. The interstitials also make heavy use of social media, including Facebook, YouTube, podcasts, and Twitter. The latter points to efforts to reach diverse audiences, forging relations as a basis to proselytize new ideas and concepts. This is of particular relevance as linguistic capacity with multiple discourses, although a necessary condition for bridging domains, does not suffice. An interstitial community's ability to exert influence depends on whether the potential of a common, boundary-spanning language is in fact met: does it create both internal cohesion and more external integration?

The Power of Internal Cohesion For organizations in established domains, speaking a common language is an expression of a shared identity. They draw on a common terminology, using distinctive keywords as part of a "discursive performance" to signal membership (Johnstone 2002: 223). For organizations in the interstice, the situation is different. They draw equally on multiple discourses, thus evading clear attribution, finding themselves—possibly not even intentionally—in the borderland between domains.

Facility with diverse discourses suggests that members of an interstitial community, even if they do not specifically identify as such, have multilingual or polyglot skills and can use them in order to engage with their peers. Public conversation in a 'foreign' language signals an organization's willingness to move out of its home turf in favor of associating with others. For an interstitial community to form a collective that actively partakes in structuration processes and in the development and dissemination of novel cultural content, internal cohesion is important in order to develop a coherent new language and orientation, rather than some glib fusion and temporary mash-up. An interstitial community whose members are interconnected is able to assemble varied perspectives and engage in collective recombination efforts, some of which might find consensus and support. If so, the concerted ability to speak with multiple voices creates leverage: a collective is a stronger driver than an individual organization and a cohesive, internally-connected interstitial community can become a potent force in the remaking of established practices, structures, and discourses.

Figure 5 provides an impression of the density of ties within the different domains, showing that organizations within the interstitial community are indeed tightly interconnected. As a collectivity, they constitute an assembly of organizations with different histories, constituents, and ideologies, which participate in a joint, if not concordant, debate about how to measure the efficacy of civic activities. These organizations' allegiance is not necessarily with the members of the interstitial community—in fact, they may presently have limited sense of forming a new community—but they are engaged in intensified interactions with one another. These interactions strengthen the joint focus on evaluation, providing

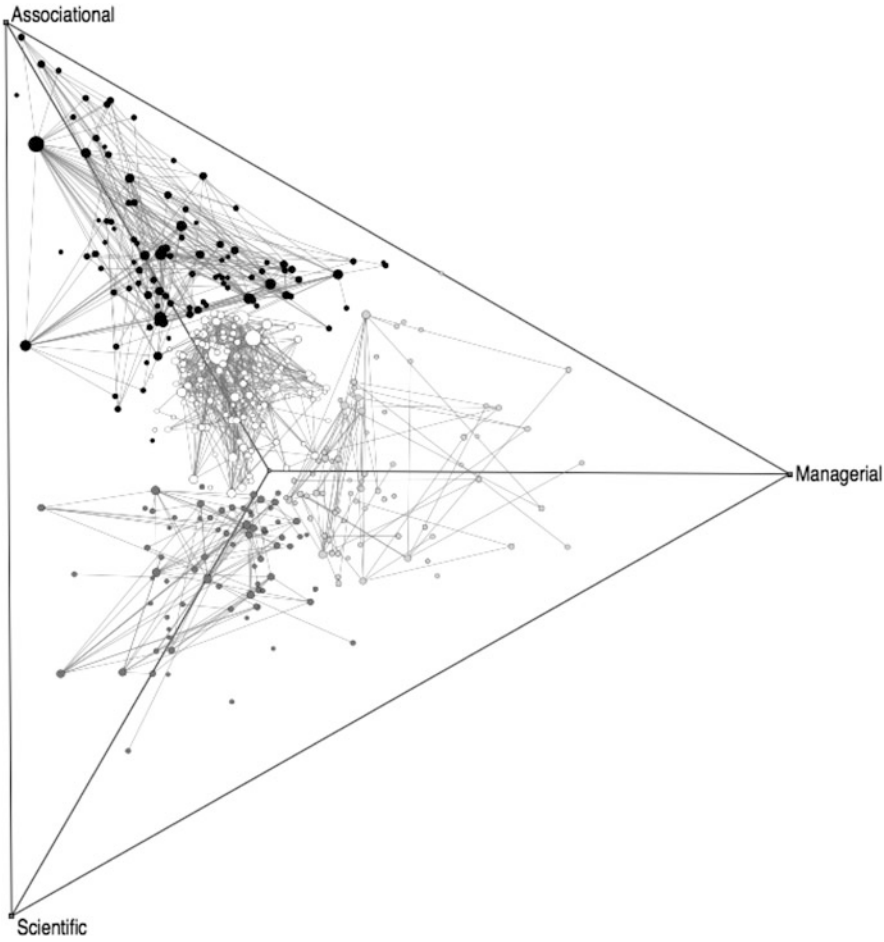

Fig. 5 Internal connectivity within different domains. For a color version of this figure, see Korff et al. (2015): Fig. 5a

reassurance over the legitimacy of such endeavor. Networks and alliances are an important theme within the interstitial community, which includes grantmakers' councils and centers for advocacy. The Worldwide Initiative for Grantmaker Support (WINGS), for example, brings together organizations serving philanthropy globally and counts more than 15,000 foundations, grantmakers and social investors among its worldwide membership. The guiding mission of this global network is to "give voices to the many cultures of giving", enable information exchange among "peers", and build a "global philanthropic community". We also see comparable initiatives at the local level. Donors Forum is an association of Chicago-area grantmakers formed to promote effective and responsive

philanthropy. They facilitate networking, provide education, and offer opportunities for the region's grantmakers to join together to form a cooperative and interactive community. Networks are also built around particular themes and forms of giving, from family philanthropy to social venture partnerships. Building relations and facilitating interactions among members of the social sector is a central project among the organizations in the interstice, and is reflected in their propensity to forge ties with one another.

The Power of External Integration Connections among interstitial organizations, however, only reach so far. Internal cohesion is a basis for action, but for an interstice to be more than a niche, the approaches generated here have to be widely communicated. With the capacity to converse in multiple languages, interstitial organizations have a broad linguistic scope that allows them to communicate across a wide array of types of organizations. Yet whether they are able to leverage this potential again depends on their relational features, or more specifically, the extent to which organizations at the interstice are integrated back into the more established domains whose boundaries they span. An internally cohesive, yet externally disconnected, interstitial community would have no capacity for network governance as its members could neither draw on older worlds as sources for inspiration, nor disseminate its own ideas. Dense internal structures provide stability; but in order to serve as a bridge facilitating the flow of practices, an interstitial community needs many linkages into other domains. Lacking such external ties, an interstice runs the risk of turning into an enclave that provides protection to communities of organizations that are at odds with their larger institutional environment (Friedman 2011). External integration, in contrast, validates legitimacy, potentially shifting the perception of an interstitial community from a congregation of misfits to a respected group of innovators. Such validation enables an interstitial community to reach a broad audience, and utilize its linguistic versatility to enroll others and become influential.

The interstitial community we observe in the discussion of nonprofit performance evaluation possesses such ability to connect and enroll (Korff et al. 2015). As Fig. 6 shows, multiple ties exist into the adjoining sectors, enabling interstitial organizations to draw information from external sources as well as to disseminate ideas widely. The interstitial community is no congress of outsiders, but a coterie of insiders and upstarts, involving wealthy foundations and networks of smaller grantmakers, multiple UN bodies and other international agencies, influential print media as well as blogs, whose voices are likely to resonate broadly. The Stanford Social Innovation Review (SSRI) is an outlet that specifically covers "cross-sector solutions" to global problems, bridging academic theory and practice with ideas about achieving social change. The Review's features on topics from microfinance and green businesses to social impact and human rights are widely read within the social sector and beyond, addressing audiences in nonprofits as well as in government and business. Not only a highly successful proselytizer itself, SSRI also offers webinars on how to communicate innovation and "making ideas move". The ambition to employ smart communication for social change also resonates with

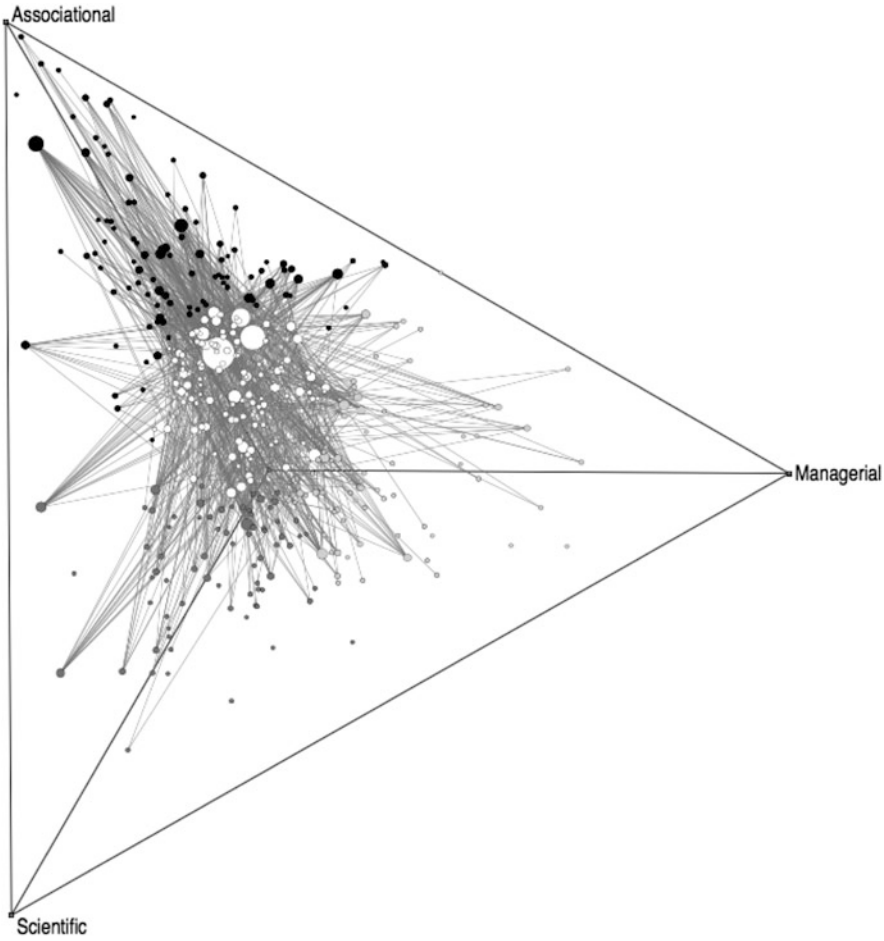

Fig. 6 External connectivity of the interstitial community. For a color version of this figure, see Korff et al. (2015): Fig. 5c

the Communications Network, a nonprofit organization whose mission is to educate and support foundations and civic organizations to "get the word out".

These communicative skills and extensive ties to organizations around the world make the interstitial community a hotbed of interaction with a reach beyond its immediate environs. Decisions, models, and approaches are taking shape and content is generated through the recombination of concepts from science, management, and civil society. Moreover, new ideas and practices of assessment are spread far afield, resonating across the global social sector and its policy-making more generally.

3 Conclusion: The Spatial Power of Bridging Domains

In ways that are significantly different from the activities of brokers, social movements, and clusters, interstitials bring together a new composite of features of other forms of influencing networks. Interstitial organizations have the relational power of brokers in that they forge connections across domains. As such, they have the ability to assemble ideas and concepts into novel recombinations, as well as social movements' capacity to create cohesion among diverse participants, which lends them a degree of internal integration not unlike clusters. Interstitials, in sum, are collectives of organizations that have access to multiple cultural repertoires, are internally integrated, and have an external reach into adjoining domains. With this combination of features, their influence on processes of coordination and decision-making in networked social structures can be substantial: the ability to reassemble cultural content, share and transform it through internal interactions, and finally, reach out and communicate with others enables members of an interstitial community to serve as bridges, potentially fusing formerly separate domains.

The recombination of civic values, a managerial emphasis on efficiency, and scientific approaches to measurement in the discussion of nonprofit performance evaluation can be attributed to the integrative activities of such a community of organizations at the interstice. Its diverse, in both language and form, yet well-connected members bring together influences from all three worlds and use this comprehensive repertoire to build novel approaches, which resonate far across the concerned spheres. "Performance management", "social impact", "effective philanthropy" have become common terms among civil society organizations, just as civic action—the coordination of action to improve some aspect of common life in society—has moved outside the confines of what is traditionally seen as the third sector (Lichterman and Eliasoph 2014). Through recombination and bridging, interstitial organizations change the boundaries of what is civic.

In his work on the network society, Castells (2000: 379) identifies cultural battles over the definition of meaning as the power battles of the information age. In his reading, power relations between organizations rely less on direct coercion, but emerge from the "networks of information exchange and symbol manipulation, which relate social actors, institutions, and cultural movements, through icons, spokespersons and intellectual amplifiers". Interstitial communities make excellent combatants in these contentions. Positioned at the center of networks and discourses, they are able to reassemble cultural content as well as control flows of information. As tributaries of both language and relations, their influence on processes of structuration and development of discourse can be considerable.

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How Personal Networks Govern Educational Decisions

Sue Heath, Alison Fuller, and Brenda Johnston

1 Introduction

In this chapter we use *educational decision making* as a case study to examine more generally the benefits of adopting a network-based approach to exploring *individual* actions and decision making. Our specific focus is on the role of personal networks in governing educational decision making in relation to potential participation in higher education (HE) in the United Kingdom (UK), drawing on data generated by the research project *Non-participation in higher education: decision-making as an embedded social practice*.[1] The chapter starts by outlining the background to our research project and some of the conceptual and theoretical influences on our approach to understanding networked individuals and networked decisions, then goes on to outline the study's research design, before considering some of the lessons we have learnt from this process and our understandings of the analytical affordance of this type of approach. We hope to demonstrate that this approach provides for the generation of rich data on the operation of network governance and

[1]The authors are grateful to the UK's Economic and Social Research Council for funding the research reported in this chapter (award number RES 139-25-0232). The project was funded between 2006 and 2008 at the University of Southampton, UK. The full research team consisted of Alison Fuller, Sue Heath, Brenda Johnston, Nick Foskett, Ros Foskett, Felix Meringe, John Taylor, Martin Dyke, Patricia Rice, Laura Staetsky, Karen Paton and Marie Kenny.

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influence at the level of the personal network, an approach that might be equally useful in exploring network governance involving organisations.

In developing 'a general theory of network governance', Jones et al. (1997: 913) asserted the importance of focusing on 'structural embeddedness'—the overall structure and context of relations surrounding transactions—in considering the social factors which influence exchanges between organisations: 'structural embeddedness provides the foundation for social mechanisms, such as restricted access, macrocultures, collective sanctions, and reputations, to coordinate and safeguard exchanges in network governance'. Jones et al thus sought to highlight forms of coordination and influence that cohere around 'organic and informal social systems' (*ibid*), as opposed to more formal bureaucratic and contractual relationships. In common with other contributions in this book, this chapter favours a focus on these more organic and informal social systems, yet it differs from others in this collection by focusing on mechanisms of network governance as played out at the level of the *personal network*, made up of family members, friends, acquaintances, workmates and others, rather than at the level of networks consisting of corporations, firms or the state. Our focus, then, is on micro-level network influence, but we nonetheless highlight very similar processes to those described by Jones et al. (1997) in relation to macro level network governance.

Our focus also highlights similar processes to those identified by Stoker in his description of network governance (this time, in the context of public administration): 'networked governance is a particular framing of collective decision making that is characterised by a trend for a wider range of participants to be seen as legitimate members of the decision making process in the context of considerable uncertainty and complexity…' (Stoker 2006: 41). Drawing on this idea, we assert that the actions of individuals cannot be understood outside of a consideration of network influence, deeply embedded as these actions are in 'the structure of the overall network of relations' (Granovetter 1992: 33). This matters because network members other than 'the ego' often appear not to be seen as 'legitimate members of the decision making process', as public policy often appeals directly to the individual in isolation rather than to the *networked* individual, or assumes that the individual acts alone in his or her transactions with agencies of the state: in our case, the education system.

2 Researching Widening Participation via a Network Approach

Our specific focus in this chapter is concerned with the role of personal networks in governing educational decision making in relation to potential participation in higher education (HE) in the United Kingdom (UK). The massive expansion of the UK's HE sector, and government attempts to widen participation within the sector to members of groups who had traditionally been under-represented within it, especially in relation to social class background, provided the broader context for our research when it was conducted between 2006 and 2008. These

years marked the peak of an era of high profile, ambitious targets for higher education participation rates in the UK: a target of 50% of under-30 year olds to have participated by 2010 (a target which failed to be met by that date) and a target of at least 40% of adults of working age participating in higher education by 2020 (see Heath et al. 2011). Alongside these targets existed a series of initiatives to encourage greater levels of participation, including the 'AimHigher' scheme targeted at teenagers, subsequently scrapped by the Conservative-Liberal Democrat Coalition Government that came to power in a recession-hit UK in 2010, and the 'Lifelong Learning Networks', whose brief was to improve progression opportunities amongst learners of all ages who had previously pursued vocational pathways. As unemployment rates increased in the wake of the 2008 global recession, so too did growing public doubts about the value of a degree. Nonetheless, at the time that our research began a few years earlier, optimism was rife about the potential for transforming the nature of the student body in the UK. Indeed, our research was one of seven projects funded by the Economic and Social Research Council as part of a UK-wide initiative focusing on different aspects of the widening participation agenda (David 2009). The full title of our own project was 'Non-participation in higher education: decision making as an embedded social practice'.

At the time, and still largely the case today, most existing research (not to mention most policy interventions) in the sphere of widening participation focused on the experiences of 'standard age' students: the 18 and 19 year olds who make up the bulk of full-time university entrants in the UK. Our own research was unusual in its focus on the potential for widening participation across the lifecourse, not just amongst potential applicants 'straight from school'. Our interest lay in a rather neglected (and certainly under-researched) group whom we described as 'potentially recruitable' in relation to HE: those who (i) possessed the relevant qualifications to gain entry to university (sometimes obtained on first leaving school, sometimes obtained subsequently as adults) *and* (ii) had not subsequently progressed to higher level study. This group, ostensibly consisting of 'non-participants', included those who might at some future point consider HE as a serious option and go on to participate as well as those who were unlikely ever to participate. Our interest was in exploring the narratives surrounding the educational and employment pathways of this group: where, if at all, did the possibility of future formal study figure?

Critically, from the outset our project placed strong emphasis on network influence and impact. At one level, this is unsurprising as the process of educational decision-making is often conceptualised as a deeply embedded social practice, inextricably linked to behaviours, attitudes and dispositions which hold sway within an individual's personal network. Empirical research informed by the theoretical approaches of writers such as Bourdieu (1976, 1986), Coleman (1988) and Putnam (2000), for example, has focused on the degree to which forms of advantage and disadvantage are transmitted between and within specific networks, including in and through the decisions and actions of network members (e.g., Ball et al. 2000;

Brooks 2005; Reay et al. 2005). Yet what is perhaps surprising is that despite this commonly shared theoretical orientation, first-hand accounts from the wider membership of networks are often absent in empirical research of this kind. Existing empirical studies of educational decision making instead tend to focus on the accounts of individuals in isolation, or perhaps at best extend to dyadic relationships, e.g. an individual and one of their parents, but very rarely extend to broader network members.

It was important for us, though, that our research design reflected our conceptual and theoretical emphasis on the influence of the network. Accordingly, we adopted an approach which we subsequently described in terms of qualitative social network analysis (see Heath et al. 2009), whereby we treated the *network*, rather than the individual, as the primary unit of analysis. We felt that situating an individual's decision-making within the context of first-hand accounts from members of their networks would not only highlight the complexity of the decision-making process, but would also illuminate the tensions, contradictions and moments of solidarity which inevitably emerge within complex, interconnected social networks. We were firmly of the view that these network-based accounts could contribute to generating a richer picture of the complexities and contradictions which operate within networks and would help us to gain a better grasp of the impact of the network on past, present and future decision-making. We also wanted to build up a picture of network-based norms and expectations, which do not always surface in individual interview accounts—or at least are not so easily spotted by the researcher. Our experience suggests that it is often only through their repetition across the accounts of multiple network members that certain network-based norms and expectations become apparent to researchers, whereas there is a danger that they can be lost or appear insignificant within the isolated accounts of individuals.

In conceptualising network influence we were also strongly influenced by Giele and Elder's (1998) lifecourse approach and in particular their useful emphasis on *the linking of lives* both within and across generations and how this tends to generate shared values, norms, dispositions and expectations within a network: in Bourdieusian terms, a shared habitus. This element of their approach emphasises the embeddedness of individuals within complex intergenerational networks and draws attention to the ways in which individuals' actions are influenced by the social relationships which flow from these connections. Giele and Elder also point to the importance of the specific location of individuals in relation to individual, generational and historical time and how their positioning affects the ways in which they act and react across the duration of their lives. This draws the attention of researchers to the need to attend to historical and generational factors in understanding the nature of network influence. In our own study, we were very conscious of the need to situate individuals in relation to specific education policy regimes and labour market conditions. These factors, in combination with the importance Giele and Elder accord to human agency, highlight that the reproduction of shared dispositions is by no means inevitable, a point we develop below.

3 Fieldwork and Analysis

The first phase of our research consisted of 32 interviews with key informants and stakeholders from the widening participation policy/practice arena, operating at local, regional and national levels in the UK (Fuller and Paton 2008). We then moved on to the main phase of the research, which was based on a qualitative exploration of 16 case study networks, spiralling out from 16 'potentially recruitable' individuals (our 16 egos). The starting point for this phase of the research was to conduct an interview with each of these 16 individuals in order to gain an overview of their educational and career histories and to get a sense of their broader network. Our egos then nominated members of their networks (their alters) whom they felt would be prepared to participate in our research. Interviews with network members explored their own educational and career histories and their decision making in these realms, as well as their perceptions of how they might have influenced the ego. In total, we interviewed 107 network members across 16 networks (including the 16 egos). The final stage of the research involved a second, more detailed interview with the egos, often several months later, to explore specific themes and issues which had emerged within their network. At the point of recruitment we were, then, looking for people who were potentially willing to give us access to their network members: this was a lot to ask of people, and we have written elsewhere on this process and its implications for our analysis (Heath et al. 2009).

As for the sample characteristics, the 16 egos ranged in age from 21 to 63, with a mean age of 46. All were resident on the south coast of England. The broader sample of alters (91 in total) ranged in age from 13 to 96, and lived mostly, but not exclusively, across southern England. The relationships represented within the 16 networks included partners, siblings, parents, grandparents, sons and daughters, aunts and uncles, nephews and nieces, in-laws, best friends, childhood friends, new friends, workmates, and teachers. Although none of our egos had, by definition, attended HE, the broader sample of alters included individuals with diverse experiences of HE and education more generally, embracing those with few or no formal qualifications as well as those with higher level degrees and professional qualifications of various kinds.

Our network data have proved to be very rich, with considerable analytical affordance. They constitute a set of parallel biographies within each network, at times divergent, but always with some, and often very many, points of linkage between the various nodes within the wider network, generating complex spiders' webs of interconnected accounts. Further, these accounts are rooted in very specific positions based on strongly classed and gendered expectations embraced by individuals, their families and various representatives of the education system whom they encountered (especially careers advisors). For example, many recalled occasions where they were explicitly directed by teachers and/or parents towards specific courses and careers entirely on the basis of their gender (engineering apprenticeships for working class boys, for example, or office work for girls, regardless of their social class background), resulting in standardized and

conformist patterns of aspiration. In this respect, the data highlight the importance of 'the timing of lives', with these kinds of influences becoming weaker over time (but still exerting some influence), as well as highlighting the importance of network-based understandings of the 'age appropriateness' of certain key transitions, including university attendance. They convey a sense of events sometimes happening 'too early', sometimes 'too late', and always embedded in the specific expectations and aspirations of the specific network. The data have therefore afforded us three different ways of approaching our analysis and writing: individual accounts of decision-making; relationship-based accounts, e.g. parent-child relationships, or relationships involving partners, siblings, or friends; and network-based accounts, and we have deployed all these levels in our analysis and writing.

4 Network Influence in Practice

4.1 Collective Learning Identities

Our research very clearly demonstrated the power of the network in exerting an influence on educational decision-making across generations, especially within the context of strongly family-orientated networks. Within many networks, for example, it has been possible to identify very distinct shared dispositions towards education, including higher education, which might best be described as 'collective learning identities'. For example, a network consisting of three generations from the same family (the ego, her parents, her sister, and her two children) was strongly permeated by the view of the ego's mother that

> I didn't expect them to set the world on fire, we're not a clever clogs[2] family, we're a pretty average family, I suppose.

She expressed this view despite the fact that she herself had obtained a place in a selective grammar school as a working class girl in the late 1940s (the elite tier of the UK's selective post-1945 tripartite system), a remarkable achievement at the time. Moreover, a recent graduate in the youngest generation (the ego's daughter, and the first person in the family to have experienced HE) was viewed as not being gifted academically ('she had to work hard to get to university, she wasn't a clever clogs'), her participation in university seen instead as providing evidence of widening participation policies having gone too far. As this young woman's aunt (the ego's sister) rather pointedly observed,

[2]'Clever clogs' is an English expression used to describe someone who is ostentatiously and annoyingly knowledgeable, but also used more generally to refer to someone who is academically able.

> 'I actually think there's too many people going to university. And I think there's a lot of averagely intelligent people going that aren't actually going to get anything out of it and they're going to spend an awful lot of time and money getting a mediocre degree that won't necessarily get them a job in what they want to do.'

The aunt had children of her own and these words suggested that it was unlikely that they would receive much, if any, encouragement to participate in higher education should they express an interest in doing so in the future (see Heath et al. 2008). Other networks were similarly characterised by assumptions that educational achievement was not something that 'people like us' aspired to, whilst in other cases the collective learning identity appeared to set limits on how far it was deemed appropriate to continue through the education system: 'thus far and no further', one might say. Depending on the network members' location in time, this could also be a highly gendered assessment of appropriateness.

4.2 Occupational Dynasties

We were also able to observe the operation of network norms and traditions in occupational and vocational terms through, for example, the identification of distinct occupational 'dynasties' with linked educational expectations within certain networks. These included networks dominated by careers in banking, the military, health care and shipbuilding, reflecting the occupational opportunities which were available in specific geographical (and, indeed, specific temporal) locations, and which were also invariably strongly gender-specific. In one network, for example, we identified a strong maritime dynasty, with network members variously employed over time as members of the Royal Navy and the Women's Royal Naval Service, as clerical workers in the Navy and in commercial shipping companies, as a Navy nurse, and as a marine accident investigator, not to mention voluntary involvement amongst network members in the Sea Cadets.

4.3 Educational Trajectories

Particular 'types' of educational trajectories also dominated certain networks, based on network-wide assessments of the value, for example, of academic versus vocational routes, of early versus delayed labour market entry, or of on the job versus off the job training opportunities. In one such network, the apprenticeship route had been passed down from the older to the younger generation as the preferred route into employment, translating into the rather idiosyncratic choice of a Modern Apprenticeship route for members of the younger generation (the ego's two children), who had attended local schools where pursuing such a route went against the predominant trend to pursue academic qualifications and continue on into higher education (see Fuller 2011). As the ego's daughter explained,

> I think they (the school) were quite surprised that I wasn't going to college because in my particular school all the talks we had about careers was going to college, there was nothing about doing a Modern Apprenticeship whatsoever, and my careers teacher she basically said if you don't go to college and university then I'm not going to make anything of my life, but I still ignored her advice and went for it.

4.4 Managed Ambivalence

Our network data have also highlighted the potential for moments of reaction, or 'disidentification', in relation to broader network expectations. Here we found Lüscher's ideas concerning intergenerational ambivalence particularly useful for providing a bridge between social structure and individual action. Lüscher (2005) states that ambivalences are rooted in the simultaneous existence of 'polarised emotions, thoughts, volitions, social relations and structures that are considered relevant for the constitution of individual or collective identities' (Lüscher 2005, p. 100) and notes that intergenerational relations amongst adults 'can be socio-scientifically interpreted as the expression of ambivalences, and as efforts to manage and negotiate these fundamental ambivalences' (Lüscher 1999). Applying Lüscher's ideas to social interactions beyond the intergenerational alone, Connidis and McMullin (2002) use the term 'structured ambivalence' and argue that this is a framework which can provide 'a bridging concept between social structure and individual action, made evident in social interaction' (*ibid*, p. 559).

Theories of ambivalence accordingly helped us in making sense of some of the reasons why individuals were on occasion able to step outside of and act against the dominant values and dispositions within their network, and yet on other occasions acted in ways which reinforced them, even when their actions were intended as forms of resistance to the network's dominant values and dispositions. In one of our networks, for instance, the ego had gone against family expectations that she apply to train as a teacher on leaving school at 18 (which would have seen her following in the footsteps of her mother, grandmother and sister) and had instead enrolled at a secretarial college before getting a secretarial post in a bank. This was a course of action that she later regretted, as it had placed constraints on her subsequent career progression and wider opportunities, but at the time it had been important to her to assert her independence in the face of network expectations:

> I didn't get on with my mother and I didn't want to be like my mother, so I just said 'no, I'm not going into teaching.

Acting against network-based expectations may, then, be a way of managing ambivalence, but may often serve to reproduce, rather than challenge, existing relations of inequality. In another network, for example, being thrown out of the family home at age 17 had led directly to an ill-fated early marriage which had left the ego in a socially disadvantaged position, ending up as a single mother of two teenage children and remaining dependent on her family of origin despite her

difficult relationship with them. However, since meeting a new partner she had been able to step back from her close family ties, even moving some distance away from where the rest of her family live, facilitating a shift, in Lüscher's terms, from 'captivation' (a divergence of outlook alongside the reluctant reproduction of traditional social forms) to 'atomisation' (a divergence of outlook alongside a desire to embrace change).

Our network data also highlighted how differential access to resources within networks could influence the degree to which ambivalence of this kind could be satisfactorily resolved by an individual. Some of the egos, for example, had been able to mobilise a range of resources in order to distance themselves (including geographically, as in the previous example) from their closest ties in order to create new possibilities for themselves, whereas others, through constrained circumstances, remained dependent upon them and lacked the resources, including emotional resources, to challenge network dispositions and felt obliged to conform to network-specific expectations. Our network approach provided, then, a very useful framework for considering the extent to which the influences and resources represented within any given network allowed for intergenerational continuity and/or change. Moreover, it highlighted how differences based on structural inequalities between individuals have the capacity to impact upon processes of network formation and/or dissolution, and how the management of ambivalence leads some individuals to deliberately broaden the basis of their social network through accessing bridging capital offered by weak ties, as Rosie's account later in the next section illustrates, whilst leading others to consolidate their bonding capital through their existing strong ties.

5 Mobilising Network Capital

5.1 The Bounds of the Possible

The mobilisation of network capital emerged as another strong theme in our data. Network influence was sometimes very tangible, but was equally likely to be implicit and intangible, and our approach often 'surfaced' these more intangible influences through revealing network habitus. A key issue here related to what might be judged to be within 'the bounds of the possible' within any given network (Dyke 2011): in other words, given what we knew about the individual and their position within their network, where might be the limits of what they would consider to be possible in educational terms? In considering this question, we sought to pull together a range of factors, such as broader network dispositions, gendered expectations, and access to and the influence of different types of capital, including bridging and bonding capital. Equally important, though, was a consideration of the shifting policy context across time. It appeared very striking to us, for example, that many of our egos, who had either left school at the earliest opportunity or, if they had stayed on into post-compulsory education, had not progressed into higher education, would probably have been part of the target audience of the

UK's recent widening participation policies if they had been born a generation later. Yet they had left school during a period dominated by a much more elite university system—with *their* children now reaping the benefits of the widening participation agenda, even though these children were probably no more or less academically able than their parents had been before them. Many of the egos had then experienced their compulsory schooling during a period when 'average' pupils, who were neither extraordinarily successful nor extraordinarily *un*successful, often failed to attract much attention at school and were left to drift, whereas such pupils today are more likely to be pushed harder to achieve. Attending school during a period when only a small minority of students continued on into higher education provided a very different context to that which younger generations experienced.

5.2 Trickle-Up Effects

We were also interested in the multidirectional nature of network influence, and were not just concerned about the influence of older generations on younger generations, which is the more conventional approach to viewing the transmission of social capital (e.g., Coleman 1988). As we observed, the experiences of younger generations could have a profound influence on the older generation, or on siblings and peers. In several networks, participation in higher education had now become the norm among the youngest generations (usually the ego's children), despite there being no prior history of going to university within their network. The experiences of siblings and other peers were becoming the key point of reference for members of these younger generations, and the nature of their experiences was not lost on their older relatives. That a trickle-*up* effect encouraging participation in HE amongst older network members might be possible is, however, premised on the assumption that these older generations would perceive the HE experiences of younger generations to have been worthwhile and positive, yet this was not always the case by any means. Instead, the experiences of younger generations often confirmed the views of older generations regarding the perceived pointlessness and irrelevance of higher education, especially when participation did not translate into 'a good job' at the end of it. We have already noted the comments made about this in one of our networks, and similar comments surfaced in several other networks, revealing considerable uncertainty about the potential gains of higher education, especially in a highly competitive graduate labour market marked by credential inflation (see Heath et al. 2010).

5.3 The Role of Non-family Peers

In practice, the experiences of *non-family peers* within a network were often far more significant in terms of creating new opportunities and opening up potential horizons for action amongst egos than those of younger relatives. Observing 'people like me'—of a similar age and generational positioning, and similar social

class background—choosing to participate in formal learning often acted as a particularly powerful motivator. Such individuals were able to provide access to important sources of bridging capital within otherwise strongly bonded networks, yet it was often only through being able to access the kinds of emotional and material support associated with bonding capital *alongside* access to bridging capital that individuals could begin to see how progression to further formal study might actually be within the bounds of the possible within networks otherwise with little or no prior experience of higher education.

This last point is illustrated well within Rosie Armstrong's network. Rosie was a 35 year old mother of five children, who by the second interview had become a single parent. She had been out of work for several years, and nominated an all-female network consisting of three generations, most of whom led chaotic lives marked by emotional and financial instability, and all of them living in a geographical location with very limited opportunities for accessing HE. Critical to this network was Anna, now a friend, who had invited Rosie to participate in a family learning centre linked to her daughter's school. Anna was the only member of Rosie's network with experience of HE (she was a part-time student). As a result of Anna's encouragement, Rosie started to take various courses, and it seemed to us that it was highly likely that at some future point she might well follow the example of her friend Anna and pursue HE-level study. Nonetheless, her ability to pursue these opportunities, in ways which departed quite radically from the expectations and norms of her broader network, was only made possible by the close emotional and practical support she received within this network, particularly from her close female friends (Fuller 2011).

6 Conclusions

Our emphasis on educational decision making as a practice which is embedded in networks, and which is governed by the relations inherent in those networks, proved to be extremely useful in developing our understanding of contemporary decision-making regarding participation in HE. Through generating data from a range of network members, rather than relying only on the accounts of egos, we were able to identity how collective learning identities, occupational dynasties and shared views on the value of particular educational trajectories emerged as powerful influences on the expectations and experiences of individual actors. This also highlighted moments of disruption and contradiction, and a focus on the management of ambivalence within networks helped us to understand how these tensions could often serve to reproduce broader network relations and orientations towards education and work. In considering 'the bounds of the possible' within any given network it was also instructive to examine the forms of social capital that were available to individuals through their networks, including the important role of weak ties in opening up new opportunities in some cases. Our approach therefore foregrounded the relational aspects of educational decision-making and shed light on processes of both continuity and change within networks, helping us to understand present day

decision-making in the broader context of family/network histories, the transmission of network-wide dispositions alongside acts of individual agency, and broader reactions to those individual acts of agency.

We have then emphasised *the importance of social relations as resources that flow into and through social networks*, with consequences for the educational aspirations and trajectories of network members. Our approach also allowed us to challenge many policy assumptions regarding non-participation in HE. We found, for example, that most networks were not dismissive of 'lifelong learning' but were characterised by rich alternative cultures of learning, including non-progression-based formal learning alongside more leisure-orientated forms of learning. We also found that higher education was seen to be of little relevance to most of our 'potentially recruitable' participants: in many cases, 'non-participation' in HE had little to do with specific 'barriers' to participation, as suggested by much of the policy literature, but was more to do with its perceived worth (not high) amongst a largely 'settled' and reasonably contented group of adults. As one ego noted, having now achieved all he had set out to achieve career-wise, 'doing HE now would take so much time… I'd rather spend the time doing something I enjoy, rather than something that would be seen as a chore!'

Although our focus has been on educational decision-making and the role of the personal network within that process, we would argue that our approach—albeit very time consuming and requiring a high level of trust between researchers and networks—could be of potential value to researchers interested in other, more institutionally-based, forms of network governance. Our method for emphasising the structural embeddedness of decision making has highlighted features of networks that are likely to be equally of relevance to those interested in organisational transactions and decision making, features such as the operation of network sanctions, the influence of and protection of network reputations, forms of accommodation and resistance to network norms and expectations. The first-hand accounts of key actors in these processes, and the ways in which these accounts link up with (and at times diverge from) the accounts of others within the network, provide, we would argue, crucial tools for developing a full understanding of decision making in contexts wherever social relations between network members form a key element in organisational transactions.

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Performing Network Theory? Reflexive Relationship Management on Social Network Sites

Gernot Grabher and Jonas König

1 From Serendipity to Strategy: Networks as Asset

Networking has become a key imperative of contemporary capitalism. The *Rolodex* (and its digital version) has turned into a critical asset, the 'know whom' it seems indeed is valued almost as much as the 'know how' (Gann and Salter 2000). Along similar lines, the social capital embodied in trust-full ties is celebrated as a key source of collective prosperity (Putnam 2000). Moreover, rather than merely as a transitory phenomenon, networks have come to be seen as defining a new area of capitalist development (Castells 1996), as a manifestation of the 'new spirit of capitalism' (Boltanksi and Chiapello 2005).

More specifically, networks offer, as a rich body of research substantiates, real economic benefits (Granovetter 2005). Social networks positively impact upon the path and pace of information flows (Granovetter 1973); they reduce uncertainty and the risk of opportunistic behavior by generating trust (Uzzi 1996); and specific positions within a network are potentially important sources of power (Burt 2004). In fact, with the transformation towards knowledge-based production and temporary project-based organization during the last decades, personal networks have turned into an ever more important asset (Wittel 2001).

On the one hand, innovation increasingly demands to tap into heterogeneous and diverse sources of knowledge. By cutting across organizational structures, personal networks afford the conduits that allow to combine information that is fragmented in the disciplinary 'silos' of organizations (Obstfeld 2005). Networks are not only key to early and accelerated information access, they also provide the relational resources for the interpretation and triangulation of information (Amin and Roberts

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2008). Networks, then, contribute to the transformation of information into knowledge (Brown and Duguid 2000).

On the other hand, the shift towards project-based organizational practices and temporary employment has fundamentally altered career paths (Jones 1996). Lifelong affiliation with a single organization has turned from the rule into a rather rare exception. The emblematic 'organizational man' who is offered job security in exchange for loyalty is increasingly being replaced by 'contractual (wo)man' struggling to remain employable in a highly volatile market for temporary assignments (Grabher and Ibert 2006). In these increasingly unstable labor markets, personal networks are critical means to screen the market for job opportunities and follow-up employment, and to gain status in an environment that is regulated by reputation rather than by certificates (Windeler and Sydow 2001; Reagans et al. 2004).

Against the background of the transformation of knowledge production, organizational strategies and labor market governance, this paper argues that we are currently witnessing a profound shift in the status, strategies and practices of personal networking. Building and maintaining relationships have become an economic activity *in its own right*. Personal networks appear to be managed in an increasingly deliberate and conscious fashion. Networking more and more represents a strategic investment in social capital deliberately renegotiating boundaries between the private and professional realm (Grabher 2004: 1502–1506).

The praxis of personal networking is more and more shaped by perceptions, tools and devices that are derived from social network analysis (Healy 2011). This instrumentalization of social network analysis, we maintain in this paper, is strongly suggestive of the performativity of social network analysis. Two interrelated dynamics reinforce the performativity of social network analysis.

First, the spread of social networking sites (SNS) like Facebook, LinkedIn or Twitter has transformed the way of how networks are perceived (Donath and Boyd 2004). SNS render relationships transparent and calculable. SNS transform the previously diffuse and intricate amalgamation of social relations into a crisp graph of ties between nodes that, in principle, can be unequivocally categorized either as family, close friend, acquaintance or business contact. Moreover, SNS incorporate features and software tools that afford "valorimeters" (Caliskan and Callon 2010: 17) that translate incommensurable values like trust, sympathy or respect into quantitative indices and competitive rankings.

Second, the proliferation of SNS and the re-appreciation of social capital set off (and in turn have been boosted by) the emergence of a distinct genre of guidelines and prescriptions of how to manage and to 'optimize' social networks. This genre evolves in various media, ranging from academic publications, 'airport-literature', 'how-to'-guides, blogs, and discussion groups to dedicated seminars and coaching. Of course, guides to socializing behavior are anything but new,[1] and the last

[1] In fact, antecedents can be traced backed to ancient Egypt up to the first comprehensive accounts by Erasmus von Rotterdam's De Civilitate (1529) or Adolph Knigge's Über den Umgang mit Menschen (1788).

decades saw a proliferation of attempts to evangelize a network gospel of linking up with 'friends in higher places'. However, in contrast to these earlier accounts, the more recent wave of networking guidelines increasingly seeks to mobilize social network analysis to legitimize advice with scientific authority.

The paper starts with a brief overview on the current debate on performativity and the emergence of SNS (Sect. 2). In Sect. 3 the paper probes into the socio-technical affordances of tools and metrics of SNS that allow to incorporate principles of social network analysis into everyday practice. Section 4 provides an analysis of the literature on network management and online networking in academic business journals. We conclude the paper with a preliminary evaluation of the performativity thesis in the realm of SNS.

2 From Description to Prescription: The Performativity Debate and Networking Practices

2.1 Science as Social Engineering

The current debate of the *performativity thesis* has been instigated by Callon (1998, 2007) and subsequently been refined by MacKenzie and Millo (2003), and MacKenzie (2006). Economics, as Callon contends, produces a body of formal models and transportable techniques that through the dissemination into the economy ('reality') by economists and gatekeepers shapes, reformats and reorganizes the phenomena that the models purport to describe. The economy, Callon (1998: 30) concludes, "is embedded not in society but in economics". In its strongest interpretation (MacKenzie 2004), this idea suggests that performative practices align empirical phenomena with the abstract models of science. The "socio-cognitive prosthesis" (Caliskan and Callon 2009: 380) of practical technologies, reproducible models and portable algorithms enable actors to accomplish calculative tasks previously beyond their reach. When enacted in everyday practice, these devices attune real settings with scientific models and their assumptions.

In the cogent and careful study of the performativity of economic theory on financial markets *An Engine, not a Camera*, MacKenzie (2006: 18–19) differentiates three kinds of performativity. Whereas *generic performativity* implies that theoretical models move beyond the realm of science and inform actual professional practices, *effective performativity* requires that theoretical models are applied so as to "make a difference" in practice. In the case of *Barnesian performativity* theoretical models alter processes "in ways that bear on their conformity to the aspect of [the theory] in question". In the case of Barnesian performativity the application of the theoretical model transforms actual practices from a state of non-conformity to a state of conformity with its own predictions. The theoretical model, of course, also might induce, analogous to a self-defeating prophecy, counter-reactions to its own predictions: a case of a *counter-performative* effect (Healy 2011: 5).

The notion of performativity, as Aspers (2007) elaborated, is neither entirely new nor does the "performative loop" operate as smoothly and universally as suggested by some of its followers (see also Santos and Rodrigues 2009).[2] Nevertheless, we start from the proposition that social network analysis is performative in a similar theoretical sense, and increasingly on a similar empirical scale as the economic models studied in the social studies of (financial) markets (Callon 1998; MacKenzie 2006; MacKenzie and Millo 2003; Muniesa et al. 2007). At least two observations support an endeavor to explore this proposition (Healy 2011: 1–2). First, as intellectual and practical projects, social network analysis and economic theory show similarities in form. Second, while evidence of weaker versions of the performativity of social network analysis is available, its stronger versions are only circumstantially supported so far (Healy 2011: 2). To what extend stronger versions of performativity can empirically be corroborated is, in other words, an open question.

2.2 The Performative Loop of Social Network Analysis

How then might social network analysis, in principle, inform, shape or transform networking practices? Of course, reflexive considerations have not been absent from networking practices up until more recently. However, a particular strand of network research consistently warned of the dangers of a contamination of 'life-world' ties by the calculus of the 'system-world' (see, for example, Lundvall 1993; Eve 2002). 'You can't buy trust' is an idiomatic expression of this line of reasoning that insisted in a strict separation between networks based on trust, and ties forged for profit. In this perspective, networks were likely to evolve according to three key principles.

First, actors normally tend to trust actors and connect with actors who share the same basic characteristics and attributes like ethnic background, gender, or socio-economic status: the power of homophily (McPherson et al. 2001). Second, relationships are more likely to be established if both actors are somehow situated proximate to each other (Powell et al. 2005). Proximity can refer to both spatial and/or social distance or to shared affiliations. Third, empirical research has elucidated that network building follows the rule of transitivity: if A is related to B and B is related to C, there is most likely a relation between A and C (Granovetter

[2]In the phenomenological tradition, Husserl and Heidegger have already theorized the interdependencies between scientific theory and "lifeworld" (Aspers 2007: 381–383). Drawing on this tradition, Giddens' (1984: 32–33) notion of "double hermeneutics" alludes to changes in society induced by the application and enactment of scientific knowledge in everyday life. Turning to economy more specifically, Callon's (1998: 22) proposition that the homo oeconomicus is not an incarnation of basic human traits but is formatted finds its precursor in Polanyi's ([1944] 1957) concept of the "double movement", albeit in different parlance of course. Finally, Callon's approach is more restricted than some of his supporters claim, and seems primarily confined to a specific class of markets (switch-role markets) (Aspers 2007).

1973; Uzzi and Gillespie 2002). In a mutually self-reinforcing manner, all three principles encourage the establishment and reinforcement of dense, homogenous and coherent networks.

Another strand of social network analysis, in contrast, advances arguments about the economic benefits of sparse and heterogeneous networks. These network configurations allow to tap into a broader range of knowledge sources and to exploit "structural holes" by brokering across disconnected sub-networks (Burt, 1992, 2004; see also Simmel 1908). Following this particular strand of reasoning, performativity of social network analysis might first induce strategies to occupy network positions that lend themselves to arbitrage behavior. Second, performativity most likely entails a deliberate search for diversity in social relations. Beyond the realm of academic network analysis, however, the individual position within a network as well as the overall configuration of networks was more a matter of subjective perception than of explicit calculation up until more recently. This has radically changed with the advent of SNS. Calculation has entered the praxis of forging social relations (Cross et al. 2003).

3 Performativity Online: Socio-Technical Affordances of SNS

Technical support for the making and breaking of relationships is by no means a contemporary phenomenon.[3] In the last decades the emergence of the Internet, of course, has opened up an unprecedented range of tools and devices supporting personal networking. Templates and theoretical models from social network analysis seem to be deeply incorporated into the design of the socio-technological affordances (Gaver 1996) of SNS (Mejias 2010).

3.1 SNS as Camera I: Revealing Actual and Potential Ties

The advent of Social Networking Sites (SNS) heralded by Sixdegress.com in 1997 has radically altered the field of personal networking. SNS can be described as partially bounded systems that allow individuals to construct a public or semi-public profile and to connect with other members (Boyd and Ellison 2007). In the ever expanding-ecology of SNS (Papachrassi 2009; Kim et al. 2010), three networks stand out. First, Facebook, with 1.79 billion active users (Facebook 2016) the most popular one, allows its users to communicate and share content (pictures, videos, links, etc.) which each other via different tools. Second, LinkedIn with 433 million members (LinkedIn 2017) is perceived as the biggest SNS in the realm

[3]In the mid-nineteenth century, to name but one example, the Carte de Visit (CDV), a small, standardized portrait photograph, shared among friends, relatives and acquaintances, gained widespread popularity in Europe and America (Plunkett 2003). As a material manifestation of the own social cosmos, CDVs were presented to others and collected in dedicated albums—a *Facebook* quite literally.

of business, and is built around the display of individual job experience and the exchange of mostly job-related personal referrals. Third, the real-time micro-blogging platform Twitter enables its 317 million active users (Twitter 2016) to send and receive restricted text-messages ('tweets') of 140 characters maximum. Unlike most other SNS, the Twitter network is asymmetric and made up of unidirectional relations; members do not necessarily mutually follow each other (Gruzd et al. 2011).

Within the expanding ecology of Internet-based platforms, the distinctions between SNS and other web-based media like blogs, wikis or online communities become increasingly blurred.[4] Yet two distinct features of SNS resonate with the notion of "socio-cognitive prostheses" (Caliskan and Callon 2009: 380) that facilitate the incorporation of social network analytical premises into actual networking practice.

On the one hand, SNS profiles usually comprise a list of other members with whom the network member shares a connection, and allow viewing this list of connections and those made by others within the network. These "networked publics" (Boyd 2010) that emerge as a result of networked technology and practice, then, transform the formerly diffuse and implicit individual social world into the explicit sociogram of ties and nodes that indicates the path-length to individual contacts (cf. Moreno 1934). Moreover, SNS allow to continuously monitor the basic architecture of the networks of friends, colleagues and competitors (Utz 2010). Since the architecture of networks is publically displayed, networks turn into a visible expression of social capital and relational status (Donath and Boyd 2004).

On the other hand, most SNS comprise "Affiliation Engines" that routinely suggest lists of "people you may know" to encourage network members to expand their network by including these suggested contacts. Despite the diverse algorithms that drive these engines, they seem to be organized around three principles. First, resonating with the rule of transitivity, most algorithms of SNS are based on the assumption that a member most likely is familiar with the friend of friends (of friends). Shared affiliations constitute a second principle of algorithms that suggest to link up with members of the same community or members who have worked for the same organization. Finally, some affiliation engines also take shared interests and "likes" (expressions of affinity and a form of "social grooming"; Boyd 2010: 6) into account. Twitter, for example, suggests to connect with members who follow the same tweets. Affiliation engines, as this third principle elucidates, are not only about transforming offline-acquaintances into online contacts and about increasing the congruence between online and offline networks. Rather, SNS also provide affordances to establish online-only relations with people whom you, according the rule of homophily, should know.

[4]Most generally, online communities are organized around common interests while the primary focus of SNS is on networking (Haythornthwaite and Kendall 2010).

3.2 SNS as Camera II: Revealing Relational Status

Rather than just rendering relational structures transparent (and expandable), SNS offer an extending spectrum of devices to quantify, statistically analyze, and evaluate personal networks. On the one hand, SNS provide basic tools that can be applied by members in everyday practice. LinkedIn, for example, offers information about the size of the personal network up to three degrees of separation; it reveals dominant industries and locations within the ego-network of a member; and it unravels network dynamics, such as fast growing network domains (in terms of shared organizational affiliations, for example). The incommensurable subjective perceptions of sympathy, social proximity or distance are translated into the quasi-objectivity of a neat sociogram.

On the other hand, there is a growing business segment that offers social network metrics. These dedicated businesses promise to assess influence and centrality in social networks with quantitative scores and figures that ostensibly measure centrality and influence in social networks. The biggest provider of SNS "valorimeters" (Caliskan and Callon 2010: 17) is the *Klout-Score*, a representation of influence ranging from 1 to 100. The company computes data from several SNS and online communities (i.e. Twitter, LinkedIn, Facebook, Google+, and Foursquare). The same holds true for *PeerIndex*, the biggest competitor of Klout. Additionally, there are several smaller providers that concentrate on a single SNS (for an overview: Strom 2011).

Although the algorithms of these network metrics are not revealed in detail, they build on general assumptions of social network analysis. Most obviously, they refer to different notions of centrality, i.e. degree and *Eigenvector*. The number of ties and the centrality of the nodes with whom a member is connected are taken as key proxies for influence in online social networks. Additionally, these algorithms calculate the frequency of interaction on SNS and of mentions in tweets and posts. Even if these metrics are discussed controversially and ritually played down in their actual significance in the SNS media environment, they unfold a significant impact on networking behavior. Rankings, as has been demonstrated for a variety of social settings (MacKenzie 2006; Kornberger and Carter 2010; Pollock and D'Adderio 2012) cannot be reduced to a mere representation of the world. Rather, they induce "mechanisms of reactivity" (Espeland and Sauder 2007: 5) amongst actors who, more or less consciously, incorporate the metrics of the ranking into their behavioral calculus.[5] Not surprisingly then the emergence of social network metrics gives rise to the proliferation of tools and templates to leverage and boost the scores like Klout-Index (Schaefer 2012). Similar to search engine optimization, technological devices increasingly align social interaction.

[5]The role of social network metrics in the individual calculus of networkers is indicated by the spread of services like *FanSlave*. By taking the marketization of social capital to the next level of outright monetarization, these services offer packages of „authentic" Facebook-"likes" and Facebook-"comments" by a sub-network that can be customized in terms of geography, language and socio-demographic criteria.

4 Performativity Offline: The Evolving Genre of Network Guidelines

The proliferation of SNS has triggered (and in turn been reinforced by) the emergence of a distinct genre of prescriptions of how to manage and to 'optimize' social networks. This genre evolves across various media, ranging from 'how to'-guidelines in business journals, check lists in newspapers, and blogs. Websites ponder the question "Does your Klout score determine your value?" (Socialmediaexaminer 2012); books deal with 'LinkedIn for Dummies', 'Networking Like a Pro' or 'The Power Formula for LinkedIn Success'; and coaches and consultants promise hands-on advice for the reengineering of networks in seminars like 'Networking Skills' or 'The Personal Network Action Plan'. The diffusion of social network analytical concepts and templates into networking praxis is further reinforced by the personal overlap between theoreticians, teachers, and coaches (see, for example, Burt and Ronchi 2007; Uzzi and Dunlap 2005). Social network analysts are increasingly employed at business schools (Healy 2011), and their theories are embraced in the curricula of an increasing number subjects (Janasz and Forret 2008).

The genre of prescriptions for self-improvement, again, is not a creation of more recent times (Illouz 2007: 9).[6] However, SNS has significantly enhanced its scope and been increasingly legitimized with the theoretical authority of network research (Cross et al. 2003). Practitioners, of course, follow these prescriptions not in a straightforward fashion. The canon of guidelines and suggestions, however, percolates through the vocabularies of individual self-understanding as well as the perception of the individual social cosmos (Illouz 2007: 10).

4.1 Translating Social Network Analysis into Business Advice: Academic Business Journals

This chapter examines publications on network management and online networking that have been published in academic business journals. As a starting point, we selected the *Journal Quality List* (45th edition, April 2012) edited by the Department of Management at the University of Melbourne (Harzing 2012).[7] In total, 184 peer-reviewed business journals were included into our analysis.

[6]We assume that the proliferation of the network imagery is also, though rather indirectly, related to the loss of significance of a very distinct, historically authoritative sociogram—the family tree.

[7]The *Journal Quality List* itself is not a ranking of academic journals, but a compilation of 21 different journal rankings from a variety of sources, including business schools and universities (e.g. ESSEC Business School Paris or Wirtschaftsuniversität Wien), newspapers (*Financial Times* Top 45 Business Journals Ranking), business magazines (e.g. *British Journal of Management*) or professional associations (e.g. *Australian Business Deans Council*). The *Journal Quality List* comprises academic journals from a broad variety of subject areas like "economics", "finance and accounting", "marketing" or "sociology". To conduct the literature review, we focused on the subject areas "communication", "entrepreneurship", "general management and strategy", "organization studies", "human resource management" and "industrial relations".

In the next step, we searched these journals for the keywords 'social networking sites', 'Facebook', 'LinkedIn', and 'social media'. From the resulting total of 967 papers, we excluded papers with an exclusively empirical focus and those that referred to inter-organizational networks. Correspondingly, we included publications on inter-personal networking that offered at least fragmentary advice about optimal network structures and networking strategies. In sum, 41 papers published in 14 different journals provided the basis for the literature review (see Appendix 2). The sample ranged from papers on specific software to essays on management education, leadership development and human resources. Only 14 papers focused exclusively on generic networking recommendations.

Following the notion of grounded theory (Strauss 1987), the texts were coded by using a set of core and sub categories (see Appendix 1). These categories were aimed at identifying favorable network structures, economically promising networking strategies as well as advantageous network positions with which actors should seek to establish contact. Furthermore, these categories elucidate possible networking risks and refer to potentially valuable conclusions drawn from social network analysis.

4.2 How to "Optimize" Your Network: Preliminary Results

Despite a certain diversity, the instructions and guidelines offered converge towards a few assumptions and propositions on economically beneficial networking strategies. Not surprisingly, nearly all papers stressed the increasing importance of social capital concerning learning and job market opportunities: "possessing effective networking skills is even more important given changes in the work environment" (P16). One paper directly made reference to the visibility of relations on SNS: "Soon, we expect, organizations will begin to seek out employees with demonstrably strong online connections (...). The best networkers will become even more highly valued" (P29).

4.3 Network Size

When it comes to the size of the optimal network, 12 of 14 papers recommended a highly selective and strategic approach towards network growth due to the limitations of managing extensive networks effectively. Only one paper (P25) argued in favor of a growth strategy following the maxim of "bigger is better". Five papers even suggest to apply "a strong hand" (P22) to end relations, and advice networkers to make "some hard decisions to back away from redundant and energy-sapping relationships" (P8).

4.4 Network Diversity

In sum, 22 papers made suggestions about the optimal network structure. Only two of them seemed to appreciate homogenous networks of technological experts, while a majority of 15 papers favored diverse network structures: "Networks of high performers are more diverse than those of average or lower performers" (P3), mainly since they allow to exploit a broader range of knowledge sources: "Highly diverse network ties can help you develop more complete, creative, and unbiased views of issues" (P41). Concurrently, only two papers emphasized the strengths of dense network configurations (P27, P30), while three recommended balancing dense and diverse networks (P31, P16, P40). The appreciation of diversity is also corroborated by two other observations.

First, when it comes to preferential attachment, 18 papers recommend to establish relationships with actors who exhibit some kind of importance, varyingly labeled "kingpins" (P2), "experts" (P11), "loveable stars" (P6) or "inner circle" (P37). Connections with these central nodes afford access to knowledge, financial resources or other contacts. These assumptions reflect different understandings of network centrality. While "hubs" (P35) seem to show high levels of degree-centrality, "super-connectors" (P41) are characterized by their closeness to other nodes.

However, at least 11 of this 18 articles accentuate the usefulness of the network periphery such as "junior colleagues who are involved in the front line" (P2) or persons without formal power (P23) since "having ties to peripheral zones makes it possible to bring new ideas to the creative process" (P7). Additionally, 15 papers suggest connecting to actors who are likely to diversify one's portfolio of relations: "leaders develop contacts not only in the typical areas—local clubs, industry associations, and customer and supplier relations—but beyond them" (P22).

Second, a decline in diversity is widely perceived as major risk in networking. At least seven articles refer quite explicitly to problems of cohesion and proximity:

> Choosing contacts to maximize a sense of trust in your network (...) can inadvertently undercut its diversity. Another obstacle (...) is the proximity principle, which holds that workers prefer to populate their networks with the people they spend the most time with. (P41)

Homophily is regarded as a key pitfall of networking strategies: "One of the greatest drawbacks of choosing to work with similar people is the limited range of perspectives that a homogeneous group often brings to bear on a problem" (P6). Especially, the senior staff is asked to be aware of network closure (P7, P8, P40): "Over time, their networks become more selective and homogenous. Consequently, they are more impaired in their ability to accurately convey what is going on" (P2).

4.5 Network Position and Networking Orientation[8]

With regard to most favorable structural positions, the suggestions (given by 18 papers) are rather inconsistent. Some authors endorse capturing the position of a hub (P9, P20, P22, P30); they see bonding as the most promising network strategy: "connectedness makes them attractive to other players" (P20). Bridging and taking advantage of structural holes is mentioned rather seldom. Only three papers consider the powerful broker benefiting from information asymmetries as a rewarding network position (P9, P15, P29). Instead, ten papers argue in favor of strategies to actively connect third parties. Sparse networks and unconnected sub-networks are not seen as an opportunity to accumulate superior information but to foster connectivity: "When you detect networks that appear to be disconnected, bridge the gap not through yourself, but helping representatives from the different networks to connect" (P2). In the reviewed literature, *tertius iungens*-approaches [i.e., approaches to introduce disconnected people and facilitate interaction among them (Obstfeld 2005)] are favored over *tertius gaudens*-approaches [i.e. approaches that seek to leverage a broker position between disconnected units by monopolizing interaction (Burt 1992)]. Although the reviewed literature endorses an ethos of strategic behavior, network members should not to be treated as "mere resources" (P16). Rather, the papers we analyzed suggest to develop reciprocity and trust in order to benefit from long-term profits.

4.6 Theoretical Points of Reference

The suggestions for network management and online networking are not simply presented as result of experiential and empirical induction. Reference to theoretical and methodological considerations of social network analysis could be found in 30 papers. First, seven of them make reference to or apply social network analysis as a means to make informal networks visible and turn relations into calculable assets: "A tool called social network analysis can be applied to make clear where such critical junctures exist within the organization" (P9). Moreover, even authors with a distinct background in business studies widely refer to social network theory:

> There is a huge amount of work in sociology, really beautiful work that shows, especially if you want innovation and novelty, that your weak ties are a better place to go than your strong ties. Your weak tie network is extremely valuable. (P28)

As regards individual authors, the reviewed literature refers, apart from 11 quotations of Mark Granovetter, extensively to Ronald Burt. In sum, 23 papers employ Burt's concept of structural holes, or at least selected aspects of

[8]The term "networking orientation" denotes a construct of medium specificity and a "strategic orientation" that refers to preferred means for approaching problems in a social context (Levine et al. 2000; Obstfeld 2005).

it. Additionally, "Dunbar's number" that suggests a cognitive limitation of the human capacity to maintain social relationships is widely cited. When it comes to networking orientation, one paper extensively makes reference to David Obstfeld's notion of *tertius iungens* (P2). Social network theories then not only represent analytical categories to describe empirical realities. Rather network concepts are regarded as socio-technological tools to deliberately engineer the social world.

5 Performing Social Network Analysis? Summary and Conclusion

Networking has more and more turned into a reflexive and strategic investment in relational capital that provides a key resource to navigate through increasingly volatile markets for information, reputation, and employment (Jones 1996; Sydow et al. 2004; Grabher and Ibert 2006). The more recent advent and global proliferation of SNS like Facebook, LinkedIn or Twitter advanced networking practices to a new level of reflexivity. The increasing mobilization of the theoretical authority of social network analysis to forge the socio-technological affordances and the actual praxis of SNS, we maintain in this paper, is highly suggestive of a performativity of networks. More specifically, the present analysis was aimed at answering the question which dimension of performativity (as identified by MacKenzie 2006: 18–19) is at play in the realm of social networking.

Generic performativity is evinced in the very imagery of nodes and ties that in itself represents an abstractified perception of personal relations. The imagery of the sociogram (cf. Moreno 1934) with its crisp geometries is a basic accomplishment of social network analysis that has shaped the basic vocabulary of SNS. As "socio-cognitive prosthesis" (Caliskan and Callon 2009: 380) SNS transform the diffuse social world of subjective sympathies, familiarity, social proximity or distance into what is perceived as *social networks*. Yet, the (almost naturalized) enactment of the idioms of social network analysis does not necessarily imply an impact on both the practices of networking and the structure of personal networks. Indeed, available evidence suggests that SNS (like Facebook or LinkedIn) are primarily employed to re-activate, maintain or strengthen relations that have been established offline (e.g. Ellison et al. 2006; Cheung et al. 2011). The socio-technological affordances of SNS, then, primarily seem to provide additional options to communicate with offline contacts.

Effective performativity requires that the employment of (an aspect of) social network analysis "makes a difference" in practice (MacKenzie 2006), i.e. impacts significantly on actual networking processes. At least two socio-technological features of SNS actually shape both tie formation and node selection. First, as an 'engine', SNS enable to extend personal networks by activating "dormant ties" (Levin et al. 2011) and by establishing "latent ties" (Genoni et al. 2005). SNS afford "persistence" (Boyd 2010: 7–8) by alerting to activities of nodes that have drifted towards the periphery of awareness, and by adding ephemeral ties to the portfolio of connections. Second, the increased transparency of networks allows to strategically

mobilize relational resources by linking up with nodes who are as close as two or three degrees of separation. Reference to shared contacts eases resource-dependent tie formation (Skeels and Grudin 2009).

Such a strategic approach is also a chief mantra of the evolving genre of network guidelines. An analysis of 41 academic publications offering advice on networking practices stresses the importance of a considerate selection of contacts and of strategic relationship management. In this literature, SNS are praised as effective socio-technologies to pursue these goals. In particular, they provide opportunities for occupying a *tertius*-position, either as a *tertius gaudens* (Burt 1992) who exploits structural wholes or as *tertius iungens* (Obstfeld 2005; Long Lingo and O'Mahony 2010) who bridges formerly decoupled sub-networks. However, it remains an open question to what extent such a functional networking orientation resonating with the paradoxical notion of "strategic friendship" (Grabher and Ibert 2006) actually impacts on every-day networking practices. Effective performativity of social network analysis, therefore, seems to apply in particular occasions and specific settings only (see also Ellison et al. 2011)

Two socio-technical affordances of SNS seem to indicate *Barnesian performativity* in the sense that theoretical models of social network analysis alter processes "in ways that bear on their conformity to the aspect of [the theory] in question" (MacKenzie 2006: 16–18). First, the algorithms of affiliation engines that are built around the rules of homophily and transitivity are increasingly molding network growth. The software-generated suggestions to connect with 'people you might know' enhance awareness of offline networks in online profiles. Moreover, by proactively contributing to the formation of ties with 'friends of friends', affiliation engines attune network structures to the rule of transitivity. Affiliation engines disperse "forbidden triads" (Granovetter 1973: 1363) by establishing at least weak ties between two nodes who have a significant overlap in their portfolio of connections. In a similar vein, affiliation engines driven by shared interests, raise the level of homophily in a network by triggering ties between "birds of a feather" (McPherson et al. 2001). Indeed, finding like-minded persons is both a promise of SNS and an important motivation to join them (Lin and Lu 2011).

Second, SNS afford the socio-technical infrastructure of an expanding spectrum of "valorimeters" (Caliskan and Callon 2010: 17). Indices like the *Klout-Score* or *PeerIndex* transform subjective perceptions into quasi-objective and commensurable scales (see Schaefer 2012). The reference to *Eigenvector* centrality is likely to trigger cumulative dynamics within wider network structures (Powell et al. 1996). In attempts to improve network ranking, nodes preferentially attach to central nodes and contribute to the ongoing stratification of networks (Newman 2001). This behavior is also consistent with the advice of networking guidelines that stress the strategic importance to link up with central nodes and "super-connectors" (Uzzi and Dunlap 2005).

The 'how to'-literature on personal networking, however, also reveals some moments of *counter-performativity* that induce, analogous to a self-defeating prophecy, counter-reactions to predictions of social network analysis. Diversity is

widely regarded as a key asset in network management since it affords access to diverse source of knowledge, and benefits individual careers as well as organizational development (Healy 2011: 19–20). Consequently, networking guidelines warn against the pitfalls of homophily and transitivity.

In the next steps of our research[9] we also seek to examine the assumption that the performativity of networking practices is not confined to the realm of SNS. Rather, these practices enacted online increasingly transform the ways we establish and maintain relationships in our offline world (Beer 2008). SNS then afford not only an online version of our offline networks, rather they precipitate a more performative approach towards our own social worlds more generally.

Appendix 1: Core and Sub Categories for the Text Analysis

Core category	Sub categorgy
Network structure	Size
	Density
	Diversity
	Sub-networks
	Other
Network position	Hub
	Broker
	Connector
	Other
Network relations, core	Hub
	Broker
	Facilitator
	Connector
	Other
Network relations, periphery	Hub
	Broker
	Connector
	Periphery
	Other
Networking orientation	Bonding
	Bridging
	Facilitating
	Other

(continued)

[9]This paper results form a research project funded by the German Research Foundation (DFG GR 1913/10-1).

Network failures	Over-embeddedness
	Cohesion
	Multiplicity
	Other
Networking rationality	Opportunistic
	Altruistic
	Other
Theoretical reference	Burt
	Granovetter
	Other

Appendix 2: Papers Included in the Literature Review on Social Network Management and Online Networking (Sect. 4)

P1: Alstyne, M. 2012. Why strong ties matter more in a fast-changing environment. *MIT Sloan Management Review* 53: 1–3.

P2: Anand, N., Conger, J.A. 2007. Capabilities of the Consummate Networker. *Organizational Dynamics* 36.1: 13–27.

P3: Athey, R. 2008. It's 2008: do you know where your talent is? Connecting people to what matters. *Journal of Business Strategy* 29.4: 4–14.

P4: Brown, R. 2010. Reputation Management. *Business Information Review* 27.1: 56–64.

P5: Byham, W.C. 2009. Start Networking Right Away (Even If You Hate It). *Harvard Business Review* January: 22.

P6: Casciaro, T., Sousa Lobo, M. 2005. Competent Jerks, Loveable Fool, and the Formation of Social Networks. *Harvard Business Review* June: 92–99.

P7: Chauvet, V., Chollet, B., Soda, G., Huault, I. 2011. The contribution of network research to managerial culture and practice. *European Management Journal* 29: 321–334.

P8: Cross, R., Gray, P., Cunningham, S., Showers, M., Thomas, R. 2010. How to Make Employee Networks Really Work. *MIT Sloan Management Review* 52.1: 83–90.

P9: Cross, R., Liedtka, J., Weiss, L. 2005. A practical guide to Social Networks. *Harvard Business Review* March: 1–9.

P10: Cross, R., Nohria, N., Parker, A. 2002. Six Myths about Informal Networking—and How to Overcome Them. *MIT Sloan Management Review* Spring: 67–75.

P11: Cross, R., Thomas, R. 2011. A Smarter Way to Network. *Harvard Business Review* July–August: 149–153.

P12: Dale, S. 2011: Surviving and thriving as a 21st century knowledge and information professional. *Business Information Review* 28.1: 30–37.

P13: Dutta, S. 2010. What's Your Personal Social Media Strategy? *Harvard Business Review* November: 127–130.

P14: Enders, A., Hungenberg, H., Denker, H.-P., Mauch, S. 2008. The long tail of social networking: Revenue models of social networking sites. *European Management Journal* 26: 199–211.

P15: Flemming, L., Juda, A. 2004. A Network of Invention. *Harvard Business Review* 82.4: 22.

P16: Friar, J.H., Eddleston, K.A. 2007. Making Connections for Success: A Networking Exercise. *Journal of Management Education* 31.1: 104–127.

P17: Gratton, L. 2009. How to "Glow" and Become a Better Leader. *Business Strategy Review* Summer: 9–12.

P18: Gratton, L. 2011. Workplace 2025—What will it look like? *Organizational Dynamics* 40: 246–254.

P19: Gray, K. 2009. Creative career development. An entrepreneur's guide. *Business Information Review* 26.4: 288–292.

P20: Harris, L., Rae, A. 2011. Building a personal brand through social networking. *Journal of Business Strategy* 32.5: 14–21.

P21: Harris, L., Rae, Al. 2010. The online connection: transforming marketing strategy for small business. *Journal of Business Strategy* 31.2: 4–12.

P22: Ibarra, H., Hansen, M. 2011. Are you a collaborative leader? *Harvard Business Review* July–August: 69–74.

P23: Ibarra, H., Hunter, M. 2007. How Leaders create and use networks. *Harvard Business Review* January: 40–47.

P24: Jacobs, G.H. 2009. Online Professional Networking. *Contract Management* August: 10–14.

P25: Janasz, S., Forret, M.L. 2008. Learning the Art of Networking: A Critical Skill for Enhancing Social Capital and Career Success. *Journal of Management Education* 32.5: 629–650.

P26: Jones, T.D., Swain, D.E. 2012. Managing Your Online Professional Identity. *Bulletin of the American Society for Information Science and Technology* 28.2: 29–31.

P27: Kietzman, J.H., Hermkens, K., McCarthy, I.P., Silvestre, B.S. 2011. Social media? Get serious! Understanding the functional building blocks of social media. *Business Horizons* 54: 241–251.

P28: Kiron, D. 2012. Interview with Andrew McAfee: What Sells CEOs on Social Networking. *MIT Sloan Management Review* 53.3: 1–6.

P29: Korotov, K., Khapova, S.N., Arthur, M.B. 2011. Career Entrepreneurship. *Organizational Dynamics* 40: 127–135.

P30: Lanzolla G., Anderson, J. 2008. Digital transformation. *Business Strategy Review* Summer: 73–76.

P31: Lengnick-Hall, M.L., Lengnick-Hall, C.A. 2003. HR's role in building relationship networks. *Academy of Management Executive* 17.4: 53–63.

P32: Levin, D.Z., Walter, J., Murnighan, J.K. 2011. Dormant Ties: The Value of Reconnecting. *Organization Science* 22.4: 923–939.

P33: Miller, L.G., Christakis, N.A. 2011. Tapping the Power of Social Networks. *Harvard Business Review* September: 28.

P34: Molinsky, A.L., Davenport, T.H., Iyler, B. 2012. Three Skills every 21st-Century Manager need. *Harvard Business Review* January–February: 139–143.

P35: Patrick, J. 2008. Coming Attractions. *Business Strategy Review* Winter: 59–60.

P36: Roberts, S.J., Roach, T. 2009. Social Networking Websites and Human Resource Personnel: Suggestions for Job Searchers. *Business Communication Quarterly* 72.1: 110–114.

P37: Sacks, M.A., Graves, N. 2012. How Many "Friends" Do You Need? Teaching Students How to Network Using Social Media. *Business Communication Quarterly* 75.1: 80–88.

P38: Schweer, M., Assimakopoulos, D., Cross, R., Thomas, R. 2012. Building a well-networked organization. *MIT Sloan Management Review* 52.2: 35–42.

P39: Strehlke, C. 2010. Social Network Sites: A starting point for career development. *Journal of Employment Counseling* 47: 38–48.

P40: Üstüner, T., Godes, D. 2006. Better Sales Networks. *Harvard Business Review* July–August: 102–112.

P41: Uzzi, B. Dunlap, S. 2005. How to Build Your Network. *Harvard Business Review* December: 53–60.

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Part III

Investigating Networked Governance: Methodological Approaches

Simulating the Dynamics of Socio-Economic Systems

Jürgen Pfeffer and Momin M. Malik

To the two traditional modes of doing science, in vivo (observation) and in vitro (experimentation), has been added "in silico": computer simulation. It has become routine in the natural sciences, as well as in systems planning and business process management (Baines et al. 2004; Laguna and Marklund 2013; Paul et al. 1999) to recreate the dynamics of physical systems in computer code. The code is then executed to give outputs that describe how a system evolves from given inputs. Simulation models of simple physical processes, like boiling water or materials rupturing, give precise outputs that reliably match the outcomes of the actual physical system. However, as Winsberg (2010, p. 71) argues, scientists who rely on simulations do so because they "assume as background knowledge that we already know a great deal about how to build good models of the very features of the target system that we are interested in learning about."

This is not the case with social simulation. It is often done precisely to try and discover the important features of the target system when those features are unknown or uncertain. Social simulation is a kind of computer-aided thought experiment (Di Paolo et al. 2000) and as such, it is most appropriate to use as a "*method of theory development*" (Gilbert and Troitzsch 2005). Unlike in the natural sciences, uncertainty and the impossibility of verification are the rule rather than the exception, and so it is rare to find attempts to use social simulation for prediction and forecasting (Feder 2002).

Many physical and biological systems are conceived as based on simple rules for the individual *agent* in the system; for example, the micro behavior of individual ants results in distinct patterns emerging on macro level of ant colonies (Gordon

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1999; Resnick 2001). The effect on the macro system of individual behavior on the micro level is called the logic of aggregation (Alexander et al. 1987) and sometimes identified as *emergence* (Johnson 2001). However, applying this to *social* systems has considerable philosophical difficulties (Epstein 2011, 2015), since (unlike ants or molecules) human society is governed by far more than individuals applying simple rules. Still, if we can create a simulation model that shows that a network of interacting individuals achieves governance behavior similar to that of an observed real-world system, it is not *proof* that there are underlying simple rules governing the system, but it becomes a compelling possibility. Similarly, if we can build a simulation model in which a particular governance strategy achieves the desired outcome, it does not mean it will work when applied in the real world (and conversely, if we cannot build such a simulation model, it does not mean the strategy will not work), but it can substantiate our theoretical intuitions about the mechanism by which a given intervention should work.

In this chapter, we strive to give a theoretical and methodological overview of social simulation, focusing specifically on how it may be used for studying networked governance. After covering the motivation for and logic of simulation modeling, we illustrate the use of simulation through historical and contemporary examples. Lastly, we go through the process of building, validating, and refining a simulation by simulating a hypothetical governance intervention on a networked financial system.

1 The Nature and Goals of Social Simulation

Following the Encyclopedia of Computer Science (Smith 2000, p. 1578), simulation is "the process of designing a model of a real or imagined system and conducting experiments with that model." The same source concludes by saying, "The purpose of simulation experiments is to understand the behavior of the system or evaluate strategies for the operation of the system." Consequently, every simulation needs a *decent* model of (a part of) the real world system of interest. Of course, it is impossible to mimic all aspects of complex socio-economic systems. The way in which simulations (and all models) simplify and abstract is a flaw in not being able to capture everything in the world, but also an advantage in forcing us to find the factors that can be theoretically identified as the most important for driving real-world dynamics.

In his general model theory, Herbert Stachowiak described three characteristics of models (Stachowiak 1973):

Mapping. A model is the representation of a system. Characteristics of the system are mapped to the model.

Reduction. It is impossible to map all characteristics of a complex system, nor is it useful. Instead, the focus is on characteristics that are relevant for the research questions.

Pragmatism. A model does not stand for itself but needs to be interpreted with respect to the real world system that it represents.

Consequently, a model is a "smaller, less detailed, less complex" representation of a real world system (Gilbert and Troitzsch 2005) that is still sufficiently faithful to allow conclusions about the real world system. A *simulation* model is a computerized experiment on a virtually constructed system. The researcher tries to encode relevant aspects of a real-world system to construct a virtual system that may be created in a computer.

There are two main types of social simulation: system dynamics models, and Agent-Based Models (ABMs), also known as Agent-Based Social Simulation (ABSS) when applied specifically to social systems. System dynamics models simulate interactions between variables of the system on macro level. ABMs are the dominant form, and are nearly synonymous with doing social simulation.

ABMs consist of 'software agents' (representing anything from ants to governments) that interact with one another, from which global properties emerge. Gilbert (2008; based on Windrum et al. 2007) describes six characteristics of these agents: (1) every entity in an agent-based simulation is its own agent (*ontological correspondence*), which allows for (2) individualism in behavior (*heterogeneous agents*) and for (3) change in behavior over time (*learning*); (4) agent knowledge is limited to its immediate situation (*bounded rationality*; Simon 1972); (5) agents can interact with the environment (*representation of environment*) and (6) with each other (*agent interaction*). When agents make contact, ideas or information or diseases pass from one agent to the other.

ABMs are one major way of studying 'complex systems,' where we cannot describe the outcome of the entire system by decomposing it into parts (as we can with any linear system). As one consequence, a slight change in initial conditions can lead to drastically different outcomes, rather than outcomes proportional to the change.

Networks are a paradigmatic case of complexity. The way that network entities (agents, companies, government institutions) are connected and influence each other cause *network effects*, which are the patterns of networks amplifying or dampening some process to produce global patterns that are distinctly nonlinear. For example, in the adoption of innovation, an innovation becomes more attractive the more people who use it (Rogers 2003). Whether or not an innovation succeeds depends on it reaching a critical threshold of early adopters after which it rapidly reaches nearly everybody in a network, such that the number of subsequent adoptees is a nonlinear (and non-monotonic) function of the number of previous adoptees.

Network simulations are most commonly done through ABMs, as ABMs can represent the network by making agent actions either constrained by the network structure, or by making agent actions create and destroy ties from which network structure emerges. We need to specify (1) a network structure, (2) a set of computational rules describing the behavior of the individuals linked in that network, and (3) a set of initial conditions. With this, we can have a computer simulate the process one step at a time and explore possible outcomes, such as the success or failure on an innovation. And by making decision processes random rather than deterministic, and by running the simulation over ranges of initial values for the variables, we can generate a distribution of outcomes that give a sense of the space

of possibilities. This allows us to ask, how many people need to adopt an innovation for it to survive? What sort of diffusion will cause an innovation to succeed? This is an attractive way to address dynamics in light of how it is difficult or even impossible to accurate gather data on the structure of a real-world networks. Diffusion does not only apply to innovation, but also to political ideas. For example, Pfeffer and Carley (2013) show the importance of local clusters of a few "infected" people for the persistence of an idea or belief.

Social simulation through ABMs also has a natural fit to modeling governance. Governance, conceived as "directed influence of social processes" (Kickert et al. 1997, p. 2), involves interactions between many actors with their own goals and strategies (Klijn and Teisman 1997, p. 98). Systems of governance have been recognized as exhibiting behavior associated with complex systems, such as self-organization (Kickert et al. 1997) and reacting to feedback; we imagine this is the result of human agency. As such, directly modeling decision-making behavior through a simulation may be able to better capture behavior, as well as generally be more meaningful and informative, than identifying variables and relationships between them.

1.1 Simulations as an Alternative/Supplement to Statistical Modeling

In terms of building mathematical models, simulation modeling is an alternative mainly to statistical modeling (Gilbert and Troitzsch 2005).[1] Simulation modeling overcomes certain key drawbacks of statistical models that are especially acute around networks, both in observation and experiment. For all its importance, statistical modeling with observational data can never *prove* causal relationships. Causal inference requires strong assumptions that can fail without us knowing (Arceneaux et al. 2010). And, out of all forms of observational data, networks are the single most difficult case for statistical study. First, it is difficult even to estimate the magnitude and significance of associations (Dow et al. 1982), and second, inferring causality in networks (Shalizi and Thomas 2011) is often impossible because of how networks are both an independent variable, influencing future outcomes, and a dependent variable, formed from previous outcomes or attributes, in a constant dynamic evolution that is impossible to disentangle.

It is also frequently impossible to conduct experiments on a system of interest for logistic or ethical reasons. This is especially true in networked governance: if a network is used to govern, that network cannot be freely experimentally manipulated, and if a network is the object of governance, it is likely not ethical

[1]Statistics uses simulations for finding numerical solutions, and simulations use statistics for summarizing outcomes, but as *types of models* they are distinguished respectively by aiming to model the world through statistical expressions of data-generating mechanisms and by aiming to model the world through interactions of decision-making agents.

to manipulate it. Experiments can be used to study processes in the abstract away from specific real-world governance networks, and indeed this is an important line of investigation for understanding general processes (see Schwaninger et al. 2017). But there is the risk of lacking ecological validity: experiments that create artificial networks (Centola 2010) may miss essential features of naturally arising networks. And if experiments are conducted on existing networks, the statistical problems of networks do not go away: the effects of a treatment on individually treated nodes can 'bleed out' to untreated nodes, making it complicated to do analysis (Rosenbaum 2007). Summarizing many of these concerns, Robins (2015, p. 223) writes,

> When we have a network-based complex system, the implications of the [empirical] conclusions are not always apparent. If we have several processes occurring simultaneously in our system, with feedback effects likely, it can be very difficult to surmise the likely overall system outcomes just from a list of the processes we have inferred. A simulation may help us to understand how these processes operate together. If we have a case study, what we observe is only one instantiation of many possibilities. With one dataset we do not understand the full range of possibilities consistent with that data: simulations let us appreciate the range of plausible outcomes. If we wish to draw conclusions about what might happen with a change to the system (perhaps from some form of policy intervention), then we may be able to adjust a simulation to mimic such a change and study the simulated outcomes.

There are also philosophical aspects to using simulation. As Abbott (1988, p. 170) points out, standard features of statistical modeling have key incompatibilities with theoretical social science: statistical modeling "assumes that the social world consists of fixed entities (the units of analysis) that have attributes (the variables). These attributes interact, in causal or actual time, to create outcomes, themselves measurable as attributes of the fixed entities," assumptions which he notes "strikingly" contradict major theoretical traditions of sociology that reject fixed entities as well as meanings that are independent of locations in interactions, sequences of events, and biographies. As other chapters in this volume show, networks have the ability to relax at least the way in which mathematical models divorce attributes from interactions. However, and despite claims that networks are an antidote to reductionism (Barabási 2011), in a social scientific sense they can be as reductionist and as contradictory with social theory as are statistical models. Erikson (2013, p. 225) identifies "formalism," a major historical and intellectual tradition in social network analysis, as the attempt to model social science after natural science. Formalism seeks to find fundamental units of social interaction (such as motifs of graphs, or a network statistic like density) whose interaction and composition not only explains society, but also do so without recourse to the content or the peculiarities of the specific instances of those units.

Do simulations offer a way out? Partially. They can be used to identify causal factors and, in addition to exploring abstract network processes, can manipulate representations of specific real-world systems. Simulations come with drawbacks, however: just like experiments, they still require the researcher to identify the key

components of the real-world system (Burton and Obel 1995), albeit with greater ability to try out multiple representations. And for the greater flexibility they provide over experiments, they require the heavy assumption that key aspects of the world can be captured in the electronic, binary executions of computer code. Lastly and importantly, simulation models are not models of data, but only of processes; that is, *they cannot be applied to describe or analyze data* (although they may be initialized with or compared to data). Considering that simulation is useful precisely when data is unavailable or impossible (such as data from hypothetical interventions), this is more a matter of what simulations are and are not appropriate for. Lastly, simulations can easily be used (and often are) for a formalist approach, thereby suffering from similar theoretical incompatibilities with certain social theories as does statistical modeling—with actors replacing variables (Macy and Willer 2002) as the mechanistic units. But, in modeling specific systems, simulations can seek to create models that are situated within a context and, depending on the model, in a sequence of events.

2 A Review of Simulations for Networks and for Governance

One of the earliest examples of simulation being used in a governance context comes from politics: John F. Kennedy's 1962 presidential campaign had a project called *Simulmatics*, which used computers to simulate information flows to try and predict voter reactions to campaign statements about fluoridated drinking water. And, as an example of simulations to support policy-making, there was also a tradition of *microsimulation*, which involved taking a population sample and simulating an 'aging' process, with each individual in the population assigned a probability for procreation (for women between certain ages) and for death (based on age) to get projections of future population size (Gilbert and Troitzsch 2005). The US military is an example of an institution that has a long tradition of attempting to manage complexity with social simulations (such as 'war games'), not usually for prediction, but rather to increase preparedness and capacity building (e.g., Lieberman 2012).

But a far more well-known use of simulation, one that to this day is still one of the most ambitious, was the *World3* model, whose results were published in *The Limits to Growth* (Meadows et al. 1972). Coming out of a simulation technique used first to describe dynamic business processes in industrial context and then social problems in urban settings (Forrester 1961, 1969, 1971), *World3* attempted to use simulations to analyze the consequences of global economic growth. It did this by considering the complex interconnections between population, industrialization, pollution, food production, and resource depletion on global level (Fig. 1). While the model was far too complex to analyze by hand, by putting the variables into a computer and simulating trends in development, the researchers could see the effect that each variable would have on the others. The results, dramatically, predicted a collapse of the global system in the second half of the twenty-first century.

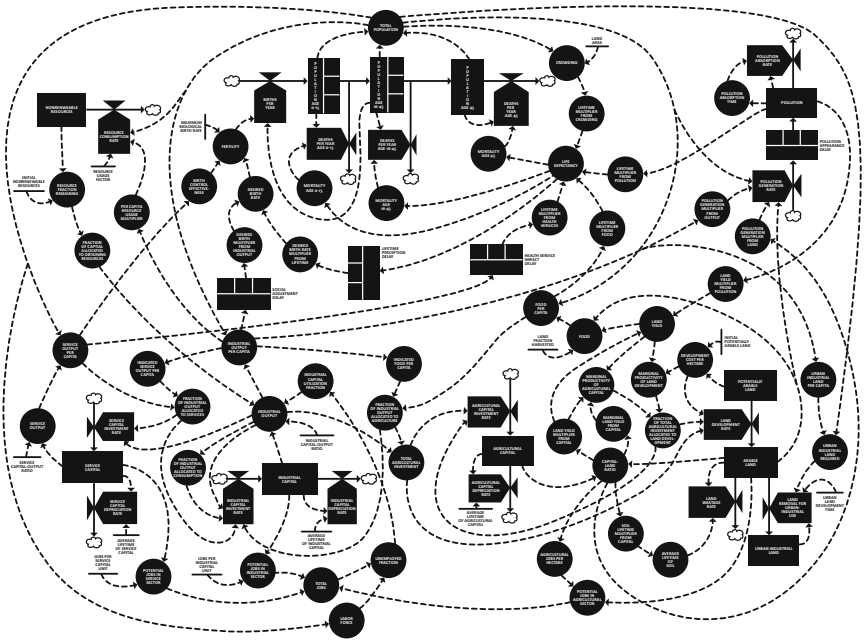

Fig. 1 The World3 model, still to date one of the most ambitious uses of simulation. Directed *solid lines* are 'flows' and represent changes in the *boxes*, which are 'stocks:' for example, the "Population age 0–15" stock is filled from the "Birth per year" stock and drained by the "Population age 16–45" stock. Variables are *circles*, and are connected by *dashed lines* to each other and to stocks, e.g., variables holding information about mortality rates are connected to the population stocks for calculating annual change in these stocks. Source: Adapted from The Limits of Growth (Meadows et al. 1972) under Creative Commons Attribution Noncommercial License

This provides an excellent illustration of a place where simulation may be used: experiments could never be large enough to capture the key feature of global interconnectedness, and extrapolations made from observations would not be able to predict when trends will change or what those change would look like, for example what would happen when a resource is exhausted.

It also illustrates some limitations. As Gilbert and Troitzsch (2005) write, "The [*World3*] simulations that predicted global environmental catastrophe made a major impact but also gave simulation an undeservedly poor reputation as it became clear that the results depended very heavily on the specific quantitative assumptions made about the model's parameters. Many of these assumptions were backed by rather little evidence." Social simulations often depend heavily on assumptions that can be difficult to support with empirical evidence, one of the reasons they are best used as a method of theory development and for testing the consequences of assumptions, rather than for prediction.

Indeed, in a 30-year update to the *Limits of Growth* study, the original authors (Meadows et al. 2004) note first that the model correctly predicted some trends, but second that the point of the model was not to predict, but only to reason through

possible consequences and how they might happen. The skeptics and critics of the study, they argue, did not appreciate this actual purpose. And judged by this standard of theory development rather than by the standard of prediction, the model was a success, providing a challenge to economic models and governance strategies that assumed infinite economic growth.

Still, since *World3*, simulation has seldom been used at the global scale. *World3* is also an example of a *system dynamics* model, which simulates interactions between variables on macro level (Fig. 1), which has since the 1990s mostly receded in favor of Agent-Based Models (ABMs). As discussed above, these are particularly appropriate for studying the complexities of networks and of governance.

In the following, we review two specific uses of social simulation: hypothesis testing and exploring possible outcomes, both of which may be used for theory development and to explore network properties.

2.1 Hypothesis Testing

One of the first Agent-Based Social Simulation (ABSS), and one that was in fact first calculated by hand rather than by computer, is Schelling's segregation model (Schelling 1971). This was later considered a "cellular automata" example of an ABM, where agents are individual cells or combinations of cells in a grid whose behavior is modeled in how nearby cells are turned "on" or "off" (i.e., toggled to one of two states—or possibly of one of more than two states) based on properties of other nearby cells. In Schelling's model, cells are either empty, or colored either white or black to represent a people of one of two races living in a given plot of land (Fig. 2a). The model sets up a series of rules about when a "person" moves to an empty cell in another "neighborhood" (another part of the simulation grid) based on

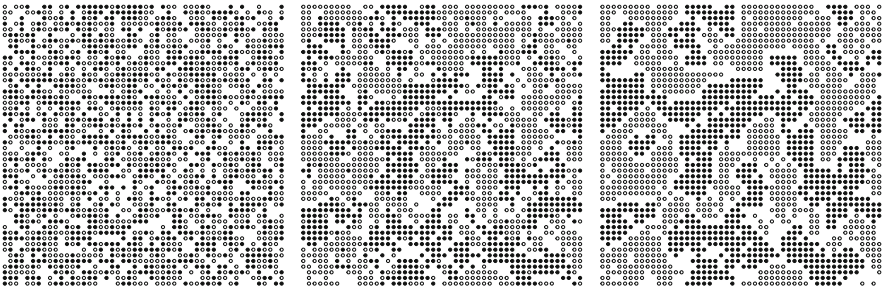

Fig. 2 An implementation of the Schelling segregation model in a 50 × 50 grid, adapted from code by Kamiński (2012). For this particular random initial configuration, the model reached equilibrium in 24 steps, at which point all cells were 'satisfied' in the number of neighbors of the same race, and no longer sought to move to an empty plot. The agent micro-level behavior produces a macroscopic pattern of total segregation. (a) Initial configuration. (b) After 6 steps. (c) After 24 steps

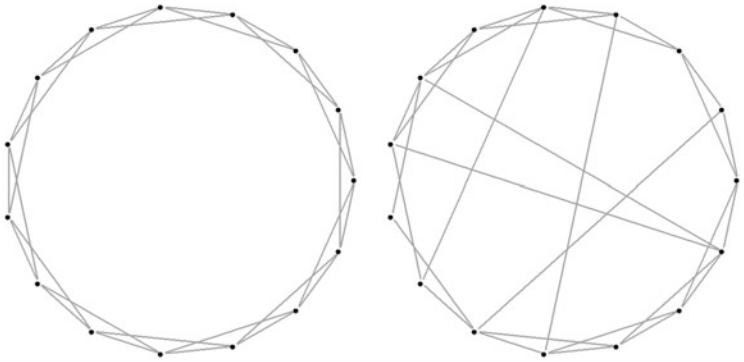

Fig. 3 The Watt-Strogatz "small-world" model, where agents start out in a circular lattice, shown on the *left* (here, connected to their immediate neighbors in the circle as well as neighbors one step away), then make decisions to randomly rewire with a certain probability (here, $p = 0.1$), shown on the *right*. This simple behavior produces one particular theoretically important characteristic of observed human networks: high clustering but low average path length

the colors of their neighboring cells (Fig. 2b). The model shows that even if people are only slightly prejudiced in having a small preference for not living next to people of another race, it is sufficient to cause total segregation (Fig. 2c). For this simulation model, Schelling had a very specific hypothesis: he was not so much interested in *how* and *why* segregation happens as in showing that low-threshold racism and prejudice *can* create racially segregated neighborhoods in cities.

One celebrated early result in what came to be known as "network science" (Watts 2004) was a simulation to test a hypothesis about network properties. Watts and Strogatz (1998) addressed the "small world problem," where social networks are observed to have high clustering but low average path length, by constructing a model where a system starts out in a circular lattice, but then has nodes randomly break connections and form new ones (Fig. 3). As a model of how humans actually operate, it is unrealistic, but it was hailed as a breakthrough (see Scott 2011) for finding a simple mechanism that could accurately (in a qualitative sense) capture observed behavior. And at least qualitatively, its suggested view of people as living in local clusters but with a few cross-cluster friendships is not unreasonable.

The agents in the Schelling model operate through a single deterministic rule, and the 'decisions' in the Watts-Strogatz model are random, but there are models that invest agents with more reasoned decision-making capability. In an example in policy, Hayes and Hayes (2014) use a simulation to investigate if a proposed bill to limit assault weapons and high-capacity magazines would limit the number of victims of mass shootings (they deliberately did not look at whether mass shootings would become more likely). They build a geometric simulation of a mass shooter agent with guns of a certain accuracy, speed, and capacity after which they must then be reloaded, and potential-victim agents who have the ability to try and run away. Under this simulation, they find that the bill would have a negligible effect.

These examples show power and limitations of using simulations for theory building and hypothesis testing. Simulations can create convincing results as an additional method for supporting research work. On the flipside, it can be quite tricky to cover the relevant aspects of a real world system, which would be a pre-condition for people *believing* the results of simulations of socio-economic systems. In the Schelling model, what are the reasons for people moving to a different neighborhood? How important a driver are, say, economic factors? And in the Hayes and Hayes example, how do people react if they find themselves in a mass shooting? Would they even try to run away, or try to hide? Is the way in which agents are programmed to flee an accurate representation of the real world? In a convincing simulation experiment that is strong enough to support theoretical considerations, the most important variables of the system need to be backed by empirical evidence (e.g. observations or surveys) or accepted theoretical models.

2.2 Simulations to Explore Possible Outcomes

Simulations of governance in particular often represent the governed as agents to examine the effects of a particular policy on their decision-making. For example, Maroulis et al. (2014) investigate what will happen if schools are no longer assigned but parents can choose. Medina et al. (2014) consider whether giving (accurate) information to people in a network about how others contribute to public goods will make them more or less likely to contribute themselves. Kovacic and Pecek (2007) use simulation to suggest a faster configuration of bureaucracy for processing social assistance benefits in Slovenia.

Simulations may also be used to simulate those making governing decisions. For example, Valkering et al. (2005) model the dynamics of a policy process for stakeholders (with very different goals and beliefs) managing a particular river in the Netherlands in the context of climate change. Bharathy and Silverman (2013) use simulations developed and refined over years to estimate the likelihood of rebellion and of insurgency in various countries based on the decisions of faction leaders, giving the examples of Thailand and Bangladesh, representing the environment in which interactions happen as the geography of these countries.

In a networks example, Zhao et al. (2012) wanted to explore how humanitarian organizations' interactions with one another lead to collaboration on projects. They built a model in which agents form new links based on events and new projects, and kept revising their initialization and model until they could generate collaboration networks with the same network properties as the real-world networks that they had observed. Once they had built this virtual system, they could use it to explore what strategies would lead to greater collaboration, and have a reasonable argument that this would have relevance to the real world. Taking a core/periphery perspective (Borgatti and Everett 1999) on the network, which involves qualitatively identifying a densely connected set of organizations forming a "core" and a

"periphery" consisting of organizations connected to the core but not to each other, they tested whether encouraging communication between core and core organizations, or between core and periphery, or between periphery and periphery led to better collaboration. They found that the periphery-periphery strategy worked best, and saw that it was because organizations on the periphery were normally not being exposed to enough opportunities to find all relevant collaborations. The authors conclude that "a computational simulation [. . .] not only enables us to study the outcome of different policies, but also helps us to gain insights into the patterns and characteristics [. . .] at both micro and macro levels" (Zhao et al. 2012, p. 621).

3 Evaluating Simulations

There are systematic ways of evaluating simulations, and these are an important part of convincing an audience (and even the simulation builders) whether or not to trust that a simulation bears enough of correspondence to the world to rely on it for reasoning about the world. The basic rule for evaluating simulations is that of the two-step process of "verification and validation." Verification is making sure the model works the way it is intended to, such as not having errors in the code. Validation is slightly different from 'validity' in social science more generally, but roughly corresponds to a combination of construct validity, face validity, and external validity.

Simulation 'validation' takes place at several levels: there are the basic checks of whether the initial conditions or input data a plausible state that the target real-world system could be in, whether the aspects of the model have construct validity, and whether the outputs are of the expected form. Beyond this, the most basic 'sanity check' is for face validity, where subject matter experts say whether the outputs are realistic or not. When outputs are not realistic, it is more likely that there is some problem with implementation or with the assumptions that went into the model, and less likely that the researcher has found an interesting result. Next is empirical validation: do observed real-world outcomes fit into the distribution of outcomes generated by multiple simulation runs? Another way of evaluation is to use multiple models for triangulation (Carley et al. 2013). There are several approaches for multi-modeling called *docking*, *collaboration*, *inter-operability*, and *integration*. If different models use overlapping input data and/or create (at least in parts) identical or comparable output data, the simulation models become much more believable. Indeed, one easy criticism of simulation models is that their outputs are entirely the result of assumptions, and that a different way of simulating the same phenomenon could give vastly different results; finding multiple different simulation models that give similar results gives confidence that this is not the case.

Bharathy and Silverman (2013) give an example of a simulation, and use it to extensively demonstrate how a simulation may be validated. They use the previously developed 'StateSim' framework, a cellular automata simulation of the likelihood of rebellion and insurgency. This framework creates agents who make decisions based on resources and alliances. They instantiate the model for two countries, Bangladesh and Thailand. Each case includes appropriate key individuals ("named leader agents") as well as political groups such as the central government, the military, and other groups as appropriate (in Bangladesh, communists and students; in Thailand, the Royalty, rural poor Buddhists and urban elite Buddhists, and southern Thai Muslims). For internal validity, they developed an extensive questionnaire given to subject matter experts, asking about the quality of the internal dynamics generated by the model. For external validity, they compared the likelihood of rebellion or insurgency from the model beginnings in January 2004 to real-world events. For Thailand, a high likelihood for rebellion in 2004 corresponded to the real events of Thai Muslim violence in response to Buddhist government and police suppressing protests. This likelihood fell in the model after the December 2004 tsunami hit (which was added into the model as an exogenous event), and in reality the unrest also decreased. In Bangladesh, the model predicted an outright rebellion that did not occur in reality; but there was a change in the Bangladeshi government in January 2007, right after the model's prediction, that was labeled a military coup by outsider observers but that the country never officially declared as one.

Evaluating the simulation models might be the hardest part when simulating complex socio-economic systems. Ultimately, the validity of the model comes down to whether or not it is perceived by decision-makers or other relevant actors are convinced that the simulation is a good enough representation of the real world, that it is useful for thinking about the problem at hand, and for thinking through various scenarios and interventions.

4 Case Study

We will illustrate a possible simulation scenario, using a real-world data set. In 2004, Josh On[2] collected the board memberships of the fortune 500 companies of the United States. This network consists of 500 companies and 4,300 people serving in the boards of these companies. As managers serve on more than one board and companies have more than one manager on their boards, a connected network is formed. The network data is what network analysts call a *two-mode* or *affiliation* network (Faust 1997). In such a network there are two different types of nodes, in this case nodes for managers and nodes for companies. Links in the network connect only managers to the companies on whose boards they set. There are no links from managers to managers nor from companies to companies. Two-mode

[2]Source: www.theyrule.net; data used with permission.

networks of people and *affiliations* can thus be seen as *indirect* social networks as we have no information about the actual interactions of these managers. Instead, we infer from shared activities that interaction is likely, an assumption that we have past work (Davis et al. 2003) to theoretically support in this context. In order to see how the most important companies of the United States are connected among each other, we perform a network 'transformation' or 'projection,' resulting in a one-mode network solely consisting of linked companies. Now, a link between two companies means there is at least one manager that serves on boards of both companies. Figure 4 shows the main connected component (433 nodes) of this transformed network of companies. The black nodes in this figure represent 75 banks and insurance companies (including health insurance companies, but not companies that actually own/run hospitals) which we label as *finance*. This one-mode network consists of 1603 interlocking connections. A third of all links in the network is either a finance/finance or a finance/non-finance link, showing the importance of these companies in the network of the US economy. Figure 4 shows only the links related to finance companies.

Fig. 4 Fortune 500 US Companies of 2004. *Black* nodes represent 75 banks and insurance companies. Interlocking director links among other companies (67%) are removed

4.1 Network Intervention by Law

Imagine that the government of the United States considers passing a law to limit the influence of finance companies in the US economy. There are several ways of implementing a legal intervention in order to get to this result, one of which is a network intervention: reduce coordination by forbidding finance companies to be directly connected via shared board members to other finance companies. Such a law was actually passed in Italy in 2012 exactly to address the practice of a small number of people dominating Italian bank boardrooms and exercising control over Italian finance (Jucca 2012). And simulation has been used to study possible financial regulation in the past, for example in Brazil as in Streit and Borenstein (2009).

Before performing any interventions on our company network, we first calculate the importance of every node in this network as baseline. Network analysis has developed a diverse array of metrics to describe the structure of networks and to identify important nodes (Hennig et al. 2012; Wasserman and Faust 1994). A widely applied metric to measure importance based on being a bottleneck of communication flow is covered by betweenness centrality (Anthonisse 1971; Freeman 1977 which measures how often a node is on the shortest path connecting two other nodes.

4.2 What-If Analysis

Let us now take the network and perform a straightforward heuristic 'what-if' calculation as we might do without resorting to agent-based simulation. The 75 finance companies have 36 links connecting them directly with each other; to comply with the above-mentioned hypothetical law, we remove all links connecting two companies from the finance companies (that is, remove all finance/finance links, but retain finance/non-finance links). We now re-calculate betweenness centrality with the reduced network and compare the results with metric from the original network. This intervention affects just 36 out of 1603 links (2.2%). However, as one can see in Fig. 5 on the left side, the intervention reduced the average betweenness centrality scores for the finance companies. Interestingly, the average score for the non-finance companies went up—as finance companies lose importance in the network, other companies take their structural role and gain importance.

4.3 Agent-Based Simulation

In the above calculation we globally removed links. But this mechanism does not match how links would actually be removed; in the real world, decisions about removing links based on the law would be made locally by individual managers and companies. Also, removing the links in the one-mode network of companies is similarly unfaithful to actual processes, as in real-life *people* drop connections to

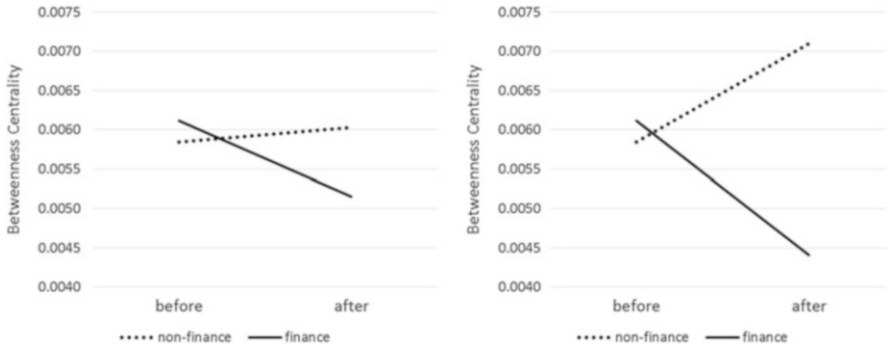

Fig. 5 *Left*: Impact of global intervention on average betweenness centrality of nodes. All links among finance companies were removed. *Right*: Impact of Agent-Based Simulation on average betweenness centrality in two-mode network

companies, with companies disconnecting from each other as a consequence. If a person drops a link to a company, then this company also loses the connections to all other non-finance companies of this person. To incorporate these aspects, we set up the following simulation experiment: every agent (representing a person) in the network who is connected to more than one finance company decides to which single company it retains an active link, and all other links get dropped. After every agent has made its decisions, we calculate betweenness centrality again to measure the structural impact of the local decisions. We have the agents make decisions randomly, as we do not know the criteria for dropping links in the real world scenario.

To avoid artifacts based on one particular randomization, we repeat this experiment 100 times and take the average betweenness scores of all these simulation runs. Randomness and repetition creates a distribution of expected outcomes in simulation experiments. The black line in the right chart of Fig. 4 shows the average of 100 simulation runs. From this, we see a greater impact of the intervention on the more realistic two-mode network than when we performed calculations on the one-mode network; that is, the more realistic scenario produced a different outcome, which we should keep in mind.

This simulation shows how we can examine, both practically and theoretically, the impact of potential governing interventions on this network before actually performing them in a way that is difficult to do with observations or experiments. As a next step, and in order to continue to make the simulation experiment behave closer to the real world system, we could add additional variables. For instance, a 'compliance' variable could define the chance of an agent to follow the law or to ignore it. And, managers normally do not drop their board memberships all at the same time; shareholder meetings are scattered throughout the year, and so might be resignations from boards. Incorporating time creates a multi-round simulation in which agents have more than one chance to make decisions. Additionally, one could model a 'counter-effect:' finance companies are aware of the policy maker's interest in reducing their influence, but they seek to retain their network position.

We could also add second-order effects by having the agents try to compensate their imminent loss of importance via new connections to non-finance companies.

5 Opportunities and Limitations

Computerized thought experiments can help motivate what sorts of empirical experiments and observations to do. Social simulations are unique in giving us a systematic way to think through systems that we often cannot explore directly, or explore scenarios that have not yet happened.

To return to *The Limits to Growth* example, although simulations have become far more sophisticated, the example holds lessons that still apply. First, simulations of social systems are highly dependent on the assumptions that go into it; it is very easy to disagree with those assumptions and thereby dismiss the model. People at the time treated the study as a prediction, not a thought experiment, and rejected it on those groups. Even if the assumptions of a simulation model are justified, simulation models may be highly sensitive to input parameters. As a definite prediction of what would happen in the future and when, *The Limits to Growth* work is dubious. As a fine-grained argument about how and why levels of resource extraction are unsustainable, it is extremely valuable.

In other classic examples, Watts and Strogatz's model of small-world network formation does not prove that networks actually form from random rewiring, nor can it predict what will happen to a given network; and Schelling's segregation model did not prove that segregation works in a particular way, nor is it a tool that can be used to predict where and when segregation will happen. Indeed, both are too abstract (respectively, starting with a circular lattice, and requiring adjacent pixels in a regular grid) to be linked with real data such as sociograms or maps and individual households. Both are thought experiments that show, in principle and within a certain specific set of abstractions, respectively that random mixing from tight clusters can produce 'small-world' effects, and that large amounts of racism are not necessary for large amounts of segregation. Both offer theoretical demonstrations opening possible ideas of what to study in the world.

There are many more possible objections that can be raised to simulation modeling, as well as responses (Chattoe-Brown 2012). But ultimately, just like how observations cannot prove causality and experiments cannot prove ecological validity (and how there are researchers that will reject one or the other approach), simulations cannot prove they have accurately represented the target system. And just as a researcher interpreting causal inference must decide whether or not to believe there are no unobserved confounders (or that they are not severe enough to change the conclusions), and a person interpreting experimental data must decide whether or not to believe that there are not factors in the world that would depart enough from experimental conditions enough to change results, a person interpreting a simulation study must decide whether or not to believe in the assumptions of how the model chooses to represent the world, and the implementation, analysis, and resulting conclusions.

Simulations can be arbitrarily detailed, realistic, and high-powered, and indeed it is tempting to immediately make models as complicated and realistic as possible. But intricate models often become unwieldy and may fail to run on computers in any reasonable amount of time. The best approach to social simulation is to first make a model that is as simple as possible to discover basic rules that can account for complex behavior. Over time, and as we carefully validate individual additions to a model, we may build up more complex models that allow us to model and examine how different decision-making criteria and behavior interact; but especially for theoretical investigation, finding possible underlying basic rules remains the most compelling contribution that social simulation can make.

Social simulations are not the only or even always necessarily best way to study any given networked system of governance or type of governance network, but they are a powerful addition to the toolbox of research in networked governance.

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Studying Policy Diffusion with Stochastic Actor-Oriented Models

Steffen Mohrenberg

1 Introduction

This chapter demonstrates the potential of stochastic actor-oriented models (SAOMs) and co-evolution designs for policy-diffusion research.[1] SAOMs are statistical models, introduced by Snijders (1995), for studying network data measured over time. In this chapter, I introduce these models in a non-technical way and present an exemplary application to the diffusion of national foreign trade policies (FTPs) via trade flows across countries.[2]

Diffusion studies frequently state that connected elements become more similar over time. These statements are usually backed by the cross-sectional observation of network autocorrelation, which means that connected elements share certain common characteristics. It is further argued that the connections function as "channels" through which the observed characteristics travel between the elements, spread, and diffuse (Holzinger et al. 2007a; Rogers 1983).

However, as in the case of the well-known chicken-or-egg causality dilemma, it frequently is hard to tell whether connected elements became more similar over time (influence) or whether elements became connected that were already similar (selection). While influence processes might qualify as diffusion, selection processes should be labeled differently. Selection and influence processes can produce identical results—connected elements are similar at a specific point in time—yet

[1]I thank Kai-Uwe Schnapp, Christian W. Martin, James Hollway, and Thomas Sommerer for helpful comments.

[2]This chapter is a revised section of Mohrenberg (2014). The application to FTP diffusion via trade flows is from a research project that I am pursuing together with Christian W. Martin (Martin and Mohrenberg 2015).

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selection mechanisms do not require that any single element of the potentially diffused variable change its value.

Therefore, if we think of diffusion as a process during which connected entities become more similar, an independent influence mechanism is a necessary condition for such a diffusion process. In order to identify independent influence mechanisms, it is necessary to check at the same time whether selection mechanisms and other structural changes are present.

SAOMs are able to address influence and selection simultaneously (Snijders et al. 2007). In this regard, they are particularly suitable for research questions about the similarity of connected elements. In contrast to more classic approaches and methods, SAOMs allow an analysis of both the "chicken" and the "egg" at the same time. They enable a joint simulation of the coevolution of two interconnected dynamics: changes of connections between elements (the network structure) and changes of monadic characteristics of these individual elements (the actor-level variable). In other words, this method equips researchers with a way of investigating whether and how connected elements become more similar over time because of their connectedness (diffusion), while, at the same time, connections between elements may also change on the basis of how (dis-)similar certain pairs of elements are (selection).

Such an interconnectedness of network structure as well as such attributes of network actors have implications for attempts to intentionally shape networks (governance of networks) and achieve political goals within or with the help of networks (governance through networks). Changing the structure of a particular network may very well also affect the actors who constitute this network. And attempts to govern a social entity (e.g., a team of co-workers, an organization, a political unit) with the help of network relations by changing the characteristics of network actors may then also affect the structure of the network that is being used for networked governance and thus render the continuation of this governing activity more or less difficult.

This chapter continues with a discussion of the concept of diffusion and how the study of policy diffusion has developed from a network-science perspective. Then, it explains why influence and selection mechanisms should be combined for analyzing policy diffusion. This holds true particularly if diffusion is defined as a process of connected elements becoming more similar over time. Whereas traditional SNA methods fail to distinguish between influence and selection, recently developed SAOMs allow for this analytical distinction.

After presenting SAOMs and their main assumptions, the final part of the current chapter provides an illustrative example of what has been laid out up to this point. I demonstrate how to make use of a network-based approach to study diffusion when diffusion channels are endogenous to the potentially diffused variable and illustrate the potentials of SAOMs for diffusion research with an example from comparative political research. To the best of my knowledge, Manger and Pickup (2016) published the first SAOM with simultaneously evolving international relations and a potentially diffusing country-level variable. Whereas the two authors studied trade agreements and democracy, the example that I present covers the diffusion of

FTP via endogenous bilateral trade flows. This is motivated by the observation that countries' openness to international trade resembles that of their important trading partners. My results suggest that this similarity is not so much due to diffusion but rather to countries selecting similar trading partners. On the basis of these results, *governance of (trade) networks* seems possible because decision-makers appear to be able to influence the international trade network's structure by determining domestic FTPs. However, these results do not indicate the feasibility of *governance through trade networks*, that is, the intended spill-over of particular countries' FTP to their trading partners.

Let us now turn to some conceptual clarifications: What is policy diffusion?

2 What Is Policy Diffusion?

Diffusion induces similarity. This affects, for example, individual behavior and attitudes such as health-related habits and conditions as well as social norms and the technology used in industrial production or warfare. Policy diffusion specifically deals with the spread of political events, policies, institutional settings, as well as the way in which political authority is organized within a country.[3]

Studies on policy diffusion have originated from research on the diffusion of technological innovations. Rogers (1983), the classic introduction to the diffusion of innovation since its first publication in 1963, referred to several diffusion studies from the very early twentieth century but honored Ryan and Gross (1943) as "one of the most influential diffusion studies of all time" (1983, p. 32). Ryan and Gross (1943)—who asked why certain farmers started using hybrid corn seeds earlier than others—are acknowledged to have conducted the first diffusion study with a focus on innovation. Subsequently, Coleman et al. (1966) were the first to study the diffusion of an innovation based on interpersonal networks. They asked physicians about their professional networks and whether they had prescribed a new drug. The point was to find out to which extent those physicians prescribing the new drug earlier were personally connected at that time. In short, the policy-diffusion literature often treats policies as innovations that certain actors adopt but others do not. Several authors have reviewed the central publications in this area of research. Holzinger et al. (2007b) addressed policy diffusion, transfer, and convergence in political science in general. Karch (2007) focused on the literature on diffusion among US states. Stone (1999), Gilardi (2012), and Solingen (2012) published comprehensive reviews from the perspective of international relations (IR).

Diffusion in a broader sense is "a consequence of interdependence" (Gilardi 2012, p. 454). In a connected world, things existing and events happening at a

[3]This list describes various examples of policy diffusion that would be more accurately described as "polity diffusion," such as institutional settings or the national legal organization of political authority. I nonetheless use the term "policy diffusion" when referring to all of these examples (cf. Gilardi 2012; Solingen 2012).

particular place might affect things and events in other places. The increasing similarity of connected places constitutes the main feature of diffusion (see, for example, Rogers 1983, p. 5 or Stone 1999, p. 52).

Policy diffusion differs from policy convergence (Holzinger et al. 2007a). Studies on *policy convergence* deal with similarity as a result. They describe the similarity itself and not so much the process that leads to this similarity. By contrast, studies on *policy diffusion* analyze processes leading to similarity. Its authors look particularly at interactions and specific interdependences of elements that render them more similar to each other. Any relation or connection that allows for a meaningful exchange between elements qualifies as interdependence in this sense. Structural connectedness is used as a different term for such a scenario. Policy diffusion, according to its narrow definition (Holzinger et al. 2007a, p. 14), is a "process by which an innovation is *communicated through certain channels* over time among the members of a social system" (Rogers 1983, p. 5, emphasis added). This narrow perspective therefore interprets the presence of certain connections as interdependence. This interdependence is further expected to be crucial for an exchange between elements and for their increasing similarity. Stone (1999, p. 52), for example, referred to this interdependence with her claim that "'policy convergence' and 'policy diffusion' (. . .) give an impression that transfer arises as a consequence of structural force."

In short, the concept of policy diffusion describes and explains the geographical spread and the spatial distribution of ideas or policies in general as well as of regime characteristics, including democracy. Diffusion studies particularly emphasize similarity owing to connectedness. In this context, the concept of "connectedness" and the term "spatial" imply more than geography (Beck et al. 2006). They relate to all sorts of connections between sociopolitical entities and territorial units, such as trade, military alliances, or diplomacy.

Various theories explain policy diffusion. Each theory builds on another explanation of why connected elements become more similar—competition, learning, and emulation being the most popular causal mechanisms. With respect to diffusion as a process involving countries, Gilardi (2012, p. 461, emphasis added) defined these mechanisms as follows: "*Competition* means that countries influence one another because they try to attract economic resources; *learning* means that the experience of other countries can supply useful information on the likely consequences of a policy; and *emulation* means that the normative and socially constructed characteristics of policies matter more than their objective consequences."

Other theories offer alternative explanations of the similarity of connected elements and, hence, challenge the explanatory power of diffusion theories. Selection is such an alternative explanation of connected elements' similarity (see, for example, Brinks and Coppedge 2006, p. 474 f. or Steglich et al. 2010). It features as part of the influence-and-selection framework, which will be presented later in this chapter.

However, there are more alternatives. Volden et al. (2008), for example, argued that game-theoretical models raise doubts about the claim that increasing similarity

of connected entities must owe itself to diffusion. Their models showed similar results for elements that are not connected with each other but learn from their own experience. This explanation comes with the assumption that non-connected elements tend to behave similarly if they resemble each other in general. Cao (2012, Appendix 4) seems to support this explanation. He reported that in his latent-space models, which control for diffusion, country pairs show greater similarity with respect to domestic policy choices if they have similar regime types. The special issue edited by Holzinger et al. (2007b) contains other contributions that differentiate similarities induced by structural connectedness (diffusion) from similarities based on independent learning or coercion.

The difficulty of employing ex-post-facto designs and cross-sectional data to distinguish between structurally induced diffusion, similar but independent reactions to identical external shocks, and internal effects is widely known as "Galton's problem." It has been repeatedly acknowledged by comparative political scientists and by diffusion scholars (see, for example, Ross and Homer 1976, Franzese and Hays 2008, Franzese et al. 2012, or Gilardi 2012, p. 453).

Altogether, my definition of diffusion follows the narrow approach. This definition invariably includes a specific interdependence among a set of elements. Defined as such, diffusion focuses on interconnected entities becoming more similar over time. The connections between elements function as channels and conjure the image of something being transported and exchanged between individual connected elements via these paths. The definition leaves open what exactly these channels are and which mechanisms they refer to—competition, learning, or emulation. However, note that I do not treat coercion or other mechanisms that are by definition based on hierarchical relations as diffusion mechanisms. Thus, I restrict the concept of diffusion to horizontal interdependences. This decision follows Gilardi (2012, p. 454).

3 Studying Diffusion by Applying a Network Approach

There is more to diffusion than similarity among geographic neighbors. As discussed above, diffusion depends on structural interdependences that enable communication or interaction. Therefore, non-geographic connections should matter as well if they enable interaction and communication. By now, it is widely accepted among political scientists that "space is more than geography" (Beck et al. 2006) and that one should "move beyond the focus on the impact of geographic proximity" (Karch 2007, p. 72) for explanations of diffusion.

I suggest employing network analysis to move beyond geographically defined diffusion channels. All kinds of connections and dependences between individual or collective actors, political units, or organizations can be captured using a network approach. A formal understanding of networks and the research paradigm of social network analysis (SNA) offer a well-established conceptual, theoretical, and methodological framework to study not only the connections themselves but

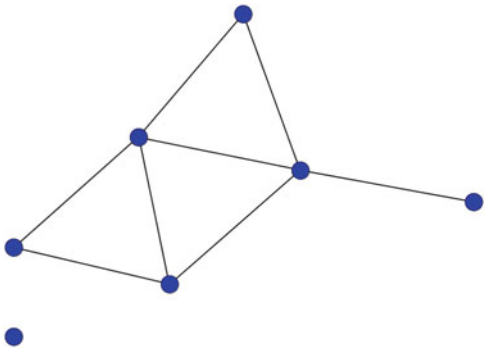

Fig. 1 Small network composed of seven vertices and eight edges

also policy diffusion along connections beyond geographic proximity (see, for example, Marin and Wellman 2011).

I think of *networks* as formal models summarizing connections among entities. Thus, a basic network as in Fig. 1 can be defined as "(. . .) a collection of points joined together in pairs by lines. In the jargon of the field the points are referred to as [*actors*,][4] *vertices*, or *nodes* and the lines are referred to as [*ties* or] *edges*" (Newman 2010, p. 1; words in square brackets are my addition). I use the term *network analysis* to refer to a quantitative research tradition aiming at the formal description and analysis of vertices and their connections with each other. Social network analysis is the "structural analytic paradigm" (Wellman 1988, p. 21) that applies formal network analysis to the realm of social science. Hence, I suggest the term *network diffusion* for a concept that allows us to focus on spatial effects of all sorts through a network-analytical lens.[5] As such, the concept captures various relational variables and their diffusion effects as a comprehensive process. That way, all social and political networks are potential candidates for such a network-diffusion effect.

Network diffusion encompasses diffusion via different relations. Relations qualify especially if they allow connected actors to interact with each other and, in the words of Marin and Wellman (2011, p. 18), if something flows through their "pipelines." With respect to interstate diffusion, examples of possible relations are trade, joint memberships in organizations, or military alliances between states. Diffusion at the level of individuals may occur between those living next door to each other or in the same neighborhood. It could as well affect the members of a clique of friends or people who are connected through kinship ties.

Various "things" appear to diffuse via network relations. SNA practitioners have addressed things as different as, for example, information about jobs, social

[4]The terms *actor*, *vertex*, and *node* as well as *tie* and *edge* are synonyms with respect to network analysis. The vocabulary mainly differs between academic disciplines.

[5]Jackson (2008) speaks of "diffusion within networks." I prefer the shorter term "network diffusion" but make no claims as to conceptual differences.

support, workplace identity, disease, or knowledge of culture (cf. Marin and Wellman 2011, p. 18). At the international level, diffusion studies have dealt with topics such as the spread of democracy (e.g., Gleditsch and Ward 2006) among others. Martin's (2009) study on cigarette taxation in the United States is an example of research on subnational policy diffusion.

I will now review the methods that SNA has used in studying diffusion phenomena. For that purpose, I draw on detailed summaries of the field's development, particularly on Valente (2005), Jackson (2008, pp. 185–222), and Kadushin (2012). This overview will be followed by an introduction of selection and influence mechanisms. I will argue that many diffusion analyses should address influence as well as selection simultaneously. Whereas older network methods applied in diffusion studies did not and were not able to differentiate between these two mechanisms, stochastic actor-oriented co-evolution models make this possible. Now that we have considered SNA and diffusion in general as well as within networks, let us turn to the methods for studying network diffusion.

3.1 Development of the Study of Diffusion from a Network Perspective

In this subsection, I sketch different methods that have been used to study diffusion in the context of networks. I focus on the major methodological steps that Valente (2005) has identified (see methods 1–3 in Table 1): the Bass model, measures of spatial autocorrelation applied to networks, and exposure models. Then, I introduce network–behavior co-evolution together with stochastic actor-oriented models, which are not addressed in the overviews by Valente (2005) and Jackson (2008).

First, the *Bass model* predicts the percentage of social actors that have adopted a certain policy y_t by time t (Bass 1969). It disaggregates the overall rate of adoption into innovation p and imitation q as shown in the following equation in the notation of Jackson (2008, p. 187):

$$y_t = y_{t-1} + p(1 - y_{t-1}) + q(1 - y_{t-1})y_{t-1}.$$

Figure 2 shows cumulative adoption rates based on Bass models with different rates of innovation and imitation. As can be seen from these curves, the Bass model

Table 1 Methods for studying diffusion from a network perspective

Method	Important feature
1. Bass model	Diffusion over time due to cumulative imitation and innovation
2. Network autocorrelation	Diffusion due to convergence of "neighbors"
3. Exposure models	Diffusion due to adoption on the basis of an actor's network position
4. Co-evolution models	Diffusion via connections that change endogenously

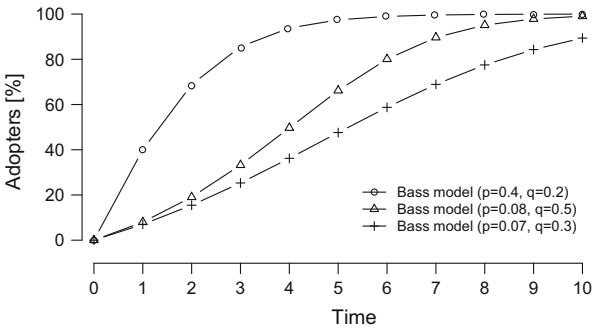

Fig. 2 Cumulative adoption curves from Bass models simulated with different rates of innovation (p) and imitation (q). The simulations start at zero percent adoption at time $t = 0$

is able to capture different diffusion processes, for example, the well-known *S*-shaped cumulative curve of adoption.

An *S*-shaped curve represents many empirical diffusion processes (Rogers 1983, p. 243): At the beginning of a diffusion process, only a few elements have adopted a decision, and, period by period, a small but over time increasing number of new adoptions occur. The adoption speed increases and then levels off again once almost all actors have adopted the innovation. The Bass model explains this specific diffusion process by small rates of innovation and relatively larger rates of imitation: it is easier to copy somebody than to independently come up with something new. The Bass model is a macro model that lacks a deeper notion of social structure. Therefore, it is not an appropriate model of network diffusion. It captures structure only insofar as it represents the aggregate effect of actors imitating each other. The model identifies neither individual adopters nor who imitates whom. For each actor who has not yet adopted the innovation, it assumes an identical probability of imitating others. Such a diffusion model would only be plausible if all elements of a social system were homogeneous and fully connected.

Second, *network autocorrelation* combines attributes with structure. The concept combines information on who has and who has not yet adopted a certain innovation with information on who is connected with whom. Network autocorrelation coefficients quantify the average similarity of those network actors who are connected.

Moran's I is a popular autocorrelation coefficient (Moran 1950; cf. Greene 2012, p. 431). Originally, it was used to determine geographic clustering. This means determining to which extent geographically contingent or proximate entities are similar to each other and jointly different from the overall average. Moran's I introduces a distance matrix—originally of geographic distances—into a formula of autocorrelation. To calculate I, one needs information about the variable of interest and the weight matrix measuring connections between all possible pairs of actors. Moran's I varies between -1 and $+1$ (perfect negative or perfect positive network autocorrelation).

An example of such a variable of interest would be GDP measured for a set of countries. As an example of a weight matrix, imagine a matrix with the same countries in the rows as well as in the columns. In this matrix, each cell could

contain binary information on how close two countries are located geographically. Network autocorrelation, then, would measure the average similarity of the GDP of country pairs that are directly connected through geographic proximity.

In spatial analyses, Moran's *I* is used to assess the amount of spatial autocorrelation of variables (see, for example, Anselin 2001, Getis 2010, p. 26 f., or Ward and Gleditsch 2008). Yet the advantage of Moran's *I* is its general applicability beyond geospatial clustering. It is applicable to any network because geographic contiguity can conceptually and mathematically be replaced by actors' direct connectedness within a network. In diffusion studies, Moran's *I* is one possibility of measuring the average similarity of connected actors or elements at specific points in time (see, for example, O'Loughlin et al. 1998 or Steglich et al. 2010).

The disadvantages of Moran's *I* and other autocorrelation measures are the following: From a diffusion perspective, they do not condition individuals' probabilities of adoption on their structural network positions and the character of their personal networks. All they measure is the average similarity of connected elements at a specific point in time (Valente 2005, p. 101). They are descriptive tools only and were never intended for modeling diffusion processes.

Third, *exposure models* brought a true network perspective to diffusion research. Valente (2005, pp. 101–104) described their basic logic as follows: Among the actors in a complete network, some early adopters or inventors are externally determined. After this initial stage, the spread of the innovation is modeled as something that travels through the network from neighbor to neighbor. The probability of whether a network actor will adopt the innovation is determined by his or her direct and indirect connections and how many of his or her direct or indirect network neighbors are adopters themselves. Valente et al. (1997), for example, applied exposure models to empirical, cross-sectional data. Using these models, they studied the spread of contraceptive practices among women. They found that a woman's personal network and her contacts to medically trained professionals affected her decision to use contraceptives. Exposure models can also take on the form of event-history models. Exposure models of an event-history type explain the time it takes for social actors or other elements of a system to adopt a certain innovation. Valente (2005, p. 109 ff.) provides more background information on diffusion applications of event-history models.

Network diffusion studies make use of *additional models* besides the canonical ones presented so far. For example, the spread of infectious diseases through personal networks is often studied by applying a rather unique set of methods. Before turning to co-evolution models in the following sections, I will briefly address such alternatives.[6]

In general, the diffusion within a network depends on its connectedness and on how well its actors can reach each other. Put another way, by definition nothing can diffuse between unconnected parts of a network. Various structural properties of

[6]For a more comprehensive treatment of these and additional alternative models, see, e.g., Jackson (2008).

networks determine the probability that something randomly moving via network connections reaches all or a certain share of all network actors. For example, if a network is rather sparse or consists of multiple disconnected parts, diffusion via network connections, if not altogether impossible, is less likely to affect all actors.

Making use of such structural laws, Jackson (2008, pp. 193–195) discussed how a network can be manipulated in a way that diffusion becomes less likely. For example, vaccination campaigns aim to prevent the spread of diseases, or security forces seek to restrict the ability of criminal organizations to communicate effectively. In both scenarios, a general strategy can be to decrease the size of the network's largest component.[7] This implies breaking the largest subset out of a network in which each actor is directly or indirectly connected with all other actors. Bearman et al. (2004), for example, studied the spread of sexually transmittable diseases (STDs) within human sexual networks. Since the observed networks turned out to be well connected and coherent, the authors suggested relying on broadcast diffusion techniques to induce structural breaks in the network that could slow down the future spread of STDs.

This subsection has briefly summarized the development of studying diffusion within networks from a social-network perspective. Such a concept of diffusion extends to things as different as the spread of technical innovations, behavior, attitudes, as well as infectious diseases. Then network autocorrelation was introduced. It describes the similarity of those actors that are connected through a network. In and of itself, the concept of network autocorrelation remains a fundamentally static one.

Exposure models provide a first step in explaining how the position of an actor in the network and the overall network structure affects this correlation of network neighbors' characteristics. This approach already makes use of a dynamic perspective, which is necessary to properly address a dynamic process such as diffusion. The following subsection deepens the discussion of how and when the similarity of connected actors can be treated as the result of a diffusion process within a network.

3.2 Network Autocorrelation as the Potential Result of Selection and Diffusion

There are shortcomings with the analytical procedures described in the previous subsection. Even the exposure models presented by Valente (2005) treat the structure of the network as exogenously given or even as fixed over time. They calculate individual exposure levels for each actor contributing to a contagion process for the whole network. Again, the connectedness and non-connectedness

[7] For non-directed networks, Wasserman and Faust (1995, p. 109) provide the following definition of components: "The nodes in a disconnected graph may be partitioned into two or more subsets in which there are no paths between the nodes in different subsets. The connected subgraphs in a graph are called components."

of certain pairs of actors is not modeled. This may work well for network relations that are not likely to change over time—spatial contiguity of countries at certain periods, for example. However, if the ties represent a relationship that is likely to change and evolve over time, this assumption seems to be an unwarranted simplification. Unfortunately, most of the relations of interest to social scientists belong to this second category of variables that are subject to change: for example, friendship within a school class, formal hierarchies and patterns of advice-seeking within an organization, or military alliances between countries.

In short, in many social contexts we find that connected actors tend to resemble each other more than unconnected actors. Their resemblance is also stronger than one would expect if actors' characteristics were randomly distributed. On the basis of these findings, one might be tempted to assume that being connected and being similar is causally related. However, network autocorrelation can be the potential result of selection and diffusion (also referred to as "influence" in this text). It can result from changes of network connections or from changes of actors' attributes. The observation of similarity among connected elements does by itself not necessarily imply an underlying diffusion mechanism because selection mechanisms could also produce the same cross-sectional phenomenon.

Selection, on the one hand, implies that "similarity breeds connection" (McPherson et al. 2001, p. 415). Selection mechanisms explain the similarity of connected elements with changes in the network structure. States change their connections in such a way that they are connected with similar others. They select others based on the principle of homophily (McPherson et al. 2001).

Diffusion or influence, on the other hand, implies that similarity or dissimilarity follows from connectedness. Related mechanisms explain the similarity of connected elements by changes as a result of connected network actors mimicking or adapting each other's characteristics (Friedkin 1998, 2001; cf. Steglich et al. 2010). The terms influence and diffusion are more or less congruent as both concepts are often assumed to induce convergence.

Figure 3 illustrates the difference between selection and influence. For an imagined network consisting of four actors, A, B, C, and D, the three sociograms represent snapshots taken at two points in time, $t = 0$ and $t = 1$. The two sociograms taken at $t = 1$ represent two different possibilities of how the network could have evolved from the initial state ($t = 0$). At the initial state (Fig. 3a), actors A, B, and C

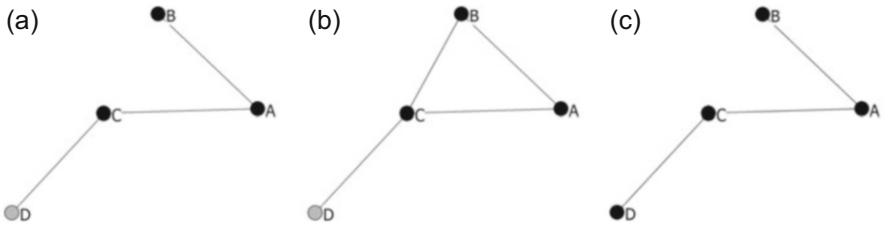

Fig. 3 Difference between selection and influence mechanisms. (**a**) Initial state ($t = 0$). (**b**) Selection ($t = 1$). (**c**) Influence ($t = 1$)

belong to one category (e.g., democratic countries) and actor D to a second group (e.g., non-democracies). Some of the actors are connected with each other. If the connection between actors B and C was created after the first snapshot had been taken, the process leading to this change would qualify as selection (Fig. 3b). If, by contrast, actor D changed the value of this attribute from non-democratic to democratic, this would qualify as the result of an influence mechanism (Fig. 3c). As a result of either influence or selection, more connections between actors of the same type exist, although this pattern might evolve out of two distinct processes.

It is crucial to understand that the process of diffusion can be rephrased as an influence mechanism affecting actors within a network. Therefore, if we want to study diffusion, and if we assume, in particular, that the observed similarities among connected actors are the result of a diffusion process, we should simultaneously address selection effects whenever they appear plausible. Robust claims of diffusion leading to the similarity of connected actors should be tested for possible selection effects.

Most exposure models fail to control for selection effects and thus are limited to telling only half the story. While they may well address influence effects, they cannot model selection at the same time because network structure is exogenous to the model. I will illustrate this using two examples already introduced above.

In Valente's (1997) study of the diffusion of contraceptive practices, he expected those women to use contraceptives who had many close contacts with others who also did. Drawing on an exposure model, he showed that individual behavior diffuses via personal networks. In short, he expected and found an influence mechanism that accounts for positive network autocorrelation. The model that the authors used treated these personal networks as exogenously given. Furthermore, they only observed network and actors at one point in time. Hence, the model failed to take into account the possibility that new close contacts can evolve over time and some pairs might have experienced disagreements and conflict and no longer trust one another. It seems possible that women who independently started using contraceptives became connected with each other through their common practice. It might even have been the case that after some women heard about the innovation for the first time, the early adopters became very popular and, because of that, closer interpersonal contacts were established with them in order to provide access to the contraceptive innovation.

As a second example, I refer to typical human reactions to the outbreak of a disease. Here, the diffusion process itself can affect the network within which it occurs (cf. Jackson 2008, p. 208). Individuals are likely to change their behavior and their personal networks if they become aware of epidemic outbreaks of dangerous diseases. For example, people stay at home, wash their hands more often, start avoiding what is thought to be infectious, or take preventive medication.

As an alternative to the network models presented so far, I suggest studying diffusion within networks using stochastic actor-oriented models. These models are specifically created to disentangle influence and selection effects and will be presented in detail in the following subsection.

3.3 Stochastic Actor-Oriented Models

SAOMs simulate simultaneous tie formation and actor-level—so-called behavioral—change within networks. In other words, they allow one to model the co-evolution of a network and a dependent actor covariate, an attribute measured for all network actors. The method is explained by Snijders (2001, 2005) and Snijders et al. (2010), and the RSiena software package has been designed to implement it (Ripley et al. 2015). Snijders et al. (2007) and Steglich et al. (2010) discussed co-evolution designs that allow the analysis of simultaneous changes in a network and of one dependent actor covariate. SAOMs thus make it possible to jointly estimate changes of network connections and changes of a variable measured at the monadic or actor-level of analysis—and, most importantly, both dynamics can interact. For the estimation of such network–behavior co-evolution, SAOMs are considered "state of the art" (Franzese et al. 2012, p. 185).

According to Snijders et al. (2007), SAOMs are able to address the co-evolution of network connections and variables at the network-actor level of analysis. They allow scholars to study network diffusion while at the same time controlling for possible selection mechanisms. In addition to this basic type of SAOM, an extension by Greenan (2015) is available that is specifically tailored to studying the diffusion of innovations. These extended SAOMs produce results for a dependent behavior variable that can be interpreted similarly to results from proportional hazards models (O'Quigley 2008). This model extension, however, is limited to dependent, potentially diffused variables that can take two different values: zero if a social actor has not adopted the innovation yet and one if an actor has already done so. The only possible changes of this variable are changes from a state of not having to one of having adopted the innovation under study. Once an actor has adopted the innovation, she or he will not be able to forget it, give it up, or be deprived of it in the future.

The concept of policy diffusion often relates to connected actors or entities that become more and less similar over time. Often the alleged diffusion mechanism could lead to an increase or decrease in the dependent variable. As an example, Martin (2009) showed how US states have changed their cigarette taxes according to the level of taxation that they observed in other US states. This can lead to either higher or lower taxes within individual states. Therefore, SAOMs of the basic type (Snijders et al. 2007) appear to fit most instances of policy diffusion better than the model extension by Greenan (2015).

Hollway (2015) extended SAOMs in another direction to address co-evolution in the context of multilevel networks. He proposed M-SAOMs as models of policy diffusion within a network connecting actors at two different levels. Using this extension, Hollway studied the diffusion of legislation and regulation within networks of states (level 1) and between regional fisheries management organizations (level 2).

The following paragraphs present the simulation of network and behavior co-evolution using SAOMs of the basic type proposed by Steglich et al. (2010). This presentation focuses on the main model assumptions that Snijders et al. (2010,

p. 45 ff.) emphasized. These assumptions are panel data, continuous time, incremental changes in ministeps, Markov process, actor-basedness in combination with actors' being fully aware of their network and having complete control over their ties. Two separate processes then determine the opportunity for change and the particular incremental change. Finally, SAOMs are stochastic.

Panel data allow for the simultaneous estimation of the co-evolution of several dependent variables. All variables must be observed at multiple points in time. SAOMs are always conditioned on the first available observation. Hence, the values of the dependent variables at the first point in time are not explained but rather only those subsequent changes between consecutive observations (Snijders et al. 2010, p. 46).

Moreover, SAOMs build on the assumption that the panel data observed at specific points in time are single snapshots of a continuously evolving process. If we observe the same set of actors and their connections with each other repeatedly over time, we do not know what has happened between the observed moments. When dealing with panel data, one has to consider the possibility of potentially drastic changes that have remained unobserved because of an equally unobserved subsequent reversal. SAOMs approach the possibility of such changes that may have escaped observation between observed panel waves via the *continuous-time assumption*. This assumption states that between each pair of consecutive observations an unknown and theoretically unlimited number of ministeps will have occurred. The sequence of these ministeps is assumed to transform the frozen image captured at one point in time into the constellation observed in the subsequent snapshot.

By definition, only one single *incremental change* is possible during each ministep: Only one actor has the possibility to change one bit of his ego network. In a co-evolution model, he or she can either establish one single new link, dissolve one existing tie, change his value of the dependent actor covariate by one unit, or just do nothing. The caveat of this assumption is that SAOMs cannot directly model coordinated or collective action. Yet this assumption allows one to model complex changes with relatively simple effects or assumptions about a specific process by decomposing these changes into their smallest possible bits and pieces.

The incremental changes of a series of ministeps are modeled as a *Markov process*. This implies that for each ministep the subsequent change depends on the current state alone. The current state's history is assumed to have no additional impact on future changes if the current state is controlled for.

SAOMs are *actor-oriented* in the way that individual as well as structural changes are modeled as if they were the result of individual actors' decisions. This does not imply an assumption about purposeful action of network actors (Snijders et al. 2010, p. 46). However, such an assumption would still be in line with the model setup: network actors could be conceived of as acting within the constraints of the network structure. This comes close to the assumptions about reality made by structural individualism (Udehn 2002; cf. Snijders et al. 2010).

Network actors *fully control* not only their own behavior but also the ties they send to others. What this assumption implies is that if actor i sends a tie to j, this

decision and the establishment of the *ij* link does not depend on *j*'s consent. It is further assumed that all network actors have *complete information* about the network, its actors, and their connections. Actors decide what to do if they are offered the opportunity to take a ministep on the basis of their evaluation of their own characteristics, the characteristics of other network actors, and the present network structure.

A Gumbel-distributed error term introduces randomness into the simulations of SAOMs. This built-in noise can be interpreted as reflecting unexplained influences and covering real-life randomness (Snijders 2001; Snijders et al. 2007). The Gumbel-distributed noise, which is included in SAOM algorithms in several ways, renders these models more realistic than a similar model with either no error term or a normally distributed one. I consider SAOMs with errors drawn from a Gumbel distribution to be more realistic because larger values are more likely under this distribution than under the standard normal distribution. Additionally, the expected value of a Gumbel-distributed variable is not zero but positive.

SAOMs simulate changes within ministeps by using two consecutive algorithms that are both executed, one after the other, during each ministep: first, the change-opportunity process and, second, the change-determination process.

The change-opportunity process is the first part of each simulated ministep. In this part, one network actor is selected and provided with the opportunity to make an incremental change. The process is modeled using the rate function from which waiting times are derived (Snijders 2001, p. 382 ff.). Given a co-evolution design, two waiting times are calculated for each actor: one for a potential network change and one for a potential behavior change. Each waiting time results from a different rate function. This twofold process determines which actor is given the opportunity of either a structural or a behavioral change.

Both waiting times are exponentially distributed. Waiting times are always conditioned on a stochastic error term, which must be included in each parameter vector. Researchers can condition the waiting times on additional variables as well, such as the present state of the network (Snijders 2001, p. 383). However, for most SAOMs, waiting times are equally distributed between all actors and are only affected by their stochastic error terms.

In each ministep, the actor with the shortest sampled waiting time is then presented with the opportunity to change either a tie value or his value of the dependent actor covariate. After a particular action has been decided by the change-determination process, a new ministep begins and new waiting times are calculated for all actors.

The change-determination process is the second part of each simulated ministep. After an actor has been given the opportunity to change, her/his particular choice is determined. An independently modeled process determines this choice on the basis of the present state of the network including characteristics of actors, dyads, and present network connections between actors. The *choices of actors* are modeled by employing the so-called *objective function* or *evaluation function*.

Stated intuitively, SAOMs look for sequences of ministeps (more precisely: sequences of changes and non-changes) that start at one observed period and

produce patterns that are similar to the network observed in the following period. In the case of a co-evolution design, this also includes simulated values of the actor-level variables which, in the end, are similar to observations of the dependent actor covariate. These sequences of changes and non-changes are found through repeated simulations.

What happens during a ministep partly depends on so-called *effects*. These are independent variables that—together with their parameters and the stochastic error term—make certain changes of the network and the dependent attribute more or less likely. The parameter values constitute the result of a SAOM and are obtained by fitting the model to the observed data.

The effects that enter a particular SAOM should be chosen on theoretical grounds. RSiena's user handbook (Ripley et al. 2015) provides a list of all possible effects together with their mathematical definitions. Here I will only list and describe important categories of effects. Effects can be classified according to the level of analysis at which they are measured and as to whether they include endogenous structural or exogenous variables.

Some of the effects that SAOMs can include are located at the network level, such as density or structural equivalence. Effects at the triadic level include measures of transitivity and generalized exchange. Dyadic effects cover such aspects as reciprocity. At the monadic or actor-level of analysis, SAOMs can, for example, include degree or actor-level covariates, such as a person's age in years in the context of a friendship network.

Another important grouping of effects is the distinction between structural effects and effects related to exogenous (dyadic or monadic) variables. On the one hand, SAOMs model changes and non-changes between two observed states of a network on the basis of the network structure observed at the first stage. This network structure is assumed to be the result of past tie-formation processes. Thus, tie changes attributed to one actor depend on previous changes made by other actors. The individual tie changes are not independent of each other. As such, structure and structural change are endogenous to the current state of the network.

On the other hand, SAOMs can condition an actor's probability of receiving ties on an exogenous variable. For example, more experienced co-workers are asked for advice more often than their younger colleagues. In this case, experience is an exogenous variable, which is not affected by other covariates and is not explicitly modeled itself.

Parameters from SAOMs can be estimated applying the "method of moments (MOM) estimation routine." Parameter estimates are approximations obtained by Markov chain Monte Carlo (MCMC) simulations (see the explanations by Snijders 2001, p. 390 ff.). As an alternative to the MOM routine, a maximum likelihood and a Bayesian estimation method have also been developed, but the MOM routine is implemented as the default method in the RSiena software package.

The MOM routine involves an iterative estimation procedure (Snijders 2001, p. 372 ff.; Snijders et al. 2007). In each run, series of ministeps are calculated to simulate the observed network and the values of any other endogenous variables. The estimation procedure compares statistics based on the observed variables with

statistics derived from the simulated variables. With incremental changes to parameters used in the previous simulation run, the algorithm attempts use the simulated statistics to approximate the observed ones as closely as possible (Ripley et al. 2015, p. 55 ff.). Algebraic solutions for SAOMs are unavailable due to the model's complexity (Snijders et al. 2010, p. 356).

To repeat it for greater clarity, SAOMs approximate the parameters of the included effects as follows: An MCMC algorithm starting with the first observed state determines the change frequencies via the rate functions and the directions of change via the objective functions. The simulated sequence of ministeps ideally ends when the last observed state has been reached. Through repeated simulations, the values of the parameters are updated in such a way that the average values of the included effects calculated on the basis of the simulated network and the simulated behavior are reasonably close to the empirical values of the network and the behavior variable at the observed time points.

3.4 Where Are We Now?

Diffusion has been introduced as a process leading to an increased similarity of connected elements. Usually, diffusion arguments state that being connected causally determines that connected elements interact, engage in physical or cognitive exchanges, and adopt traits from one another.

SNA is one possible approach to the study of diffusion. In fact, SNA appears to be a natural way to approach diffusion. This follows from the fact that diffusion and its drivers are relational concepts and that network analysis deals with such concepts in particular. As the short review of SNA has shown, there is a well-established tradition of analyzing the diffusion of technologies, innovations, attitudes, or infections within a social-network perspective.

Diffusion and changes in the network structure may both induce similarity among connected elements. If our goal is to attribute such a positive network autocorrelation to diffusion, we should also look at the possibility of these structural changes being present. If possible, influence and selection mechanisms should be analyzed together, for example, by using stochastic actor-oriented models.

Two problems arise when explaining network autocorrelation by influence mechanisms without addressing potential endogenous selection processes. First, similarity through selection cannot be ruled out. Second, the parameter estimates of the influence mechanism are likely to be affected by a simultaneous equations bias. This form of bias may arise as influence effects depend on present network ties and the model neglects potentially endogenous changes of these ties. Thus, causality may go both ways between the dependent variable and a so-called independent variable. If network panel data are at hand and if the alleged diffusion channels change over time, an informed quantitative analysis of diffusion should apply a co-evolution design. This is the main argument of this chapter. SAOMs specifically provide a means of jointly testing hypotheses of influence and selection.

Before proceeding with an illustrative application of SAOMs, let us compare one more time the view on networks from the perspectives of co-evolution designs and the networked governance literature. Networked governance, as defined in the introduction to the book at hand, tends to treat governance networks as consisting of homogeneous actors. All actors are assumed to have similar or identical interests, and power is exercised, if at all, by the network or from within the network towards the environment. In contrast to this perspective, co-evolution designs based on SAOMs focus entirely on networks consisting of actors and their relations with each other. Nothing is studied that is disconnected from networks and that is supposed to be governed by or from within networks. This, of course, is based on the definition of networks as a set of actors, their attributes, and their connections with each other. If all relevant actors, their characteristics, and their connections with each other are captured in terms of SNA, co-evolution designs allow us to approach questions of governance in a way that differs from the networked governance literature as defined in the introduction. Co-evolution designs introduce the possibility, and provide a way of empirically modeling it, that connections and actors change simultaneously and that changes of either actors or connections may result in changes of the other. Therefore, such a perspective goes beyond a notion of network connections as exogenous, given, or even static tools that can be used by members of a network to manipulate others in a certain way. I now turn to a demonstration of how SAOMs and co-evolution designs can be applied to study global diffusion processes between countries.

4 Diffusion of Countries' Foreign Trade Policies via International Trade

In the following paragraphs, I apply SAOMs to the simultaneous formation of ties and behavioral changes. In so doing, I demonstrate a way of studying the co-evolution of international relations and national political characteristics, which allegedly diffuse along these relations. In this application, I look at the potential co-evolution of international trade and national foreign trade policies by drawing on joint work with Christian W. Martin (Martin and Mohrenberg 2015; Mohrenberg 2014). This application is intended as an illustration of how SAOMs and a co-evolution design can be used for studying policy diffusion when diffusion channels are endogenous to the variable under study. It is not meant as a thorough empirical analysis; rather, the remainder of this text is to illustrate what has been laid out in the previous sections.

I measure *trade* between countries i and j from i's perspective on the basis of the sum of their bilateral trade within a given year. This sum is divided by the total of i's trade with all other countries (cf. Martin and Schneider 2007). I interpret this i–j flow as the economic importance that i attributes to j. That is, the trade relations between all possible pairs out of n countries are contained in matrix $T = \left(t_{ij}\right)_{i,j=1}^{n}$ with $t_{ij} = \frac{imports_{ij}+exports_{ij}}{\sum_{h=1}^{n} imports_{ih}+exports_{ih}}$ ($i \neq j$ and $i \neq h$).

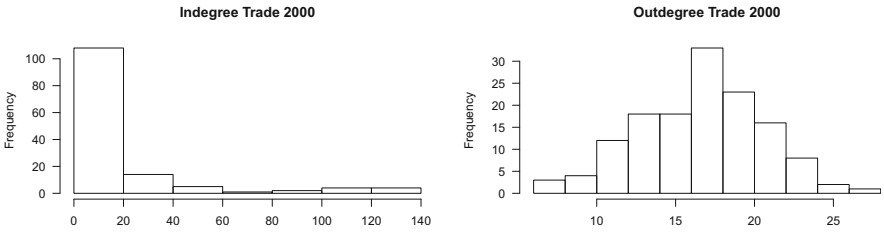

Fig. 4 Histograms of the number of countries' important trading partners (outdegree) and the number of countries for which a focal country constitutes an important trading partner (indegree). This only includes data from 2000. Histograms for 1995 and 2005 look similar

For the following SAOM, the trade variable is based on data from Barbieri et al. (2009) and Barbieri and Keshk (2012). It is dichotomized using a threshold of 0.01. According to this operation, j constitutes an important trading partner for i if the overall i–j trade contributes to more than one percent of i's total foreign trade, that is, if $t_{ij} > 0.01$. This threshold of one percent is a somewhat arbitrary choice, but it appears as a plausible one considering the following:

First, the choice of the one-percent threshold creates a plausible indicator of important trade. Univariate distributions derived from the variable that is dichotomized according to this one-percent rule confirm my intuitive expectation of important trade relations (see Fig. 4). On the one hand, the distribution of countries' number of important trading partners obtained from this specification confirms the intuitive expectation that the number of important trading partners per country should be relatively small. On the other hand, the distribution of the number of countries for which a particular country constitutes an important trading partner is positively skewed. This skew implies that most countries do not constitute an important trading partner for any other country while a small number of countries is important to a large number of alters.

Second, different thresholds produce results that are similar with respect to the variables of interest. Results from a SAOM (see Table 2) are robust to alternative operationalizations of important trade relations when using a half-percent threshold or a five-percent threshold.

The variable *open* (for openness) captures an individual country's FTP, including import barriers, the mean tariff rate, taxes on international trade, and capital account restrictions. I use the sub-indicator *economic restrictions* from the KOF Index of Globalization (Dreher 2006; Dreher et al. 2008).

From 1995 to 2005, two states with strong trade relations tended to have similar FTPs. Annually, the network autocorrelation took on Moran's I values between 0.07 and 0.16. Figure 5 plots the trends of these values for four different operationalizations of the dyadic trade network: raw values of t_{ij}as well as three dummy variables based on the dichotomization of t_{ij} using thresholds of 0.005, 0.01, and 0.05.

As for an influence-based explanation, I expect that FTP diffuses via international trade and therefore induces the positive network autocorrelation that is shown in Fig. 5. Simmons and Elkins (2004), for example, make strong theoretical

Table 2 Stochastic actor-oriented model of the co-evolution of *trade flows* and national foreign-trade policy (*FTP*) based on data from three points in time resulting in two panel waves (1995–2000 and 2000–2005)

Effect	par	(s.e.)
Network dynamics (dependent variable: trade)		
Constant trade rate (period 1)	8.711	(0.415)
Constant trade rate (period 2)	8.008	(0.431)
Outdegree (density)	1.024†	(0.553)
Reciprocity	2.488***	(0.138)
Transitive triplets	0.254***	(0.026)
Transitive recipr. triplets	0.020	(0.027)
Three-cycles	–0.143***	(0.035)
Betweenness	0.004	(0.006)
Indegree popularity (sqrt)	–0.088**	(0.031)
Outdegree activity (sqrt)	–0.922***	(0.130)
Open alter	0.042†	(0.025)
Open squared alter	–0.027***	(0.008)
Open ego	–0.062***	(0.019)
Open ego × open alter	0.027***	(0.006)
GDP alter	0.353***	(0.038)
GDP squared alter	0.001	(0.010)
GDP ego	–0.267***	(0.033)
GDP ego × GDP alter	0.104***	(0.013)
Polity alter	–0.029**	(0.011)
Polity squared alter	–0.002	(0.001)
Polity ego	0.003	(0.005)
Polity ego × polity alter	0.001	(0.001)
Behavior dynamics (dependent variable: open (FTP))		
Rate open (period 1)	1.063	(0.166)
Rate open (period 2)	1.754	(0.299)
Linear shape	1.320	(1.089)
Quadratic shape	–0.253***	(0.074)
Average alter	–0.240	(0.545)
GDP	0.100	(0.090)
GDP per capita	0.472*	(0.211)
Government spending	0.028	(0.025)
Polity	0.027	(0.022)
Average alter × period-2-dummy	–1.033	(0.646)
Period-2 dummy	1.584	(1.296)

$^{\dagger}p < 0.1$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

and empirical arguments that a country's FTP depends on the FTPs of other countries that it competes with for international capital or foreign direct investment (FDI). Additionally, the authors describe an adaptation towards the trade policies of sociocultural peers. Martin and Schneider (2007) support this assessment and interpretation of international interdependence. They found that a focal country's FTP

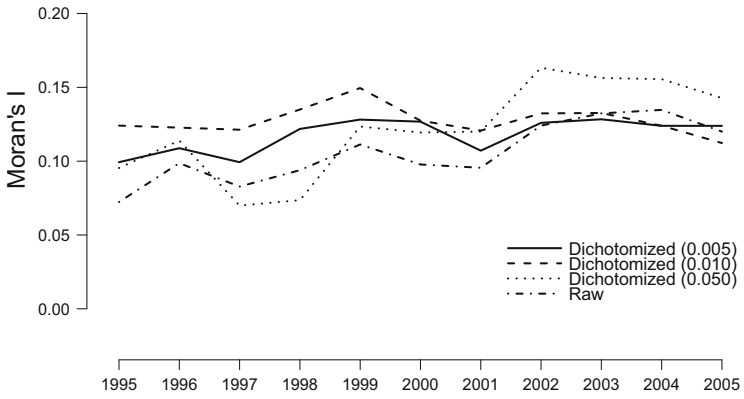

Fig. 5 Network autocorrelation (Moran's *I*) of *open* (open FTP) within the global *trade* network based on 138 states. The plot shows four curves with different dichotomization thresholds for trade relations as well as the raw values of *trade*

positively correlates with the FTP of countries that are important trading partners for the focal country.

As for a selection-based explanation, I expect that two countries that are similarly open to international trade are more likely to trade extensively with each other. This expectation that countries select similar others as international partners is a classic homophily argument from SNA. It has not only been confirmed over and over again for social networks between individuals (see, for example, McPherson et al. 2001) but also for several interstate networks and country attributes, such as for military allies that share specific cultural and political regime characteristics (Maoz 2012; Warren 2010), for trading partners that share specific regime traits and cultural variables (Rhue and Sundararajan 2014; Zhou 2011), and for diplomatic ties between similar political regimes (Kinne 2014; Neumayer 2008).

A different explanation for the homophilic selection of trade partners is based on Krugman (1981). He expects that national economies with similar factor endowments engage in intra-industry trade. He explains such trade patterns with the natural limits of national economies to achieve economies of scale for all products that they technologically are able to produce.

I estimate a SAOM with data from the three time points 1995, 2000, and 2005 (see the result in Table 2). This model captures the simultaneous formation of international trade relations and change of individual countries' level of FTP as measured by the variable *open*.

The following control variables are also added to the model: A country's *GDP* is measured in million PPP-$ and log-transformed. *Per capita GDP* is given in log-transformed PPP-$ as well (Heston et al. 2012). Finally, I measure *government spending* as general government final consumption (% of GDP), which I have adopted from the World Development Indicators, and a country's national *polity* on the basis of the POLITY IV project's variable Polity2 (Marshall et al. 2011).

The results support the expectation of a strong selection effect. They indicate no solid diffusion effect and hence do not support the expected influence mechanism.

The part of the co-evolution model explaining changes of the global trade network displays clear signs of homophilic selection. The positive parameter of the variable *open ego* × *open alter* indicates that two states—ego and alter—with similar FTPs are more likely to engage in trade with each other. While this does not constitute a solid test of Krugman's (1981) expectation about the effect of similarity in factor endowments, it does support this expectation and is in line with previous analyses of political networks that have frequently demonstrated homophilic tie creation.

When controlling for this preference for similar alters, the analysis shows that a country *i* is more likely to choose or keep country *j* as an important trading partner, the more open *j*'s national economy is and the less open country *i*'s economy is (the parameter of alter's *open* values is positive; the effect of ego's *open* value is negative). This finding that more open countries are more likely to become or constitute important trade partners for other countries supports the theoretical expectation that higher tariffs or quotas in a country result in diminished trade flows into the country.

In the part of the co-evolution model explaining changes in countries' FTP, the variable *average alter*, which measures the average FTP of a focal country's important trade partners, has a negative but statistically nonsignificant effect. Larger positive values would indicate countries' tendency to adjust their FTPs towards the policies of their important trading partners. A linear and a quadratic trend variable constitute the baseline of the behavioral part of our model. According to this baseline, countries, on average, tend to open up their domestic economies over time (a positive but not statistically significant *linear shape effect*). However, this effect levels off with larger FTP values (negative *quadratic shape effect*). Thus, the more open a country's domestic economy, the smaller the probability that it will liberalize further.

All in all, trade relations appear to be established and maintained according to the principle of homophily, meaning that countries with similar FTPs preferentially trade with each other. Moreover, FTP appears not to diffuse between countries via trade. Future SAOMs could pursue the question of whether the positive ego–alter interaction effect for *open* disappears if similar factor endowments are controlled for. Such a result would strengthen the explanation derived from Krugman (1981).

5 Summary

I defined *diffusion* as a process leading to an increasing similarity of connected elements. Thus, diffusion requires the presence of channels that allow for communication and other exchanges between connected units. If such a diffusion process continues for some time, this similarity should be measurable as positive network autocorrelation.

Explanations of positive network autocorrelation should be interpreted with skepticism if they treat connectedness as given. In particular, regressions of dyadic similarity on whether or not a tie is present may be problematic. Even spatial regression models with exogenously determined weights (Franzese and Hays 2008) and models for diffusion within exogenously given networks may be futile. This is especially true if the ties themselves change over time and if these changes are likely to depend on the autocorrelated attribute. This has already been identified elsewhere as a weakness of past research on diffusion in networks and general spatial interdependence (see, for example, Valente 2005 or Franzese and Hays 2008, fn. 34).

While the social network paradigm in general is a very intuitive approach towards relational concepts such as diffusion, the logic of co-evolution designs and SAOMs perfectly fits in an analysis of policy diffusion beyond mere geographic proximity. SAOMs offer a way to overcome the weakness of studies that focus entirely on either influence or selection and a means of testing whether positive network autocorrelation is due to influence or selection, or both.

This chapter has illustrated the potential of co-evolution approaches to and a network perspective on diffusion problems. I have found that the similarity between the foreign-trade policies of countries that also trade a great deal with each other is mostly the product of a selection mechanism. Diffusion of countries' openness to trade via trade flows was also expected but was not supported by the results.

To conclude, co-evolution designs, network analysis, and stochastic actor-oriented models are beneficial to those studying policy diffusion between territorial units. They allow what independent analyses of either influence or selection are unable to achieve: to wit, more reliable statements as to whether the similarity of connected elements is the result of a diffusion process. At the same time, the exemplary application warrants caution: just because network autocorrelation looks like diffusion does not mean that diffusion is in fact present.

With respect to networked governance, this acknowledgment of potentially simultaneous and interrelated changes in network structure and actors implies at least three things: First, future work on the governance of networks should clearly spell out which parts of a network are meant to be regulated or influenced in a certain way, for instance, the characteristics of individual network actors or how network actors are connected with each other. Second, analyses of and strategies to govern social or political networks should always reflect possible effects of changes at the actor level on the network structure and vice versa. Third, governance through networks—understood as influencing network actors on the basis of their connections and relations—should also be approached with the potentially simultaneous and interconnected evolution of structure and actors in mind.

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Contributions of Experimental Research to Network Governance

Manuel Schwaninger, Sabine Neuhofer, and Bernhard Kittel

1 Introduction

While the experimental method has long been established in various social scientific disciplines, experiments have so far not received much attention in the study of network governance. This is not surprising in view of the self-conception of the field:

> Governance network research is empirically oriented, but the study of the conditions, functioning and implications of interactive forms of network governance certainly carries an explanatory ambition, though not in the classical sense of aiming to establish deterministic causalities with a law-like character (Sørensen and Torfing 2007, p. 7).

By contrast, experimental research distinctly emphasizes causality and tries to identify causal relations by abstracting from a context-specific environment. It is the major tool for examining theories and hypotheses built on underlying assumptions about human behavior. Whether a scholar derives a formal-mathematical theory or explores an empirical pattern, in order to find macro-level regularities to be described in general terms, it is necessary for the social sciences to assume some minimum of systematic human behavior. These assumptions have to be critically scrutinized and investigated.

For this purpose, experimental social scientists make use of three ingredients, which together pave the way for *ceteris paribus* variations: control, randomization, and incentives. In an elaborate laboratory experiment, the design that the researcher chooses determines all possible situations and relevant parameters. This means that input and output, such as the possible set of actions, are the same for all participants

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exposed to the same treatment, which controls for confounding variables. At the same time, randomization ensures that the distribution of uncontrollable factors, such as occurrences prior to the experiment or particular personality traits, is equal on average across two different treatments. The idea is that, if the number of observations is reasonably large, unobservable traits cancel out one another at the aggregate level when two treatments are compared. In the 'model case', two treatments mirror each other in every aspect apart from one specific parameter that is varied in a controlled way by holding everything else constant. Using the *ceteris paribus* concept allows the researcher to make inferences about causal relationships, which in many cases would not be possible in natural environments. If a treatment effect is found, it must be a causal relationship since the change in aggregate subject behavior could not have caused the varied parameter to change while the other variables remained constant. It is noteworthy that, in contrast to other methods, experiments are able to elicit preferences by incentivizing the action set (Smith 1976). For example, rather than asking about social preferences, which might trigger socially desirable answers, social action can be directly evaluated. Through these techniques, experimental research works as a kind of 'wind tunnel' (Roth 2002) for theories and models in the social sciences, thus making a significant contribution to a richer understanding of human behavior.[1,2]

At first glance, network governance research does not need to establish a behavioral concept that requires experimental testing. For instance, central agents in governance research may be states, corporations, or families rather than single individuals.[3] Experimental research tends to find that groups act more in line with the rational and selfish behavior assumed by game theory (Kugler et al. 2012). In some respects, this result undermines the importance of the experimental examination of individual behavior when explaining the behavior of entities is the issue. Furthermore, network governance research stresses the complexity of interactions and interdependencies between agents (Klijn and Koppenjan 2012). The focus is on understanding and disentangling the network, whereas individual behavior becomes relevant once the network's structure, interaction patterns, and institutional norms are identified. Moreover, experiments cannot contribute to many research questions purportedly important for network governance. The typical methods of studying governance networks are focus-group interviews, diaries, observations, interviews, documentary analysis, expert reports, and social-network analysis (Bogason and Zølner 2007). In fact, experiments are rarely directly applied to external environments and seem more appropriate for basic research. However, even though experiments are not considered the first choice in this research

[1]Prominent contributions include "present bias" (Laibson 1997; Strotz 1955), "prospect theory" (Kahneman and Tversky 1979), or "inequality aversion" (Fehr and Schmidt 1999).

[2]For overviews of experimental research in the social sciences, see, for example, Druckman et al. (2011), Fréchette and Schotter (2015), Kagel and Roth (1995), Kittel et al. (2012), Plott and Smith (2008) and Webster and Sell (2014).

[3]For an exception, see, for example, Gluesing et al. (2016).

tradition, we can identify two central questions of network governance in which experimental findings certainly have the potential to complement systematic analysis.

One fundamental step towards a systematic understanding of the process is the question, *"Why and how are governance networks formed, developed, reshaped and terminated?"* (Sørensen and Torfing 2007, p. 8). Jones et al. (1997) developed a theory explaining the emergence of governance networks. Transaction-cost economics highlights that the connecting links between the dyads forming a network can be rationalized. Theories of strategic network formation have long been studied by scholars experimentally (Kosfeld 2004, provides an early survey on economic network experiments, including a section devoted to network formation). The insights of this research field might be informative for network-governance research. Some scholars have already made use of rational choice and game theory to interpret the formation of governing networks (e.g., Hertting 2007).

A second important question of network governance concerns the distribution of power in networks (Jones et al. 1997; Klijn and Koppenjan 2012; Sørensen and Torfing 2007). In particular, network management requires sophisticated knowledge about the effect of power on the efficiency and the distribution of outcomes. Networks do not develop in a void, but are rather guided by institutional norms and rules. "*Network management is about influencing the organizations in that network*" (Bevir 2012, p. 69). Ultimately, it is necessary to know the effects of power on decision making and the distribution of resources if networks are to be administered by public law. Research on network governance draws on social network analysis to become informed about structural power differences. In turn, much of the knowledge on power, notably in networks, has been obtained through experimental investigations. Furthermore, experiments suggest which network structures foster reciprocal exchange, cooperation, and efficient outcomes.

2 Network Formation

Network formation is a broad theoretical and experimental research field. Our goal in this section is twofold: On the one hand, we recapitulate basic concepts and results of studies that can be interpreted in terms of governance networks. On the other hand, we suggest ways to adjust designs for future research. It seems reasonable that agents in governance networks would cooperate intentionally and in mutual consent. We thus focus on strategic in contrast to random network formation (e.g., Erdös and Rényi 1959, 1960, 1961; Watts and Strogatz 1998) and on the concept of pairwise stability (Jackson and Wolinsky 1996). Pairwise stability, or cooperative network formation, refers to the notion that two players need to bilaterally agree to form a link, as opposed to unilateral links in one- or two-way flow models (which examine Nash-stable equilibria), first developed by Bala and Goyal (2000), or deviating coalitions of more than two players, beginning with the model of Aumann and Myerson (1988).

2.1 Basic Concepts

A network is defined as a set of connected agents who can engage in exchange with other connected agents. The basic concept of cooperative network formation is quite simple. Building and maintaining a link between two nodes is costly. In terms of governance networks, it can be considered costly for several reasons depending on the context: Building trust between two agents takes time, relying on reciprocity is risky, or opting for network interaction involves sacrificing short-term gains from more beneficial market exchanges. An agent is willing to bear the costs of forming a link if the gains exceed the costs, that is, if the agent is better off with the link than without it. The gains (and costs) of a connection in real-world networks are seldom entirely clear, but in order to simplify the theory the benefits (and costs) are assumed to be known in "pure" network-formation games.[4] The network consists of all available agents that are able to establish and sever links such that they maximize their own outcome. A situation in which no two agents want to connect and no agent wants to dissolve a connection is pairwise stable; in other words, a network structure has formed. Not all nodes in a network are necessarily connected. Sums of connected nodes are called components. These components are identified and analyzed in empirical network-governance research. By abstracting from complexities, the theoretical and experimental analyses help us to understand how they emerged.

Jackson and Wolinsky (1996) were the first to provide a general model introducing pairwise stability. In one application, the "connections model," the agents benefit from both direct and indirect connections (positive externalities of a link). The model is inspired by the idea of social capital; that is, knowing many people is advantageous in many dimensions of life, including the job market, business opportunities, or access to information. The theoretical analysis concerned the relation between stable and efficient networks. Similarly, stability and efficiency were studied in another application, the "co-author model," which targeted the tradeoff between productivity and the number of co-authored papers (negative externalities of a link). Obviously, the traits of these models are specific and not immediately applicable to governance networks. However, the general model could be adapted to governance networks with any set of preferences.

By way of example, consider the 3-node network in Fig. 1, which informally depicts a simple, possible governance network that illustrates the concept of pairwise network stability.[5] Technically, the numbers denote the payoffs in each

[4]The benefits depend, for example, on the network structure, which will be discussed in the following section. As no bargaining takes place here, the power aspect in network-formation models is typically neglected. However, models include externalities of connections affecting other network members. Also, there are some experiments, which we will discuss later, in which the connection yields no direct payoff. In this case, the link allows the actors to play a game to create payoffs.

[5]Networks are described in different ways in the fields discussed in this chapter, for example, by reference to the number of nodes, the number of links, or the overall pattern (such as a line or a kite). At the risk of generating some ambivalence in terminology, we stick to the labels used by the original authors.

possible network. We assume that forming a link is costly, represented by a deduction of 1 unit per link. In the empty network, each agent receives a payoff of 3. In the 1-link network, the two connected agents receive a payoff of 4, whereas the unconnected agent receives no payoff at all. Note that the payoffs are symmetric in the sense that it makes no difference whether node A and node B, node A and node C, or node B and node C are connected. In all three cases, the two connected agents receive 4, the unconnected ones 0. Similarly, the payoffs are also given for the 2-link and complete network. If we take the sum of the individual payoffs, we see that, in the parametrization of this specific example, the empty network is the most efficient arrangement (maximum sum of payoffs), whereas the complete network is least efficient, as each link reduces efficiency by 1. Other parametrizations generate different dynamics and outcomes, but the concepts to analyze network formation are the same.

A substantive framing of this network could be as follows: There are three decision-makers—for example, three political parties in parliament. If no party is connected, the chances of enforcing one's own interests and ideology are intermediate and the parties struggle to find a majority for each issue. However, when two parties form a coalition, both benefit and are more likely to enact laws in their interest. The increase in payoff is illustrated through an increase from 3 to 4. Additionally, the coalition can impose external costs on the third party, and the payoff decreases from 3 to 0. Now, if two parties form another coalition, the previously connected party becomes even more powerful as it is in a comfortable position to play the other parties off against each other. The party that was previously unconnected also increases its benefit, as it now has at least some influence on the policy. Finally, the peripheral parties may form a coalition, too, in order to offset power inequalities. In the complete network, each law requires unanimity and decision costs are high.[6]

In the next step, stability concepts are introduced to predict which type of network will be formed. We can roughly divide the literature on cooperative network formation into two classes. Early analyses of network formation assumed myopic behavior of agents (Herings et al. 2009; Jackson and Van den Nouweland 2005; Jackson and Wolinsky 1996). This means that only immediate changes in payoff were considered. In the network example in Fig. 1, the complete network is

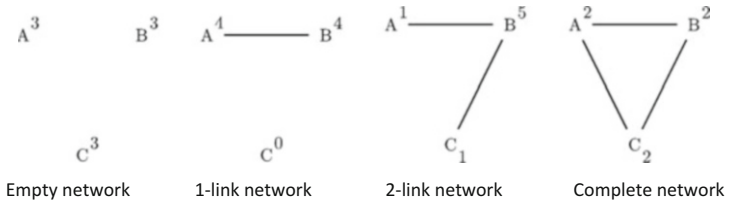

Fig. 1 A network-formation example

[6]These variations parallel the tradeoff between external costs and decision costs introduced by Buchanan and Tullock (1962).

the only pairwise stable network, as in every other network the agents are able to improve their immediate payoff by forming or severing a link. The second concept is that of farsighted stability (Herings et al. 2009; Von Neumann and Morgenstern 1944). Here agents evaluate whether they are better off in the present or the final network if they deviate from the current network. Intuitively, farsighted agents are assumed to maximize the final payoff, whereas myopic behavior aims to maximize immediate payoff. Thus, the agents also consider the behavior of other agents who, vice versa, rationally evaluate the behavior of all other agents.[7] In the example above, the complete network and any 1-link network would be farsighted stable. The 1-link networks are stable because agents anticipate that in the long run they would end up in the complete network (where they would be worse off) if they form another link. The complete network is stable since most definitions require the existence of a farsighted improving path from outside the stable set to some network in the set. There is no farsighted improving path from the 2-link networks to any of the 1-link networks, and therefore also from the complete to the 1-link networks, which means the complete network is in fact stable.

Additionally, there is also a subclass of farsighted concepts that incorporates pessimistic beliefs (Chwe 1994; Herings et al. 2009; Page et al. 2005; Teteryatnikova 2015). In contrast to farsighted behavior in which agents are optimistic about the eventual outcome, cautious farsightedness implies no departure from a network if no sure improving path exists. We cannot distinguish between farsighted and cautious farsighted behavior in our example owing to the simplicity of the example. However, it is possible to gain an intuitive understanding. The farsighted concept does not take into account the uncertainty underlying the process of network formation. For example, any two of the three agents in the empty network in Fig. 1 are equally likely to connect. Cautious farsightedness alleges that agents also take this aspect into account and strictly do not depart from a stable network if there is a slight chance of being worse off in the final network.

All of these concepts have their theoretical justification and are applicable to a general set of networks. Experimental examination compares models' predictions empirically, each with specific underlying assumptions about human behavior.

2.2 Laboratory Experiments

There is a small but growing literature examining the bilateral linking rule in network formation. Carrillo and Gaduh (2012) tested the myopic behavior of subjects in 6-node networks with different payoffs. In their design, the formation process converged to a stable network (defined as three consecutive turns) in more than 50% of the cases if a stable network existed in theory. When no pairwise stable network existed in theory, the networks seldom converged to a stable structure

[7]Note that in this model agents do not base their decision on reciprocity but only on their own rationality and that of other agents.

empirically. Furthermore, the outcome was rarely efficient, which would imply that subjects do not search intentionally for efficient networks. Additionally, the subjects were frequently able to coordinate on farsighted stable networks and overcome myopic pairwise stability. The percentage of myopically rational behavior was still high, except when the marginal payoff losses in early rounds were small or the myopically rational decision would have been to dissolve links. Kirchsteiger et al. (2013) compared myopic and farsighted stability models directly in a 4-node environment. Overall, the models correctly predicted 75% of the final outcomes. Moreover, the authors found that subjects were farsightedly rational only to a limited extent. When it was necessary to think more than two turns ahead to understand that the myopic rational move would be costly, deciding rationally became difficult for subjects, and they rarely coordinated on farsighted stable networks. An interesting extension of the farsighted concept suggests 'limited farsightedness,' which proposes farsighted behavior to a certain extent (Herings et al. 2014).

Teteryatnikova and Tremewan (2015) conducted a direct test of the cautious farsighted stability concept. The game in this experiment was played within a time span of 30 seconds in which subjects received payoffs not only for the final network but also for each second in intermediate networks. They studied 3-node networks and found that the most stable networks coordinated on the myopically pairwise stable network, which in their design was a subset of the (cautious) farsighted stable network as in our example. In direct comparison, the farsighted stable concepts performed worse than the cautious stable concepts in predicting the full range of stable networks.

To challenge the aforementioned stability concepts, the experimental investigations also included fairness or efficiency considerations. Preferences for fairness suggest that agents prefer networks with similar payoffs across agents, whereas preferences for efficiency suggest that agents prefer networks that maximize overall payoff. If agents take these considerations into account in their behavior, network formation could significantly deviate from what the theory would predict. However, Burger and Buskens (2009), who varied the cost dimension of the links, observed that the pairwise stability concept predicted the final network structure very well. Van Dolder and Buskens (2014), who also studied cooperative network formation, found that social preferences had almost no influence, except for situations that degenerated into a two-person decision task in which one subject was solely responsible for the payoff of another subject.

Departing from pure network formation towards a more interactive form of network formation adds a game to a link. That is, if players are willing to form a link, they are able to play a game, for example, a prisoner's dilemma game, instead of deriving a simple payoff. This extends the analysis as the process of endogenous link formation is amended by considerations about cooperation and trust. In other words, the field is slowly departing from the most abstract form of network formation that reduces a connection to a deviation of (expected) payoff toward more interactive networks. Hertting (2007) already discussed the problem of rationally solving three classic games in network-formation contexts in one-shot

scenarios. Also, in finite versions of these games, it is often considered rational to defect on account of backwards induction. However, experimental results have shown that mutual link formation frequently leads to cooperation.

Hauk and Nagel (2001) conducted a finite prisoners' dilemma experiment with 7-node networks and compared behavioral differences in exogenous and endogenous networks in which agents were allowed to choose their neighbors. They found that overall defection was about three times as high when two players were exogenously connected compared to endogenous connections. After mutual cooperation, the link-formation rate in the next period was very high. However, as is typical of finite games, cooperation rates decreased during final periods. Similarly, in Riedl and Ule (2002), cooperation rates were higher when links were endogenously formed, links with previous cooperators were sustained, and links with previous defectors were severed even if this was costly. Also, Brown et al. (2004) showed that in a market lacking third-party enforcement of contracts, long-term relationships which were based on reciprocity emerged and led to high rents. Corbae and Duffy (2008) designed a finite 4-node stag-hunt game and found that separate dyads, which were also payoff dominant, were the only stable network structure, even though other stable structures exist in theory. In the coordination game of Corten and Buskens (2010), subjects chose to form ties with actors playing the same action and dissolve ties with those playing the alternative action and many networks turned into stable groups. Finally, Tsvetkova and Buskens (2013) studied the coevolution of behavior and structure using a chicken game in which agents could separately choose their action for each connection. The authors found that egalitarian conventions were chosen significantly more often and lasted significantly longer than any other convention.

2.3 Limitations and Prospects

Taken together, experiments on 'pure' network formation tend to find that pairwise stability predicts the emerging network structure reasonably well. Second, (cautious) farsighted stability sets help to explain some of the variance. Third, efficiency and fairness considerations play a minor role in pure network-formation games. The experiments that add a game to a link suggest that building trust, reputation, or a shared identity sustains mutually agreed connections in a network (Jones et al. 1997). The results imply that social mechanisms do in fact influence the formation of stable networks.

To understand governance networks, it is important to ask how they were formed and why they are maintained. Have we come closer to an answer? Naturally, we should be cautious in extrapolating findings from the lab to the field. Nevertheless, from an analytical perspective, it makes sense to disentangle a network by approximating the costs and gains of a connection. Even though this might be challenging for many empirical applications, insights derived from theoretical and experimental investigations complement qualitative analyses by making specific networks comparable in terms of their fundamental structures and behavioral

patterns. In this respect, to understand a network in the field, it needs to be studied over a longer time horizon. From experimentally tested theoretical models, we might, for example, derive predictions about the stability of an empirically observed network. For this purpose, experimental tests of behavioral theories allow us to identify the concepts that best predict the behavior. The results suggest that pairwise stability is a promising concept for studying the stability of networks. Therefore, the challenge seems to be to appropriately evaluate the benefits of interdependent connections, first, and then apply the pairwise-stability concept over a longer time horizon in order to understand how networks form and why they persist.

Network formation theory also highlights the role of unconnected actors in governance networks. When a network is described, it is tempting to disregard unconnected actors. Nevertheless, the network structure is a dynamic process, and information would be lost if networks were considered to be static. Take, for example, a healthcare network with several actors: hospitals, ambulances, private clinics, daycare, etc. To gain a full picture of the network structure at a certain point in time, we would be ill advised to disregard, say, a currently not contracted ambulance service. The existence of alternative suppliers might eventually influence the shape of the network or change its structure in the future. Practically, it might be quite difficult at times to identify certain actors that are potentially of interest but not part of the observable network.

Lastly, in governance networks, there is a third and a fourth option apart from establishing or severing a link in the network. That is, actors with the same goal but different competences are able to merge and organized actors are able to split, respectively. So far, network-formation theory cannot contribute to answering the question of why and when actors prefer to form a network over engaging in free-market interaction but at the same time do not want to merge. Jones et al. (1997) offered a theoretical account of when networks emerge. Future laboratory experiments could be developed to test whether actors behave as predicted under such conditions.

3 Experiments on Social Exchange in Networks

Not only the emergence of networks but also interactions within these networks are essential for network governance. The structure and form of exchange especially influences the behavior of subjects and thus the outcome in the network and the subjects' profits. Power distributions in social-exchange networks have been extensively studied by sociologists in the last 50 years (Cook et al. 2013). George Homans (1958), Peter Blau (1964), and Richard Emerson (1972a, b) are among the founding fathers of the field who have contributed basic concepts. In the early approaches, the distribution of power through the structure of a network was of key interest. The power a subject holds is inherent in the structure, and thus the structure of the network influences behavior and profit. Note that the structure was initially assumed to be stable and therefore to be determined exogenously in the majority of

theories and empirical work. Only recently have endogenous variations of network structure been introduced.

Whereas the use of network analysis for the study of network governance (Gluesing et al. 2016; Mayntz 2016) is a first step in a new direction, introducing network-exchange theory can be seen as a further extension in the field of network governance by adding more dynamic and behavioral elements.

To introduce the field of social exchange in networks, we will first present basic concepts. A short overview of the development of social exchange theory follows to illustrate different conceptions of power, as the distribution of power has been one major driving force of early research on social exchange and a factor that is crucial for network governance. Subsequently we will give a selective overview of experimental work. Finally, we will briefly broach recent concepts that challenge the assumption of exogenously determined network structures. For this purpose, we will introduce a field in which pure network-formation models overlap with social exchange theory. Both the analysis of individual behavior within a network and its influence on the structure of the network can add substantively to the study of network governance.

3.1 Basic Concepts

All interactions between individuals can be viewed as a kind of exchange (Homans 1958). The coordination of three political parties deciding on the terms and schedule of passing a law can be seen as social exchange in which three actors exchange their preferences. When they manage to coordinate, this can be viewed as a successful interaction or exchange. For reasons of simplicity and measurability, experiments tend to use monetary rewards as the units of exchange.[8]

By definition, social exchange occurs between at least two connected agents. The connection can be positive—that is, exchange in one relation is independent of another—or negative in the sense that exchange in one relation is contingent on exchange in another, which means that the total number of exchanges is limited. The nature of connections severely influences the process and outcome of exchanges. Both positive and negative connections may occur in governance networks, depending on the context and regulating institutions. The resources in exchange can range from tangible goods to services and non-tangible goods. These resources are under the control of one subject and valued by another.

Four forms of exchange are usually distinguished (Lawler et al. 2000; Molm 2007). Exchange can be directly negotiated, directly reciprocal, indirect (or generalized), or productive (see Fig. 2). When engaged in *negotiated exchange*, subjects bargain about the binding terms of exchange. In *reciprocal exchange*, no negotiations take place, and transfers are unilateral, non-binding, and independent.

[8]Bargaining does not imply the division of some kind of profit (points, money) per se. Also, tasks or responsibilities can be divided between organizations.

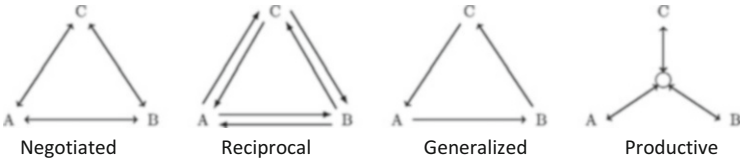

Fig. 2 Forms of exchange (Lawler et al. 2008, p. 525)

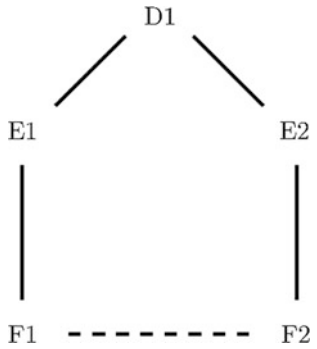

Fig. 3 Network used by Cook et al. (1983, p. 208). In the relation denoted by the *dashed line*, 8 points could be divided. In the relation denoted with *solid lines*, 24 points could be divided

In *indirect exchange*, a subject transfers resources to another subject but receives resources from a third subject (for example, a feedback chain in a ministerial department or among the proponents of a policy in different organizations). In *productive exchange*, all subjects in the network have to contribute to the production of a desired good. The defection of one subject impedes exchanges among the others (for example, implementing a policy that requires several ministries to cooperate). In productive exchange, both negotiated and reciprocal exchange are possible. In most studies, subjects are assumed to be self-interested and profit-maximizing within the scope of their options.

In a real world context these forms of exchange may not be as pure as these conceptions. The latter may be seen as ideal types in the sense of Max Weber. These types can be constructed and examined under highly controlled conditions in laboratory experiments. The ideal types can then be contrasted with the findings from these laboratory experiments. Usually only one type of exchange is allowed in one experimental setting in order to maximize control. Research relaxing the strict limitation to one form is reviewed below.

We first describe the most commonly used experimental setting, which was introduced by Cook et al. (1983) and designed for negatively connected networks with subjects engaged in negotiated exchange. The goal of the experiment was to examine the behavior of subjects and the effects of power and dependence through structural positions within this specific network. In the given example (see Fig. 3), there were at least two subjects assigned to a position in a network, which they kept

for the entire experiment. Connected subjects were then allowed to bargain over the distribution of a fixed amount of a resource. The experiment assumed selfish utility maximization, and the subjects were expected to maximize the number of points that they could appropriate. Bargaining could last until an agreement or a time limit was reached. If the subjects failed to reach an agreement, no one received any points. The information available about the others' performance, the structure of the network, or the position a subject held was varied. Cook et al. (1983) used a restricted-information setting to limit the effects of the subjects' equity preferences on bargaining outcomes. The subjects were informed about their individual profits from exchange, but they knew neither the size of the constant sum (which was either 24 or 8 points in the experiment) nor their exchange partners' profit or the structure of the network. Agents' behavior in a network was predicted from their positions, which differed in point centrality (closeness and betweenness), dependence and, in consequence, power. Cook and her colleagues (Cook et al. 1983; Cook and Yamagishi 1992) defined power as a function of dependence. They proposed that a subject's dependence is determined by the number of available alternatives. Even latent relations, that is, relations that are barely used or even unused, influence the dependence and thus power of a subject (in the example, this would be the connection in which only 8 points can be divided). The theory predicted that an agreement would be reached at the point at which two subjects were equally dependent on one another: the so-called point of equi-dependence. Equi-dependence does not imply an equal distribution of points but rather reflects the distribution of power within this relation. Structural power was expressed numerically by the maximum profit a subject was able to appropriate.

The experimental findings suggest that power can be predicted from the concept of dependence but not from centrality in negatively connected networks. The agents holding the structurally equivalent positions E1 and E2 were found to be most powerful, which is equivalent to being the least dependent agent, and they received higher profits than agents holding other positions. The agents in positions F1 and F2 were more dependent on agents E1/E2 than agent D on E1/E2, and obtained smaller profits. The higher dependence of F1/F2 on E1/E2 enhanced the profit of E. Thus, positions in a network determine power and, as a consequence, the outcome.

The concept of dependence may be useful for network governance, as agents may be in different dependency relationships with respect to each other. Much has been learned about exchange outcomes of various network structures, even though the focus is generally on the predictive capacity of different models. If the network structure is known in the field, insights gained from experiments can be used to develop hypotheses about power relations and relative outcomes for the different agents in the given network.

As mentioned above, a large number of theories and models have been developed, each predicting the distribution of power and payoffs in different ways using different concepts (Cook et al. 2013). For example, the equi-dependence theory (Cook et al. 1983) introduced above was criticized by advocates of network exchange theory (NET; Lovaglia et al. 1995; Markovsky et al. 1988), which was further developed into a model by using a graph-theoretical power index (GPI) to

identify weak and strong power positions and networks. The probability of exclusion from an exchange plays a crucial role in the assessment of power. The concept of resistance was introduced by Skvoretz and Willer (1993) in a variant of NET, exchange-resistance theory. According to this approach, a subject's resistance to a low offer is weak if the probability of exclusion is high. In a further step in the development of NET, the concepts of resistance and degree—that is, the connectedness of a node to other nodes—were added to the GPI model. A higher degree was assumed to lead to a higher outcome from bargaining (Lovaglia et al. 1995). The GPI-R and GPI-RD models' predictions were tested, among other approaches, on experimental data. Willer and Emanuelson (2008) found that the GPI-R offers the best predictions compared to nine other approaches.

3.2 Laboratory Experiments

In more recent developments of empirical work on social exchange, the focus of studies on negotiated exchange in negatively connected networks, such as the work of Cook et al. (1983), shifted to reciprocal exchange and the difference between negotiated and non-negotiated exchange. Kuwabara (2011) presented a first approach to relate two major streams of research that differ in their predictions of the effects of negotiated versus reciprocal exchange of profits, but also of trust and the cohesion of relations. These factors were found to be important for exchange between subjects (Lawler et al. 2008; Molm et al. 2009). Two forces were assumed to influence the success of exchange: conflict and the experience of joint action during an exchange (negotiated or non-negotiated). Kuwabara found that both the salience of conflict inherent in negotiated exchange (Molm 2010) and the jointness of action in negotiated exchange (Lawler et al. 2008) influence the cohesion of an exchange relation as well as perceived trust and profit, depending on which of these forces is highlighted in the experiment (or the relation in general). For network governance, the cohesion between actors or networks can be an important attribute, because the higher stability of cohesive networks simplifies control and thus improves the predictability of agents' behavior.

Another factor that should not be neglected in network governance is trust because it stabilizes relations. Depending on the desired outcome (higher trust, cohesion, or profit), the form of exchange and the framing of the exchange as a joint or conflictual task needs to be varied by whoever is trying to produce an outcome in a network. This can be the experimenter in the laboratory or a channeling agent in the sense of meta-governance.

Until recently, experiments were designed such that participants could not change the type of exchange within one relation or network. In networks in the real world, the types of exchange may not be pure and shift from one type to another within one relation or network. To our knowledge, there are no experiments that allow agents to shift from one type to another and back completely endogenously. However, allowing subjects to choose the type of exchange endogenously, one could elicit their preferences for types of exchange and provide a means of

investigating the influence of types of exchange on each other. Molm et al. (2013) related reciprocal and negotiated exchange and embedded one form of exchange in the other in order to explore whether and, if so, how non-negotiated reciprocal exchange and negotiated exchange influence each other. Even though actors could not choose the form of exchange themselves, both forms were sequentially implemented in the same network and the same relations. In their experiment, the authors observed that negotiated exchange embedded in reciprocal exchange led to a more equal distribution of final profits and higher relational cohesion between exchange partners than negotiated exchange alone. The outcome of reciprocal exchange did not change when embedded in a setting of negotiated exchange. As relations may change over time, the embeddedness of one form of exchange within another is important. For example, relations between a state and some organization may develop from repeated negotiations towards non-negotiated exchange and assume a more reciprocal form. An organization subcontracted by the state might be employed repeatedly and thus regularly deliver qualitative services just as the state trusted the organization to do.

Trust can be affected by the change of one form of exchange to another. Cheshire et al. (2010) examined the effect of the transition between reciprocal, non-binding, and binding negotiated exchange on trust. Uncertainty of exchange was expected to be negatively related to trust. They found that trust did not differ between reciprocal and non-binding negotiated exchange when the rate of cooperation was held constant, but trust was lower in binding negotiated exchange. The results of the experiment indicate that the level of cooperation and the shift from one form of exchange to another both affect trust but are independent of one another in their effect on trust.

Hence, trust is especially important in forms of exchange that do not rely on binding agreements (Molm et al. 2009). Situations requiring trust can also be modeled, for example, as coordination games involving a social dilemma. Buskens et al. (2010), among others, used the trust game to examine the effect of network structure from a game-theoretical perspective. In the trust game (Berg et al. 1995) one subject, named the trustor, can choose whether to invest (that is, trust) in another subject, named the trustee. The trustor's investment is multiplied by a factor larger than one. The trustee then can honor the trust by returning a share of the received amount to the trustor. Of course, the rational myopic strategy of the trustee would be to abuse trust and refrain from returning anything. Using backward induction, the trustor can reason that the trustee will abuse trust and abstain from investing. The authors showed experimentally that, in a network comprising two trustors and one trustee, information sharing between the trustors about the trustee's behavior can enhance trust and overall profit. Profit is higher when the trustors are connected to each other, as the trustee anticipates that behavior in one relation may influence other trustors and that trustors can coordinate their behavior to control him. As a result, the trustee honors trust (that is, returns potential payoff) and the trustors learn from this behavior to trust or not. The institution of information sharing between trustors may be valuable for network governance to the extent that this situation is found in real-world contexts. The sharing of information can

also contribute to the control of the behavior of trustees, as the experimental results indicate, and the line between trust and control is blurred. The possibility of obtaining knowledge about the behavior of other agents in a network and the coordination of actions can generate power differentials. In this sense, the phrase 'knowledge is power' applies here. Agents controlling the installation of an information-sharing institution (such as blacklists) can empower trustors (or investors).

Social exchange theory has developed beyond these early interests and recent contributions have challenged the assumption of the stability of network structures. Social-exchange theory today not only assumes that structure influences behavior but also considers the reverse effect (Buskens et al. 2014). The introduction of the opportunity to form coalitions has been a first step towards relaxing this assumption. The classical experiment by Cook and Emerson (1984), which allowed for coalition formation, remained solitary in its design for more than a decade. In this particular experiment, three low-power subjects were connected to a high-power one who could only engage in exchange with two low-power subjects. As a result, one subject was always excluded from exchange if coalition formation was impossible. The three low-power subjects were thus expected to outbid each other in a "bidding war" leading to a race to the bottom. However, when low-power subjects were allowed to form coalitions, they could coordinate on a joint offer and split the profit from the exchange. For a coalition to be successful, a minimum size, the so-called "critical mass" (Simpson and Macy 2001), needed to be reached. When two out of three agents formed a coalition and two exchanges were possible, no subject was excluded from exchange and the power of the high-power subject was weakened. When all three low-power subjects formed a coalition, then the power could even be reversed, as Cook and Emerson (1984) demonstrated.

A major problem arises when free-riding on the coalition's offer is possible (Simpson and Macy 2001) because under this condition the formation of a coalition becomes a coordination problem. Assume that the three weak-power subjects agree to offer an equal split to the high-power subject. When free-riding is possible, the best strategy would be to exit the coalition and offer slightly more. But if all weak-power subjects do so, the coalition breaks and the bidding war recommences. Simpson and Macy (2001) confirmed the findings of Cook and Emerson and discovered, contrary to their expectations, that this leads to the formation of stable coalitions that exceed the critical mass of two subjects. They ascribed this finding to the individual expectation of all three actors that one of the others will free-ride. To avoid exclusion, all three stayed in the coalition. Further experiments on coalition formation have identified and further explored coordination problems and games in the coalition formation process and support previous findings. Other influencing factors, such as the endorsement of a coalition or the identity of a subject, have also been investigated (Borch and Willer 2006; Simpson and Macy 2004; Simpson and Willer 2005; Walker and Willer 2014). Understanding coalition formation, including its limits and stimuli, may provide useful stylized facts for research on network governance, not only with respect to government formation of political parties but also in regard to coalitions among corporations or associations.

3.3 Limits and Prospects

Criticism of experiments on social exchange in networks targets the size of the tested networks and deficiencies in their complexity. Complexity is minimized when only one form of exchange is possible or when networks are considered stable. Network formation adds complexity, and the coevolution of structure and behavior may even exceed the possibilities of laboratory testing. In recent work, simulations have therefore been used to test models of network formation (e.g., Frey et al. 2015; Raub et al. 2014). Willer et al. (2012) have offered a tool, domain analysis (DA), which breaks large networks into subnetworks along unused relations, in which case these subnetworks function in the same way whether they are part of or outside of the larger network (domains), and into subnetworks in which the dynamics change when disconnected from the larger network (components). This approach to analyze larger networks may be of use for research on network governance as it is able to identify different networks among a larger group of connected agents, which can be useful in studying large multi-actor networks, as, for example, in Gluesing et al. (2016). DA provides a way of studying more complex networks than previously used in network-exchange experiments.

The breakup of networks highlights a point at which network governance and social exchange theories diverge. In social exchange theory, all existing connections within a network are relevant to the distribution of power and thus incorporated in the assessment of it; this applies even to so-called latent relations, which are rarely or never used, as they offer a potential exchange opportunity and thus influence the dependence of one actor on another (Cook et al. 1983). In network governance, only actively used relations are considered, which may lead to a different assessment of potential power in a network. Nevertheless, social exchange theories might suggest potentially latent relations whose existence actually influences behavior.

4 Conclusion

We have discussed two broad streams of experimental research on networks that are potentially informative for network governance theory and empirical research inspired by this theoretical framework. The streams are embedded in different disciplinary contexts and research traditions and study different aspects of networks. Nevertheless, in recent years they have not only developed a set of stylized facts corroborated by experimental tests that empirical studies can use to develop more focused research questions. They have also learned from each other, and we observe some convergence in the joint concern for the process of network formation and the outcome effects of network structures. These more dynamic models of network development may even better inform empirical work in the future.

For example, network experiments have pointed to the importance of reciprocity and trust building when striving for more effective and efficient governance

structures, with respect to the enforcement of contracts in particular. Leaving it to the agents to organize their own relations is a crucial condition of mutual trust, which, in turn, is conducive to higher outputs. Negotiation is not a sufficient condition of trust building because of the perennial uncertainty about the intentions of others. Negotiations rely on words only; reciprocity builds on deeds. From these experimental results, we can learn that agents may need to prove their goodwill by exposing themselves to the risk of exploitation by their exchange partners. By design, network experiments focus on individual behavior. Network governance, by contrast, typically addresses constellations in which corporative and collective actors play the game. Although one could imagine experimental studies with such composite actors, these are difficult to operationalize and implement in practice. Nevertheless, experimental results may allow research to derive propositions about the implications of structural conditions on meta-governance and thus support improving designs of network structures as a means of governance.

With respect to network governance, the models could be changed in various dimensions. For example, it would be possible to design nodes as groups rather than individuals in experiments. So far, group behavior (e.g., a company's board) and networks have been examined separately in experiments. Furthermore, to integrate results from social-exchange experiments, insights can be used to modify the payoffs in network-formation experiments. Rather than fixed payoffs in pure network-formation games, they could also be changed into expected payoffs with a certain variance (risk). Moreover, network-formation and social-exchange experiments could be combined by introducing costs to exchange networks. In an experiment conducted by Deck and Johnson (2004), for example, both players decided independently which share of the total cost of the link each was willing to invest. The groups were randomly re-matched every period; if groups stayed the same over time, then bargaining patterns might have occurred. Also, networks could be studied in infinite time horizons. Sometimes it might be reasonable to assume that the time span of governance networks cannot be exactly identified in real governance environments. This feature of infinitely played games with a probability of an external intervention terminating the network structure (e.g., technological change) can be, and is, designed in laboratory experiments. In classical game theory, a depreciation rate between zero and one allows players (and researchers) to calculate income streams of future rounds and evaluate whether it is (or would be) rational to cooperate or not.

The possibilities to test theories in the laboratory are manifold, but obviously the more complex the model, the more complex the calculations and predictions. At the end of the day, one is only willing to increase a model's complexity if this increases its predictive power substantially. Models that wrongly predict the outcome of networks can be excluded, which allows researchers to focus on promising theories. Even a model that makes relatively precise predictions in the field but cannot predict well in the laboratory should be reconsidered, as it is likely that driving forces were not properly understood. Although, in accordance with Friedman (1953), one could argue that what is important is the correct prediction of a theory in the field whether it builds on plausible assumptions or not, one might also be

interested in the underlying mechanisms and behavioral regularities. Experiments are a first test of theories under clearly defined and restrictive conditions, which may be organized in a way so as to maximize the inferential leverage the theory. An experiment that fails to generate data supporting the theory gives reason to question the descriptive and predictive capacity of the theory under the more complex conditions of real-world interactions. Likewise, experimental conditions may test the limits of theories that apparently fare well in empirical studies. In any case, given that any governance intervention is a real-world experiment because it will have consequences, both intended and unintended, policymakers and institutional designers may be well advised to first explore the implications of different network structures under laboratory conditions. It is easy to do harm, and it is better to be prepared.

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Environmental Governance in Multi-stakeholder Contexts: An Integrated Methods Set for Examining Decision-Making

Julia Gluesing, Ken Riopelle, and Christina Wasson

1 Introduction

Environmental governance is of growing concern in a world that is more interconnected and interdependent than ever and threatened by climate change and the depletion or contamination of natural resources that are often shared by multiple stakeholders. Governance at the local, national, and international level requires representatives of diverse stakeholder groups with often competing ideologies and interests to make decisions collaboratively (Buck et al. 2001; Folke et al. 2005; Wondolleck and Yaffee 2000). This collaborative decision-making often takes place in formalized groups who are given the responsibility for developing governmental regulations that determine how natural resources will be used and protected.

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Investigations of decision-making in environmental governance generally have focused attention on either the decision-making processes that take place within the stakeholder groups (Dewulf et al. 2011; Dewulf and Bouwen 2012; Roncoli et al. 2011) or on the conditions outside the groups that need to be in place for good governance to take place, such as the sustainability of social-ecological systems, co-management structures and networks, institutional complexity, and polycentric governance (Ostrom 2009; Carlsson and Sandstrom 2008; Lubell 2013; Nagendra and Ostrom 2012). Yet to understand decision-making as it is actually practiced in reality, on the ground, it is important to understand decision-making more holistically, integrating the examination of meetings with the examination of broader stakeholder interactions and sources of influence outside the meetings that might impact the decision-making processes as they unfold.

This chapter presents some of the findings from an exploratory study of a city commission appointed to recommend revisions to an ordinance that governed gas wells in the local area. The purpose of our study was to develop a new integrative, interdisciplinary, and multi-level analysis methodology that combines the longitudinal study of stakeholder interactions inside the decision-making meetings at a micro level with their interactions outside of meetings and among their broader stakeholder networks and with the sources of information at a more macro level that might influence stakeholders' decision-making. Our overall research question was the following: Can conversational analysis (CA) and issue framing (IF) be integrated with semantic network analysis (SemNA) and social network analysis (SocNA) to provide a comprehensive examination of decision-making in multi-stakeholder contexts considering interactions both inside and outside the decision-making meeting context? This chapter provides a case illustration of how we achieved data integration to address the complex issues of multistakeholder governance, specifically related to decision-making. While our study focused on governance in the environmental context, our integrative research methodology can be successfully applied to illuminate decision-making in any governance context involving multiple stakeholders.

Figure 1 depicts our integrated research methodology to study environmental governance in multi-stakeholder contexts. The study focused on four aspects of decision-making: trajectories of information and frames, the influence of relationships among stakeholders on decisions, the agency of the social actors, and the perceptions of decision-making, and on the focus of the decision-making task, the ordinance itself. The figure includes the ordinance as the object of the commission's work to develop recommendations for revising it.

Our research design was to combine Wasson's expertise in analyzing face-to-face meetings using conversation analysis and issue framing with Gluesing and Riopelle's expertise in analyzing online communications using semantic and social network analysis. The overall research design is shown in Table 1. With methodological integration we set out to achieve a broad yet detailed view of the dynamic movement of an interrelated set of social phenomena across time and space. Our plan was to trace four aspects of decision-making across multiple scales of analysis. This analysis process helped us to situate the decisions of the decision-making

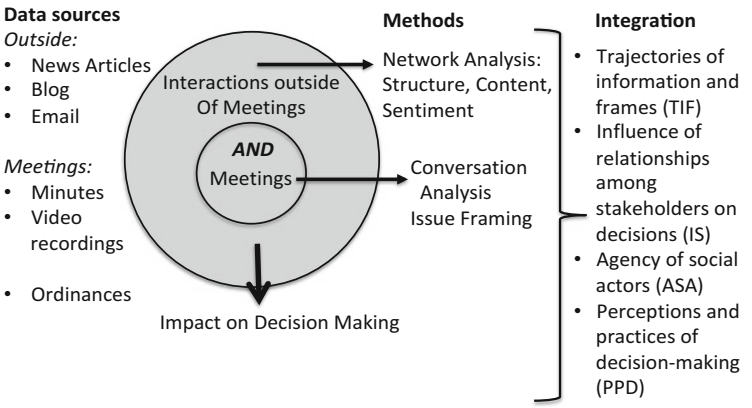


Fig. 1 Integrated research methodology to combine analysis of both meetings and interactions outside of meetings

Table 1 Combination of analytic tools for each aspect of decision-making

	Meetings approach		Networks approach	
Four aspects of decision-making	Conversation analysis	Issue framing	Social network analysis	Semantic network analysis
1. Trajectories of information and frames		X	X	X
2. Influence of relationships among stakeholders on decisions	X		X	
3. Agency of social actors	X		X	
4. Perceptions of decision making	X			X

within a holistic context of shifts in stakeholder relationships and perspectives, cultural norms of decision-making, and the agency of particular individuals.

Each of the four aspects of decision-making draws on different combinations of tools from our methodological toolkit. Table 1 summarizes the primary tools we used for each aspect. In each case, an analytic tool from the meetings approach is combined with an analytic tool from the networks approach to cross-compare and unify the results of both approaches.

In this chapter we do not attempt to describe all of the methods and tools and analytical strategies we used to develop an integrated methodology for analysis of decision-making in multistakeholder governance. We present a case example and a methods set that illustrate how the use of semantic and social network analysis, using quantitative software tools such as Wordij, LIWC, and Condor can be combined with conversation analysis and issue framing using Atlas.ti, a qualitative software tool. The case example focuses primarily on the semantic and social

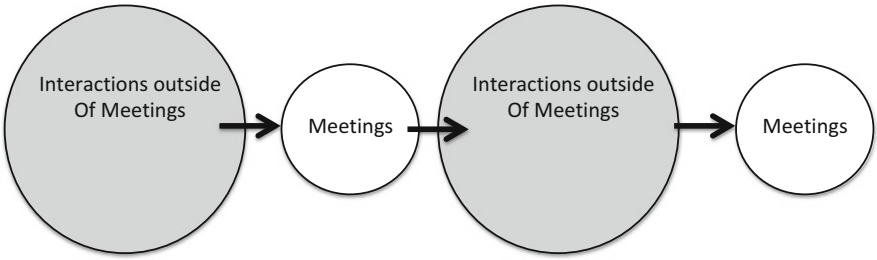
network analysis but includes brief illustrations of how we integrated conversation analysis and issue framing into our social networks approach as well. Our objective in the case example is not to present the study results, although we will provide some of our findings to show how our multidisciplinary perspective and integrated methodological approach can address specific governance issues involved in decision-making. Rather our example is a sampling of how we used the analytical tools and techniques that form the basis of an integrated methods set that we believe can be generalizable, replicable, and scalable to provide a comprehensive view of governance in multistakeholder decision-making. We demonstrate how semantic and social network analysis can facilitate the strategic use of ethnography and qualitative methods.

We begin with some background information about the multiple disciplinary perspectives that informed our work and the e-Research approach we adopted to facilitate both our research and our collaboration. We follow this explanation with the description of our case example and the detailed illustration of our integrated methods set. Finally, we present some concluding thoughts and implications of our approach for governance studies.

2 Multidisciplinary Perspectives that Informed Our Semantic and Social Network Integrated Methods Set and Team Collaboration

Before we present our case example, it is important to describe the diverse disciplinary perspectives and approaches we drew upon to create the integrated methods set for examining decision-making in multi-stakeholder environments. The disciplines that informed our research were communication, psychology, anthropology, social psychology and network science. We present each in turn and show how these perspectives and their associated methods, developed over decades, contributed to our novel integrated methods set to examine the content, sentiment, and structure of decision-making practices and processes longitudinally. Figure 2 illustrates this interdisciplinary, mixed methods, and integrated approach for analyzing structure, content, and sentiment over time.

From the discipline of communication we incorporated text analysis methods to help us understand the content and structure of the messages both inside and outside the stakeholder meetings. Semantic network studies reveal the content of conversations and how they dynamically change over time by examining the topics being discussed and the emotions around these topics, identifying what is new, what remains the same or re-occurs, and what drops out of the conversation. Danowski (2011) shows how a multi-level semantic network approach can be used to uncover both formal and informal discursive networks in organizations. In environmental studies, Lesfrud (2013) recently uncovered the discursive network and integrated cultural, environmental and economic perceptions surrounding oil sands and their development in Canada, and how these perceptions changed over time. Specifically, we used the WORDij text analysis method developed by Danowski (2013,



Text	Six Methods	Discipline
Content	1. Proper Noun Index Method 2. Text Correlation Comparison Method 3. Text Word and Word Pair Comparison Method	Communication
Sentiment	4. Positivity Index Method	Psychology
Structure	5. Conversation Networks Method	Linguistic Anthropology/ Network Science
	6. Social Influence Network Theory	Social Psychology/Network Science/Anthropology

Atlas.ti for additional coding and analysis

Fig. 2 Interdisciplinary mixed methods approach for integrated analysis over time

1993) to extract proper nouns, calculate a correlation coefficient of text to test the similarity of two texts, and statistically compare words and word pairs in texts to understand more deeply how they are alike or different and how a given text evolves over time. In traditional content analysis of text, a user manually selects a segment of text and assigns one or more codes to the segment and codes are counted, grouped, linked, analyzed, and summarized as a story. In contrast, Danowski's WORDij semantic network method automatically counts the number of times a word and a word pair occurs in a text. Words are then treated as nodes and word pairs as links for network analysis and other statistical analysis. This quantifies the strength of the relationship of words from the natural language of the text in a ratio scale from 1 to n. The strength of this methodological approach is that it is fast, it scales from small to large texts, and it is not subject to researcher skills or biases. The approach also has the conceptual strength of network theory, metrics and other statistical analyses methods behind it (Danowski et al. 2011).

Psychology contributed to the integrated methodology to aid in the analysis of text as well. James Pennebaker (2011) developed Linquistic Inquiry and Word Count (LIWC) to analyze texts written by patients in the context of therapy with the idea "that the words people used—whether in a trauma essay or everyday speech—would reflect their feelings and that by the simple process of counting these words we could gain insights into their emotional states" (Kindle loc. 149 of 5368). LIWC classifies text using a standard dictionary into 80 categories. Two of those categories are especially useful in the calculation of sentiment, positive emotion

and negative emotion. We used these two categories to calculate a positivity index for a given text. The positive index is simply the ratio of the percentage of positive to the percentage of negative words. If the positivity index is above 2.9, individuals, marriages, and groups flourish; and if the index is below 2.9, they languish (Fredrickson and Losada 2005). Losada's research also indicates that a 2.9:1 (positive to negative) index is needed for healthy social interactions, referred to as the Losada Line. Studies suggest that high performance teams have a positivity index of 5.6, mixed teams an index of 1.8, and low performance teams an index of .4 (Fredrickson and Losada 2005). There also appears to be an upper limit of 11.6 where you can have too high of a positivity index.

Linguistic anthropology provided our research team with a micro perspective on both the interactions among commission members in the context of stakeholder meetings and the topics under discussion. Through the examination of interactional moves and sequences that constitute negotiations in meetings we were able to investigate interactional processes using conversation analysis (CA) and understand how these sequences played out in the stakeholder meetings (Wasson 1996, 2000, n.d.; Sacks et al. 1974; Schegloff 2007). Using issue framing (IF), which concerns the content of the negotiations, we were able to understand the perspectives on issues or topics of concern under discussion (Putnam and Holmer 1992). Conversation analysis and issue framing have been combined effectively to consider both the process of negotiation as well as the content (Wasson, n.d.). We also converted the conversation analysis turn-taking format into a social network format for network analysis. Speakers (nodes) could be then sized by seconds of talk time or other attributes, and the links could be sized by their frequency of occurrence. In addition, we compared issue frames with topics uncovered in semantic network analysis to both corroborate and explore content.

Network science (Wasserman and Katherine 1994; Monge and Contractor 2003; Gloor 2006, 2010; Gloor and Cooper 2007; Borgatti et al. 2013; Dominguez and Hollstein 2014; Robbins 2015), and social network analysis in particular, contributed theoretical and methodological approaches to our examination of the interactions both inside and outside stakeholder meetings. Efforts to develop a general theory of network governance advocate for an understanding of macrocultures and their development as well as the interaction of social mechanisms among members of a group collaborating within a joint activity (Jones et al. 1997). We considered network governance to be socially bound with evolving macro and microstructures of relationships among actors within specific contexts. We specifically used social network analysis to integrate email interactions with interactions inside the meetings.

Social network influence theory developed over the past 35 years by the social psychologist Noah Friedkin (1998) and Friedkin and Johnsen (2011) provided a useful framework for integrating analysis of computational social structure with data about social relationships to study social influence, opinion formation, and decision-outcomes in social networks. We employed Friedkin's algorithms and applied them to the turn sequences in the meetings and voting outcomes and to the broader social networks outside the meetings, revealed through analysis of

email, to examine social influence. We gained an understanding of the social power of the stakeholders both inside and outside the meetings and were able to map the evolution of stakeholder power in the decision-making process.

The disciplinary background of our research team members informed the development of our integrated methodology as well, of course. Wasson and Gluesing are both anthropologists with backgrounds in linguistic and cultural anthropology whose applied research has focused on the study of business and organization, specifically on group processes. Wasson has expertise in conversation analysis (CA) and the integration of CA with issue framing. Gluesing and Riopelle both have expertise in social and semantic network analysis. The interdisciplinary expertise enabled the intermingling of both an anthropological lens and a computational lens to examine and interpret the data.

A few words must be said about how our team collaborated online as well as face-to-face to conduct the exploratory research we describe in this chapter, as this collaboration model was also an important part of our integrative exploratory method. Our research team was mobile but was primarily located in the United States in California, Michigan, Oklahoma, and Texas. Our work online fulfilled both social and technical needs. We used an online platform, Amazon Workspaces,[1] which essentially served to facilitate easy desktop sharing of each other's work and provided an automatic backup of our data. The members of our research team, including a graduate research assistant, were all able to access the shared workspace, view each other's work, and locate and share all analyses. Only one person could access the Workspace at a time; however, we could view the Workspace by taking turns with online screen sharing. We could also demonstrate different techniques and discuss issues such as data preparation and coding and resolve technical problems as they arose. In addition, we took advantage of Dropbox to store and share project documents. The Dropbox folder was available inside Amazon Workspaces enabling us to integrate documents into our analysis software that we had installed in the Workspace. Online collaboration accommodated our team members' distributed locations and mobility, reduced our costs because we did not need to purchase dedicated computers, only one software license was required, and the services were free or billed monthly. Essentially, the study presented in this chapter represents an example of what Myer and Schroeder (Meyer and Schroeder 2009, 2015) are calling e-Research, "defined as the use of digital tools and data for the distributed and collaborative production of knowledge" (Kindle loc. 91 of 3408). E-Research is based on the understanding that the Internet and its associated infrastructure are enabling collaboration and advances in research practices that cross and connect multiple disciplines and domains (Meyer and Schroeder 2015). The e-Research that supported the collaboration in our own small team has the potential to expand and be extended to a large community of researchers studying environmental governance and governance in general.

[1] http://aws.amazon.com/workspaces/

3 Case Example: The Ordinance Commission

The study site was a city in the United States whose city council had recently decided to update its ordinance on gas well drilling, because of the rise of hydraulic fracturing in the area. The city council appointed a commission of five people to hold a series of eleven public meetings over a three-month period to make recommendations to the city to revise their current gas well ordinance. The example was bounded by known start and end dates and provided ready access to publicly available online data in addition to primary data we obtained through interviews and the personal email archives of commission members and city staff. The commission's meetings were open to the public and facilitated by a member of the city's staff. All the meetings were video recorded and meeting minutes were taken and published on the city's website. In parallel, an independent group of local citizens created a blog to serve as a sounding board and as a voice in recommending their own set of gas well ordinance revisions to the commission and city council for their consideration. Local news agencies covered the commission's meetings and the city council meetings and published articles about their deliberations.

Our study of the commission's deliberations began almost two years after their work together. The city records and citizen blog were readily accessible to us for analysis. We gathered news articles about the commission's activities through a LexisNexis search. Three of the five commission members and one city official who participated in the commission's meetings agreed to share their email archives with us. We also obtained copies of the city's existing gas well ordinance, the various revisions to the ordinance, and the final revised ordinance. Lastly, we conducted interviews with four of the five task members, a city staff member who attended the meetings, and the community blogger to ask about their perceptions of the commission's decision-making processes and the group's interactions. Table 2 provides a summary of all the data sources we used, and Fig. 3 illustrates the historical timeline of the data we gathered and studied to understand the commission's decision-making processes and practices and the commission's influence networks.

4 Methodological Integration of Multiple Network Analysis Tools

To integrate the meetings and networks data we gathered from a variety of online sources, we employed a variety of software tools to analyze the conversation and the issue framing in the commission's meetings and the structure, content, and sentiment of their networks, both inside and outside the meetings. Figure 4 shows the primary analytical software tools we employed to achieve the methodological integration. For networks we used Condor as our principal tool to analyze the email. We also used UCINET to calculate eigenvector centrality, relying on NetDraw to visual the results. To conduct semantic network analysis our primary tool was WORDij, and LIWC was used for sentiment analysis. Our qualitative analysis

Table 2 Data source summary

Data Sources	Kind	Number	Comment
1. Ordinances—official versions	Public Online	2	Official ordinance prior to commission and after recommendations were implemented
2. Ordinances—in-progress versions	Private Confidential	18	Versions of ordinance that sought to implement recommendations of commission, edited by city staff and consultants
3. Newspaper articles	Public Online	116	National (2), Metro1 (19), Metro2 (59), Local (36)
4. Annotated quasi-transcripts of decision-making meetings and their videorecordings	Public Online	11	All 11 decision-making meetings were quasi-transcribed and analyzed using conversation analysis[a]
5. Commission meeting minutes, before and after decision-making	Public Online	6	Minutes prepared by city staff
6. Blog	Public Online	1	Online blog archive
7. Email archives	Private Confidential	4	3 of 5 commission members plus 1 city official's email
8. Interviews	Private Confidential	6	Interviews with 4 of the 5 commission members, 1 city staff member, and 1 community stakeholder

[a]We prepared "quasi-transcripts" by writing turn-by-turn notes on what meeting participants said. We drew on the meeting minutes, but expanded them significantly. The quasi-transcripts were then analyzed using the principles of conversation analysis

software was Atlas.ti, which we used to do coding and to integrate analysis across the documents we created and to depict the results we obtained from the different data sources and tools. Amazon Workspaces, was our Cloud platform for the software tools and our research team collaboration. A detailed description of the software tools is included in Appendix.

We next describe the six methods and show how we conducted our analyses drawing on our mixed quantitative and qualitative toolkit of the content, sentiment, and structure of the interactions inside the commission meetings and outside the meetings among the commission members themselves and in the larger community. These six methods are just a sample taken from our work to share our generalizable, replicable, and scalable integrated methodology to demonstrate how it can contribute to our understanding of environmental governance in the hope that other researchers will find it useful and valuable. For each method we provide a brief example from our analyses to demonstrate how it actually works.

Our research process was both parallel and iterative. While Wasson was annotating the quasi-transcripts for conversation analysis and issue framing,

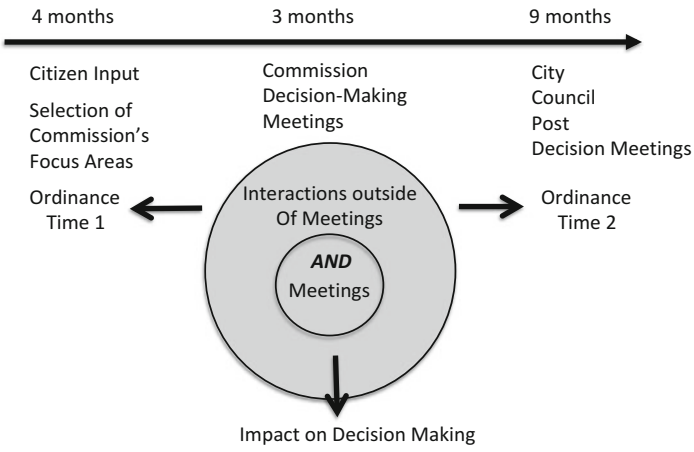


Fig. 3 Study timeline

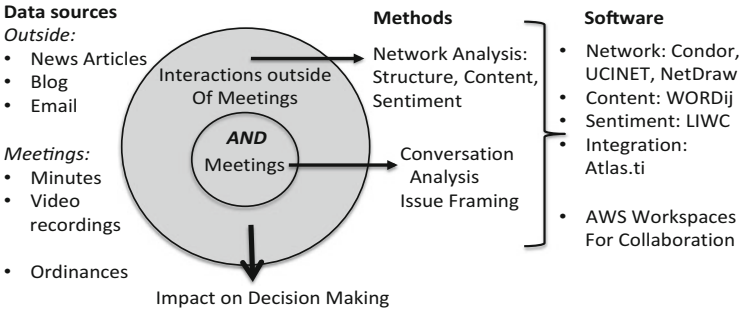


Fig. 4 Research software tools

Gluesing and Riopelle were conducting semantic and social network analysis on news articles, blogs, the meeting transcripts, the email, and the ordinance. We brought the results of these analyses along with the original texts (with the exception of email) into Atlas.ti for additional qualitative coding. We queried the data to find patterns. We used the results from the semantic and social network analysis to pinpoint areas for further in-depth investigation using qualitative methods, examining the text further for patterns and themes.

4.1 Method 1: Content—Proper Noun Index Method

Our first method shows how analyzing our data to uncover the trajectories of information in the commission's decision-making process was aided by the proper noun extraction utility in the WORDij software. For each of the four primary

Table 3 Sample proper noun extraction master list

Proper noun	Category	Blog	News	Email	Meeting minutes	Index: total number of sources
Name_01	Person	1	1	1	1	4
Name_02	Place	1	1			2
Name_03	Document				1	1
Name_n	Category_n					

sources of texts -- the news articles, the blog, the email, and the meeting transcripts[2]—we extracted a list of proper nouns (capitalized words and phrases) and edited this list to remove duplicates and leading capitalization of words at the start of a sentence. We combined these clean lists of proper nouns into a master list, which we sorted alphabetically and categorized by type: people, places, documents, organizations, regulations, topics, programs, events, funds, etc. We used the master list to indicate whether each proper noun was present (1) or absent (blank) in the blog, news, email, or meetings, and then totaled the number of sources for each proper noun, from 1 to 4, shown in Table 3, which is a sample of the proper noun master list by data source and category.

This tabulation gave us an indication of how prevalent a proper noun was across the data sources, which was an index of its influence, shown in Table 4.

To further examine the influence of proper nouns, we selected the 24 proper nouns that appeared across all four sources of data and tabulated them by category, shown in Table 5. For confidentiality, the table only includes the categories and is not a listing of the specific names or proper nouns assigned to each category. However, with this example, we want to provide a description of the analytical path that we used to reveal who, where, and what entered into the conversation most prominently in the meetings and in the extended social influence networks. The proper nouns provide an initial code list to use in Atlas.ti to further examine them in the specific context in which they appear to fully understand their meaning and the sentiment that surrounds them, for example, whether a person or organization was positively or negatively viewed by various stakeholders in the decision-making about the ordinance revision.

Not only could we analyze the most prominent proper nouns in context, but also those that were unique to a data source. With this view on the data, shown in Table 6, we could understand how each data source contributed a unique or specialized emphasis in the overall decision-making conversation. For example, the community blog included the most mentions of news sources (20 out of 32 were unique), and the news sources themselves had more mentions of organizations and people (organizations: 119 out of 224 were unique and people: 190 out of 352) than any of the other data sources. The email among the commission members

[2]The meeting transcripts were created by taking the meeting minutes available online at the city's website and elaborating them to create an abbreviated transcript for each meeting. This transcript was annotated using conversation analysis and issue framing and imported into Atlas.ti for coding.

Table 4 Tabulation of proper nouns by data source

Index number of sources	Count	Percent
4	24	1.5
3	38	2.4
2	129	8.1
1	1408	88.1
Total	1599	100

Table 5 Commonality of proper noun categories across data sources

Proper nouns common across all four data sources		
Category	Count	Percent
Role	1	4.2
Place	6	25.0
Person	9	37.5
Organization	6	25.0
News source	1	4.2
Group	1	4.2
Total	24	100

accounted for the majority of the unique topics (178 out of 333), roles (33 out of 50), regulations (24 out of 55), and documents (32 out of 54) in their discussion of the ordinance revision outside their meetings, which points to the importance of email as a medium for information sharing among the commission members. The meetings themselves were unique in their emphasis on the decision-making process itself and the phases of the process (8 out of 10).

The analysis of proper nouns and their categories enabled data integration across sources in a standardized way to see the way people, organizations, places, documents and other sources of information and discussion topics entered into the commission conversations and deliberations both outside and inside the meetings. This method makes the behind-the-scenes role of email in the interactions among the network of commission members, city officials, and others in the community readily apparent. With the filtering of proper nouns, Atlas.ti could be used to auto code text segments to get a contextual understanding of their associated meanings and roles they played in the decision-making.

For example, we chose one of the of six places identified in Table 5 that appeared in each of the four data sources—newspaper articles, the blog, meetings, and email—and searched for the place name in Atlas.ti to code manually for its meaning in context. The place, a neighboring city in the metro area we studied, and which we refer to as “City 1”, made headlines for its adoption of tough oil and gas drilling regulations. The tough regulations were covered in national and local news as well. In the blog, City 1 was held up as an example of a strong ordinance that should serve as a model for the study city and as justification for amendments to the current city ordinance. In the meetings as well, commission members discussed City 1’s ordinance as an example for upgrading the study city’s own ordinance. In email, the commission members and others from the community exchanged views about

Table 6 Unique proper nouns by category and data source

	Sole source category	Blog count	News count	Email count	Meetings count	Category count	Category percent
1	Document	5	5	32	12	54	3.8
2	Event	6	2	5	5	18	1.3
3	Forum	4	0	0	0	4	0.3
4	Fund	0	1	0	1	2	0.1
5	Group	4	6	8	5	23	1.6
6	Movie	1	1	1	1	4	0.3
7	News source	20	6	5	1	32	2.3
8	Organization	33	119	62	10	224	15.9
9	Person	49	190	45	68	352	25.0
10	Phase	0	0	1	2	3	0.2
11	Place	21	73	59	37	190	13.5
12	Plan	1	0	2	0	3	0.2
13	Process	0	0	1	6	7	0.5
14	Program	1	0	5	1	7	0.5
15	Project	1	0	0	0	1	0.1
16	Radio program	0	0	1	0	1	0.1
17	Regulation	10	2	24	19	55	3.9
18	Role	5	7	33	5	50	3.6
19	Social media	2	1	2	0	5	0.4
20	Topic	66	44	178	45	333	23.7
21	Type	1	6	24	9	40	2.8
Source count		230	463	488	227		1408
Source percent		16	33	35	16		100

the pros and cons of using City 1's ordinance as a role model and highlighted the role of citizen action in the successful adoption of City 1's tough regulations. Different codes related to City 1's ordinance, such as "Benchmark ordinance" or "Oil and gas regulation: tough" could be quickly applied to mentions of City 1. We learned by applying semantic network analysis to extract proper nouns and then strategically doing qualitative coding for meaning in context that benchmarking of neighboring cities' ordinances was influential in the commission's decision-making activity. This same searching and quick coding process could be applied to the other 25 proper nouns that we determined were important from the proper noun index method.

4.2 Method 2: Content—Text Correlation Comparison Method

This second method continues our illustration of the analysis of content with the text correlation comparison method. We used this method to analyze how the original ordinance, which was the object of the commission's decision-making,

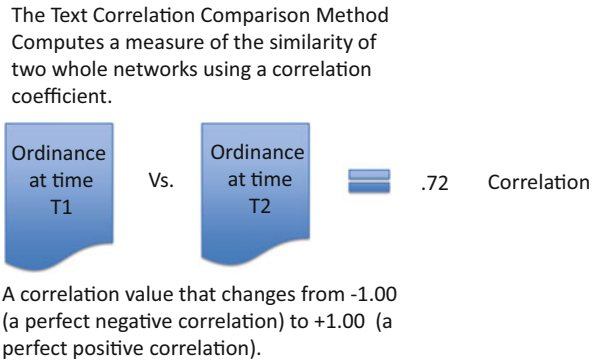


Fig. 5 Method 2—Text correlation comparison method using WORDij to run QAPNet.

changed over time. We compared the initial version of the ordinance at the start of the decision-making meetings with the final ordinance that eventually was adopted by the city. We want to point out that the nature of the commission's work was advisory. Their job was only to make recommendations to the city council about the way the ordinance should be revised. Ultimately, once the commission had disbanded, the ordinance went into a review and revision process within the city government that eventually produced a draft for public comment and the final legal document that became the revised city ordinance governing gas wells.

Our analysis used the WORDij software and the QAPnet module to get a statistical correlation of the similarity or difference between the two versions of the ordinance, Fig. 5. The Pearson Correlation was 0.72, which indicates that 28% of the revised document was different from the initial document.

Although our second method of analysis is focused on the comparison of a city ordinance at two different points in time, the text correlation comparison method contributes a great deal to our integrated methods set because it can be used on any two texts or combined texts, such as newspaper stories, blogs, emails, and meeting minutes to obtain a simple static comparison of two different texts or a measure of change over time in the same text. This quantitative comparison of text resulting in a single measure of correlation provides a broad indication of similarity or difference in two bodies of text. It does not lend itself to qualitative coding, except perhaps to pinpoint variation that might be worthy of qualitative investigation. Comments could be appended to the documents to characterize contents and annotate the relationship of the document to others in the dataset. We did this to annotate changes over time and compare documents in one time segment with those in another.

4.3 Method 3: Content—Text Word and Word Pair Comparison Method

Method 3 further elaborates the text comparison method by showing not only how similar or different two texts are but also *how* they are alike or different by identifying the words and word pairs that are unique to each text and what words or word pairs they share. For our analysis of the ordinance we used the WORDij Z-Utilities module to tell us statistically what words and word pairs were new in the final version and what was dropped in the wording.

Table 7 shows a comparison of the word frequencies between the old and the new ordinance. It indicates that there is a difference in emphasis in the new ordinance. There are some abbreviations and word substitutions, such as inspector for marshal, that reflect changes in the government structure for gas well oversight. The new ordinance also focuses more on the administration and regulation of the production process and on health and environmental factors than did the old ordinance (specific words are: production, government, health, quality, regulation, water, site, emissions, fencing), and the difference is statistically significant at the ± 1.96 level on standardized z-scores.

In Table 8, the words water, site, and fracturing are mentioned proportionally in both, and while there is not a significant difference between the two ordinances at the ± 1.96 level, there is a noticeable increase in the use of these words in the new ordinance.

The initial ordinance has statistically significantly more mentions of community, development, area, and planned, indicating more of a planning focus rather than on the regulation of existing wells, shown in Table 9. The words railroad, fire, and marshal all reflect the change in naming conventions and in government structure for regulation of gas wells.

In addition to examining single words, we also analyzed the word pair frequencies, sorting by the first word in the word pair and the second word in the word pair. The results, Table 10, reinforce the interpretation that there is more of a focus on the quality of water in the revised ordinance. There were no mentions of these word pairs in the initial version of the ordinance.

In presenting our third method, we illustrated how a text comparison method at the word and word pair level can contribute to our understanding of how governance evolves because texts, such as the gas well ordinance in our case, are often the objects of decision-making. The method was also invaluable in analyzing the content of the conversations in blogs, emails, newspaper stories, and the meetings themselves to understand the evolution of the general governance conversation about the ordinance as it unfolded.

Using this "first look" at the content enabled us to follow up with word or word pair searches and auto coding in Atlas.ti of the meeting texts to elaborate our understanding of discussions about water, for example, and to see how the commission members were framing the issues. A search in Atlas.ti of the revised ordinance for the word pair "water pit" revealed a definition for the term and a list of requirements related to the use of water pits, which were not in the initial

Table 7 Comparison of the words in the initial and final revised city ordinance

Word	Old ordinance frequency	New ordinance frequency	Old ordinance proportion	New ordinance proportion	Z-score	Chi square
[Abbreviation]	0	27	0.000	0.003	−4.31	NA
Inspector	18	68	0.003	0.008	−3.75	29.07
Oil	27	86	0.005	0.011	−3.65	30.81
Soil	0	17	0.000	0.002	−3.42	NA
Adjustment	0	16	0.000	0.002	−3.32	NA
Amendatory	0	16	0.000	0.002	−3.32	NA
Petition	0	13	0.000	0.002	−2.99	NA
Variance	0	13	0.000	0.002	−2.99	NA
Twelve	0	12	0.000	0.001	−2.87	NA
Data	0	11	0.000	0.001	−2.75	NA
Disposal	0	11	0.000	0.001	−2.75	NA
Flowback	0	11	0.000	0.001	−2.75	NA
Compressor	0	10	0.000	0.001	−2.62	NA
Hydraulic	0	10	0.000	0.001	−2.62	NA
Sampling	0	9	0.000	0.001	−2.49	NA
Subsequent	0	9	0.000	0.001	−2.49	NA
Production	81	162	0.015	0.020	−2.36	27.00
Exception	0	8	0.000	0.001	−2.34	NA
Extent	0	8	0.000	0.001	−2.34	NA
Government	0	8	0.000	0.001	−2.34	NA
Health	0	8	0.000	0.001	−2.34	NA
Quality	0	8	0.000	0.001	−2.34	NA
Regulation	0	8	0.000	0.001	−2.34	NA
Ordinance	6	23	0.001	0.003	−2.20	9.97
Closure	0	7	0.000	0.001	−2.19	NA
Compatible	0	7	0.000	0.001	−2.19	NA
Emissions	0	7	0.000	0.001	−2.19	NA
Fencing	0	7	0.000	0.001	−2.19	NA

Table 8 Key words in the ordinance

Word	Old ordinance frequency	New ordinance frequency	Old ordinance proportion	New ordinance proportion	Z-score	Chi square
Water	19	42	0.003	0.005	−1.52	8.67
Site	102	178	0.018	0.022	−1.47	20.63
Fracturing	3	11	0.001	0.001	−1.47	NA

ordinance. Codes such as “Water pit: definition” or “Water pit: new requirements” could be applied easily to the text along with other similar codes related to water to get a more holistic picture of how regulations in the ordinance related to water use.

Table 9 Planning focus in ordinance

Word	Old ordinance frequency	New ordinance frequency	Old ordinance proportion	New ordinance proportion	Z-score	Chi square
Community	11	4	0.002	0.000	2.57	NA
Development	96	92	0.017	0.011	2.91	0.09
etj	6	0	0.001	0.000	2.96	NA
Area	28	16	0.005	0.002	3.10	3.27
Drill	26	14	0.005	0.002	3.13	3.60
Commission	24	12	0.004	0.001	3.17	4.00
Permit	152	151	0.027	0.019	3.39	0.00
Railroad	21	5	0.004	0.001	4.16	9.85
Planned	24	5	0.004	0.001	4.61	12.45
Fire	54	25	0.010	0.003	5.02	10.65
Marshal	45	12	0.008	0.001	5.89	19.11

The online availability of a municipality's ordinances, either on the city's own website or from services such as municode.com, make it possible to easily download a set of ordinances and use the text correlation comparison method and the text word and word pair comparison method to understand how an existing or proposed ordinance is evolving or how two cities' ordinances are similar or different. Researchers can aggregate ordinances across states or larger geographical areas or time spans and perform the same type of analysis with these methods by simply appending the ordinance text files together at the desired level of analysis. E-Research like this is a powerful method to understand and evaluate environmental governance.

Word and word pair comparison method proved to be a useful corroboration of the issue frames that were qualitatively derived through coding. For instance, two of the issue frames that emerged as important in the commission's first decision-making meeting concerned whether or not the wording of commission's recommendations mattered. Segments of the text from the meeting transcript were coded "Frame: wording matters" and other segments were coded "Frame: wording doesn't matter". When we compared the issue frames from the first decision-making meeting with the results of the word pair comparison, we found similar framing in word pairs like "wording not" and "[commission member] wording. In the first meeting, one industry commission member was predominant in using the "wording matters" frame (64% of the text segments were coded with this frame). It is not surprising that his name was associated with wording in the word pairs as well. Issue frames derived from coding can best be compared with word pairs derived from WORDij when in vivo coding is done. Qualitative in vivo coding and WORDij word pair comparison can inform each other.

Table 10 Dominant word pairs in the revised ordinance

Word 1	Word 2	Old ordinance frequency	New ordinance frequency	Old ordinance proportion	New ordinance proportion	Z-score
Water	Pit	0	6	0	0.001	−2.14
Water	Supply	0	6	0	0.001	−2.14
Water	Condensate	0	4	0	0.001	−1.75
Water	Conservation	0	3	0	0.000	−1.51
Water	Process	0	3	0	0.000	−1.51
Water	Production	0	3	0	0.000	−1.51
Watershed	Application	0	4	0	0.001	−1.75
Watershed	Permits	0	3	0	0.000	−1.51
Fresh	Water	0	5	0	0.001	−1.95
Contaminating	Water	0	4	0	0.001	−1.75
Process	Water	0	3	0	0.000	−1.51

4.4 Method 4: Sentiment—Positivity Index Method

Method 4, the Positivity Index Method, measures the sentiment present in text. It has proven to be one of the most revealing measures in understanding the ratio of positive to negative words in a text as measured by the Linguistic Inquiry and Word Count (LIWC) standard dictionary. The Positivity Index of a body of text, especially when it is benchmarked against the Losada Line (2.9) that is the threshold or tipping point at which social interactions are thought to flourish or flounder (Fredrickson and Losada 2005), signals when a deeper look at social interactions might prove fruitful. In our study we used the Positivity Index Method to help us understand when a more in-depth, ethnographic investigation might be necessary to understand the issues being discussed in the commission meetings. With online video recordings freely available, we could look more closely at interactions to understand people's positions and their framing of issues as well as the content under discussion. Watching the interactions helped us understand the decision-making process and how it changed in relationship to the topics the commission was discussing.

Figure 6 depicts the Positivity Index for all seventeen of the commission meetings that were part of our study. The eleven core decision-making meetings are numbers four through fourteen. It is easy to see that meetings six through eleven were low points in the commission's decision-making process where negative emotion was prevalent.

Specifically, meetings nine and eleven represent the most meetings with the most negative sentiment, well below the Losada Line at 1.68 and 1.65 respectively. In each of these two meetings there were three defeated motions. All three of the industry commission members voted nay to defeat these proposed motions with two yay and three nay votes. There was a clear split between the three industry members on the commission and the two environmental members in their voting patterns. The highest number of nay votes occurred in these two meetings, 9 and 11 respectively, thus the Positivity Index proved to be a good indicator of the contentiousness or controversy over issues being discussed. We further explored the issues under discussion by examining the transcript and watching the videos. The defeated motions all concerned on-site requirements for gas well drilling regarding ambient noise levels, maintenance of storage tanks, and boundary lines. It is clearly possible also to explore the text sources outside of the meetings such as in the email, news, and blog to look for mentions of these issues and learn how the issues are positioned, what the evidence is pro or con for each issue, and to understand the framing of the issues by various stakeholders. We could also learn whether the issues were unique to the local community we were studying or shared by other communities using key words identified in the meeting text to search the additional text sources. The positivity index was especially powerful in helping us decide which of the meetings should get additional coding for the conversation networks method, described in Method 5. In general, when the positivity index is applied in longitudinal analysis or across different text sources, the variability in sentiment can be quickly identified, which can be very useful in qualitative data analysis when

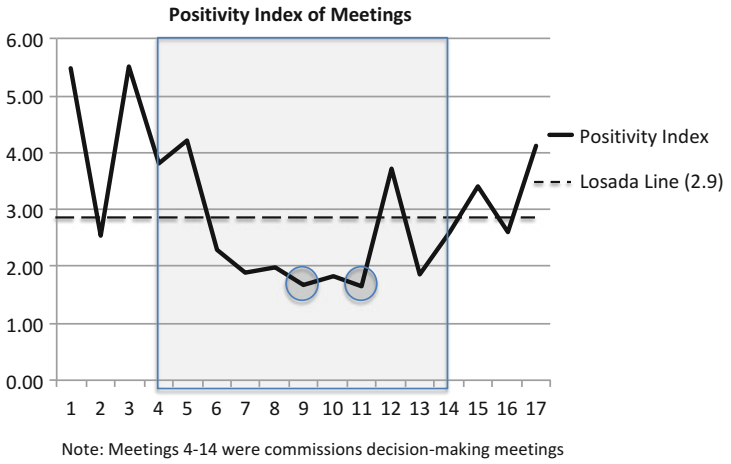


Fig. 6 Positivity Index by meeting as a measure of sentiment for all 17 meetings. The 11 decision-making meetings are shaded and numbered 4–14

there is a very large body of text. Text can be prioritized for analysis based upon the research questions being investigated.

We developed the Positivity Index Method in a previous National Science Foundation grant[3] (Gluesing 2012; Riopelle 2012) and have been using the method with much success ever since. However, we must mention one caveat about the Positivity Index. We have found that in some texts the LIWC dictionary does not find any negative text to calculate the negative emotion, rendering it impossible to calculate a Positivity Index because division by zero is undefined.

4.5 Method 5: Structure—Conversation Networks Method

Our fifth method is an example of one of the ways that we understood the influence of relationships among stakeholders on decisions and the agency of social actors in the decision-making process. To examine these two aspects of decision-making, we created network views and calculated network statistics for interactions in the meetings and outside the meetings using email. We used the Friedkin and Johnsen social influence network theory (Friedkin and Johnsen 2011) and the model[4] for the

[3]DHB: Accelerating the Diffusion of Innovations: A Digital Diffusion Dashboard Methodology for Global Networked Organizations. Award No. SES-0527487

[4]$\mathbf{y}^{(t)} = \mathbf{AWy}^{(t-1)} + (\mathbf{I} - \mathbf{A})\mathbf{y}^{(0)} \quad (t = 1, 2, \ldots)$ $y^{(t)}$ is an opinion vector of n × 1 dimensions at time t. Matrix A is a diagonal matrix of n x n where n represents the influential nodes in the network and the diagonal, a_{ii}, is an indicator of susceptibility to another's influence from 0 to 1. Matrix W is an interpersonal influence matrix, which is row stochastic (rows sum to 1) and the diagonal, w_{ii}, is equal to 1-a_{ii}. If $w_{ii} = 1$, then a person is completely closed-minded, and if $w_{ii} = 0$ then a person is

From:
Conversation Analysis Format:

Turn	Start Time	End Time	Total Turn Time	Speaker	Content	IF	CA
Introduction							
1	0:00	4:03	4:03	A	Opened Meeting, reviewed agenda	IF coding	CA coding
2	4:03	4:30	0:27	B	. . . abbreviated transcript . . .	IF coding	CA coding

To:
Network Analysis Format

Speaker's or Nodes are assigned unique Ids		Sequence of Speaker Turns are Reformatted as Network Links: FROM this speaker TO this speaker	
Id	Node	From Id	To Id
1	A	1	2
2	B	2	3
3	C	3	1

Fig. 7 Conversion of turn taking in meeting transcript to network analysis format

evolution of social influence networks (Friedkin 2014) to calculate and predict opinions (votes) in decision-making.

We began our analysis by converting a meeting transcript with conversational turns annotated into a network analysis format in which each speaker or "node" was assigned a unique identification (id) number and the sequence of speaker turns was formatted as the links (FROM speaker TO speaker) as depicted in Fig. 7.

Figure 8 shows the results of the conversion for the first official meeting of the commission's decision-making process.

In the network visualization depicted in Fig. 8, the nodes or persons are labeled A through H and have been sized by the number of seconds each person spoke during the meeting. The turns or links are sized to indicate the frequency of the links between nodes. The network diagram is essentially a summary of the interactions in the first commission decision-making meeting. One of the nodes is quite a lot larger than the others. This node, Node A, represents the meeting facilitator who is a dominant person in this meeting. When we watched the video recording of the meeting, we could observe that much of the interaction in the meeting was focused on the topic of meeting organization and process, so the network map made a great

completely open-minded. I is an identity matrix where the diagonal is equal to 1. $y^{(0)}$ is a vector of people's initial opinions.

From A listing of Turns

Turn	Start Time	End Time	Total Turn Time	Speaker	Content	IF	CA
	Introduction						
1	0:00	4:03	4:03	A	Opened meeting, reviewed agenda	IF coding	CA coding
2	4:03	4:30	0:27	B	……abbreviated transcript …	IF coding	CA coding

To a Network Map of Interactions

Speakers/Nodes Sized by seconds talking

Turns (From-To)/Links Sized by frequency

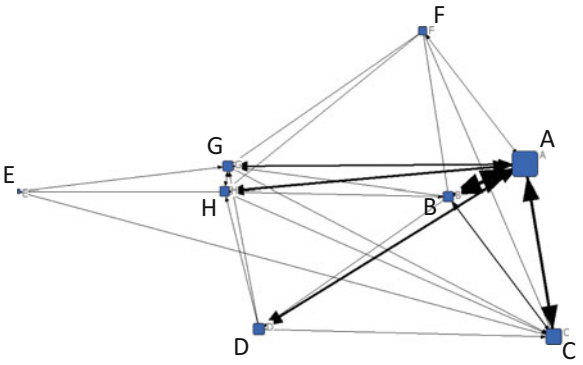


Fig. 8 Results of conversion of turn-taking in transcript form to network visualization

deal of sense to us. We were also able to observe in the map that there was considerable directed interaction among the commission members themselves, which was also evident in the video recordings. The network map is a quantifiable indication of the pattern of interactions and a measure of each person's relative "talk time" and interactions with others in the meeting. It also is a reliable and replicable method because it reduces researcher bias in qualitative coding or interpreting meeting interactions.

4.6 Method 6: Structure—Social Influence Network Theory Method

Our sixth and final method is another structural network method complemented by qualitative conversation analysis. This method particularly illustrates how the formal structural analysis can be used to detect and define specific areas of interest in the group interaction that can be most profitably analyzed using qualitative methods to gain a deeper understanding of group dynamics.

4.6.1 Structural Network Method

The conversion of the meeting transcript to a network format based on turn taking opened up the use of network metrics for additional analysis, specifically the

calculation of eigenvector centrality, the primary influence metric in the Friedkin and Johnsen (2014) social influence network model. Eigenvector centrality can be defined as one method of computing the "centrality", or approximate importance, of each node in a graph. The assumption is that each node's centrality is the sum of the centrality values of the nodes that it is connected to.[5] Jia et al. (2016) equates a person's eigenvector centrality to that person's social power, or their ability to influence an outcome, a decision or vote in a meeting, for example. The illustrations in Fig. 9 provide a conceptual overview of the networks in the two weeks prior to the first decision-making meeting, during the decision-making meeting, and the two weeks after the decision-making meeting.

There are two important points to make about these networks. First, in the two weeks prior to the meeting there are many more people involved in the email conversation, twenty-one versus eight, than just the commission members. A look at the email content indicated to us that there was considerable information gathering and sharing of resources to inform the commission's decision-making. Second, it is possible to see the increase in prominence of Nodes A, E, and F prior to the meeting. These nodes represent the meeting facilitator and two city staff members. During the commission meeting their prominence declines, and then picks up again in the two weeks following the meeting. The Social Influence Network Theory Method contributed greatly to our understanding of the influence or agency of specific social actors in the commission's network both inside and outside the commission's meetings. We were able to integrate nicely as well the quantitative results of social network analysis with the qualitative data from conversation analysis and ethnographic observation. For example, the qualitative conversation analysis revealed that the commission members maintained the same frames throughout the interactions across meetings, and when we interviewed them two years after the conclusion of their commission work, their issue framing remained the same.

Table 11 and Fig. 10 shows the eigenvector centrality scores that were used to calculate the influence of meeting participants and of those outside the meeting who also had a measure of influence based upon their email correspondence. In this particular meeting there were eight participants labeled with IDs A through H and an indication of their roles within the meeting. For example, the city facilitator is shown as ID A with eigenvector centrality scores of 0.409, 0.631, and 0.382. The graph in the figure visualizes the change in network influence across the three time periods.

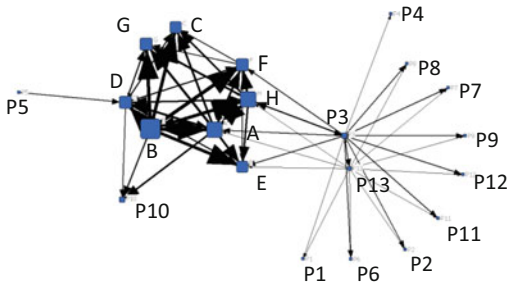
There are several points of interest in the influence network depicted in Fig. 10, elaborating the results shown in the network views in Fig. 9. First, it is clear that the city facilitator played the most prominent role in the meeting. The facilitator had less of an influence in the interactions pre- and post- meetings, but he was still an important person, dropping only to second outside the meeting according to the eigenvector centrality score. Second, nodes E and F, who represent city staff that

[5] http://demonstrations.wolfram.com/NetworkCentralityUsingEigenvectors/

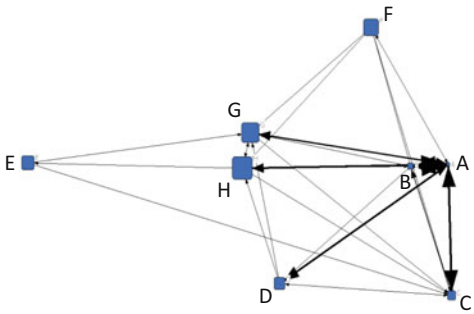
$$y^{(t)} = AWy^{(t-1)} + (I\text{-}A)\, y^{(0)} \quad (t=1, 2, \ldots)$$

All nodes sized by eigenvector centrality. Links sized by from-to frequency.

Email Network Prior 2 weeks: Nodes=21, Links = 343



Task Group Meeting: Nodes=8 Turns, Links = 198



Email Network Post 2 weeks: Nodes=21, Links=1002

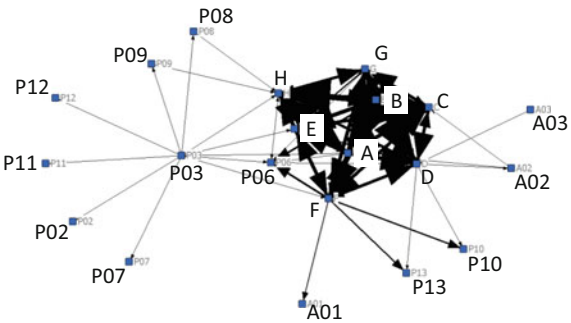


Fig. 9 Application of the concept of social influence network theory to the first commission deliberation decision-making meeting and the 2 weeks pre- and post-meeting

Table 11 Eigenvector centrality scores for Commission members A–H

Commission members and city staff	ID	Pre 2 weeks Eigenvector centrality	Meeting date	Post 2 weeks Eigenvector centrality
City facilitator	A	0.41	0.63	0.38
Industry	B	0.53	0.47	0.47
Industry	C	0.25	0.41	0.34
Industry	D	0.30	0.27	0.31
City staff	E	0.26	0.04	0.28
City staff	F	0.30	0.09	0.34
Environment	G	0.28	0.24	0.33
Environment	H	0.39	0.28	0.34
	P01	0.00		
	P02	0.00		0.00
	P03	0.08		0.02
	P04	0.00		
	P05	0.01		
	P06	0.00		0.07
	P07	0.00		0.00
	P08	0.00		0.00
	P09	0.00		0.00
	P10	0.09		0.02
	P11	0.00		0.00
	P12	0.00		0.00
	P13	0.02		0.02
	A01			0.01
	A02			0.01
	A03			0.00

interact with commission members via email outside the meeting, had scores below .1 on the eigenvector centrality measure during the meeting, indicating that their influence was minimal within the meeting interactions. Third, one industry commission member, ID B, had consistent influence both outside and inside the meeting. The two members of the commission who represent the voice of the environmentalists, IDs G and H, were also consistent in their influence pre-, during, and post-meeting, but they had less influence in general than the industry members. Fourth, it is possible to see that there was a wider group of people who interacted with the commission members and city staff prior to the first meeting, labeled P01 through P13, however, their influence appeared to be minimal. They all had eigenvector centrality scores below .1. Likewise, after the meeting, some of the people participating in the email network pre-meeting dropped out of the email network after the meeting (P01, P04, P05), and three new people entered the network after the meeting (A01, A02, A03).

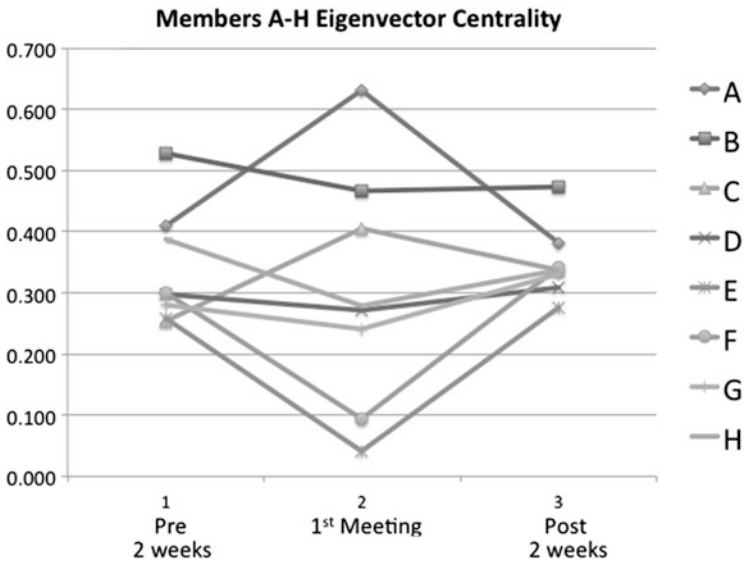


Fig. 10 Illustration of the social influence network with eigenvector centrality scores pre-, during, and post- first commission decision-making meeting

4.6.2 Qualitative Conversation Analysis

Looking at the actual content of the meeting and email transcripts provided us with a closer, qualitative look at the nature of the content being discussed and the information being exchanged, which helped us to elaborate how the commission members, the city staff, and those in their extended networks influenced the issues in the deliberations about the ordinance revision. For example, in emails during the two weeks prior to first meeting, the city facilitator dealt primarily with administrative issues such as the following, taken from an email:

> Would you please send proposed Actions/Remedies to address the Air Quality Focus Area prior to the [date] meeting. This will give us the opportunity to put them in some sort of report or presentation and may save some time during the actual meeting.

During the meeting, the facilitator moderated the flow of the meeting and summarized proposal and votes. In the two weeks following the meeting the facilitator continued to clarify the meeting process and decision-making practices sending out meeting minutes for review, requesting proposals for the next meeting focused on the topic of water, reminding people that the meetings would be recorded and posted on the city web site, and discussing the vetting of public meeting cards. The facilitator also answered questions of clarification not just from commission members but from city council members and others in the community, for example:

> A concern was raised and I wanted to get some clarification on it—it relates to the task force members' use of PowerPoint slides during the meetings. Are you enacting a no-PP policy?

In another example taken from the two weeks prior to the first meeting, the email also contains evidence of attempts at coalition building among two of the industry representatives to the commission:

> I especially wanted you to receive a copy [of my discussion paper] because I hope you will help me sell the idea of best practices as a means of controlling some of the environmental problems without unreasonable cost to the gas companies.

In the wider interactions pre- and post- meeting, community members also sent reports to commission members and discussed key points that should be represented in their deliberations. In one email, for example, one resident points out recent links to gas well drilling news. In another, a community member suggests that the city could send a representative to a workshop at a university. The content of the email was a rich source of insight into how topics from the extended network got introduced into the discussion among the commission members.

In our analysis, we also set out to see if we could predict the commission's vote on the first motion in the first meeting. We calculated the influence measures needed as input for the Friedkin and Johnsen model (2014), we spent some time watching the video recording of the first meeting to see what we perceived to be the initial positions on the first motion based upon how the members discussed the issue. We used the eigenvector centrality of the members leading up to the vote as a measure of w_{ii}. We then calculated the remaining w_{ij} scores based upon network count of in-degree links. We set the city staff position to be neutral on the issue at .5. The resulting prediction is depicted in Fig. 9. We were successful in our prediction. In this first vote, four of the five commission members voted yay (1), and one commission member voted nay (0). We had predicted that this one member would indeed vote this way.

What is important to emphasize in using the model calculation is that its reliability depends upon an understanding of context and an estimation of people's initial positions based on this understanding. We relied on our ethnographic analysis of the video recording in combination with the structural analysis of turn taking to obtain the prediction. As Friedkin himself has stated (Friedkin 1998, p. 213):

> Ironically, this work leads to an appreciation of qualitative ethnography as an adjunct to structural analysis. The outcomes of the social influence process that I have described are determined by the particular, more or less idiosyncratic, set of conditions under which the process occurs. The contextual conditions of the process are the structure of social space and the influence network that connects the actors in this space; and these conditions are shaped by numerous factors. For an understanding of the exact structure of a given social space and influence network, we not only must attend to the important bases of social differentiation and to the status characteristics of the actors, but also may have to take into account unique local conditions (traditions, ecology, events) and individual personalities and animosities. Because the structure of social space and influence networks do not conform to standard templates, the analysis of an influence system is a form of descriptive ethnography—a network ethnography.

Overall, the methodological conversion of conversational turn taking in meeting transcripts into a network format, the application of network analysis to email and meeting interactions, and the use of the Friedkin and Johnsen (2014) social network theory model, all supported by qualitative analysis, appear to be fruitful means to study decision-making in the context of environmental governance.

5 Conclusion

Recall that the purpose of this study was to conduct exploratory research to develop a potentially transformative research methodology to examine decision-making in the context of environmental governance. We integrated two previously separate approaches, the analysis of decision-making inside meetings and the analysis of conditions in the broader context outside meetings, using multiple methods to uncover and understand the complex decision-making processes that involve multiple stakeholders with diverse interests and sometimes differing ideologies. Our research incorporated multiple data sources and ethnographic and computational perspectives and methods, integrating them in new ways to conduct an evolutionary and systems oriented analysis of decision-making in context.

Although this chapter only described some of the methods we used in the study, focusing primarily on semantic and social network analysis that we elaborated with qualitative data analysis, we believe that these approaches can stand on their own. They combine publicly available online data with primary data gathered through ethnography and are a powerful way to achieve integration of insights about both the context that surrounds and influences specific decision-making processes and practices and the decision-making processes and practices themselves that constitute governance. The methodology described here integrates interdisciplinary perspectives, methods, and tools at the data level.

In addition, we believe the Integrated Methods Set, and specifically the Proper Noun, Positivity Index, Text Correlation Comparison, and Text Word and Word Pair Comparison Methods, are generalizable to other environmental governance contexts and can be scaled to examine the interactions in local, state, national, and even international governance groups and issues. Other researchers should also be able to reproduce the same results given the same data because the methods are computational. The Conversation to Network Method is generalizable but limited to speaker turn data sources, such as meeting transcriptions or video recordings, but it is reproducible nonetheless. It does have limited scalability due to the manual coding of turns required to format the data for network analysis. Social Influence Network Theory also is generalizable and reproducible but limited to data sources that lend themselves to network analysis, such as email and meeting interactions, and to ethnography. The full power of the Integrated Methods Set can be realized when the methods are used in conjunction with qualitative methods and analysis software, such as Atlas.ti, that facilitate additional coding and grounded theory building. Ethnography, and network ethnography especially, also are essential to understand fully the context of environmental governance and decision-making.

While our primary purpose in the study was on developing data integration of diverse methods and tools, we did learn about the four aspects of decision-making on which we focused our analyses. We offer just a few of our insights here. First, regarding trajectories of information and the frames commission members used in their interactions, we can say that discussions in the meetings were limited to the publicly informed focus areas for which the commission members were to make recommendations to the city for ordinance revision. However, the email discussions among commission members were much broader, including members of the public and outreach to sources of expertise to obtain information about these focus areas.

Second, we learned about the influence of relationships among stakeholders on commission decisions. Surprisingly, the commission members did not develop interpersonal relationships with one another outside the commission meetings (Wasson and Gluesing 2015), and they had rather different networks as revealed in the email analysis. In some ways, these diverse networks contributed to the decision-making by bringing in a wide perspective of views shaped by their membership in different stakeholder groups. However, unlike in business contexts where relationships are longer term, the commission members were with each other for a short and defined period and perhaps did not feel the need to engage in affiliation behaviors. The most influential stakeholder groups, according to the frequency of mention across meetings, news articles, and the blog were the industry stakeholders, followed by city officials and city residents, and then by the environmental activists whose voices were primarily heard through the blog.

The findings about the agency of social actors was revealing of the governance process, particularly about the role of the commission with respect to city government. The city council and government officials exerted quite a bit of influence over the commission, in the selection of its members and in the facilitation of the meetings. We also learned further about the importance of examining the content as well as the structure of interactions. In our network analysis, we found that the environmentalist responsible for the blog structurally had the highest degree central in the email network. However, when we analyzed the message influence, the environmentalist dropped to tenth place.

In perceptions of decision-making, the city staff spent a lot of time in the emails prior to the decision-making meetings and in the first meetings enculturating the commission members. The commission meeting process itself was shaped by the broader city culture of decision-making and normative practices in public councils and committees, most of which involved a loose reliance on Robert's Rules of Order (RRO). In early email interactions, one of the commission members suggested that Robert's Rules of Order be adopted in proffering motions and in the voting process. The conversation analysis revealed that the majority of conversation sequences were either information sequences or Robert's Rules of Order sequences.

In this exploratory study, the digital tools, online data, and Cloud collaboration we used collectively and in distributed mode are also examples of new research methods. Research conducted online, called e-Research, is reshaping how knowledge advances occur in disciplines that range from physics to literary analysis

(Meyer and Schroeder 2015). Social scientists have generally been historically trained to work as independent researchers or in small teams, limiting the amount of data that they can process and the scope of their research. The Internet infrastructure and the Integrated Methods Set we have described in this chapter enable an expansion of the role social scientists can play in understanding domains of analysis such as environmental governance by enlarging both the amount and scope of data that social scientists are able to analyze. The relationships among social scientists and among social scientists and researchers from other disciplines are also facilitated by this integrated approach. Lastly, the Integrated Methods Set can shorten the time it takes to code a large corpus of text in comparison to the manual coding in traditional qualitative research and can direct attention to novel insights in the text through the strategic application of quantitative methods to target qualitative coding. We believe the Integrated Methods Set can be transformative as a new methodology to conduct social science e-Research.

While this research project represents an analysis of an historical case, the methodology we used could be applied in near real time to analyze an ongoing governance situation and to project trends going forward. We plan to continue our research in that vein and hope that other researchers will also find our integrated methodology valuable in their own work to understand the processes of environmental governance as part of a dynamic, complex system with its own unique contextual influences.

Appendix

The following is a brief description of the primary software tools used in this study, namely: Atlas.ti, Condor 3, Linguistic Inquiry and Word Count (LIWC) and WORDij.

Atlas.ti 7 http://www.atlasti.com

Atlas.ti is a qualitative data analysis (QDA) software program with over 20 years + in the making. It handles text, pdfs, multi-media data and quantitative surveys. Coded data can be exported to SPSS for quantitative analysis. A primary strength of the software is the theoretical model building capability. ATLAS.ti is the only QDA software that offers universal data export and supports open data formats. Project data remain "free," permanently accessible, and reusable in a myriad of other applications, including long-term archives.

Condor 3

Condor 3 is a social network program, which enables a single user, a team, or a company to visualize and measure the structure, content, sentiment and influence of social communication networks over time. It has the ability to generate interactive movies of communication flows for in-depth analysis. Users can analyze different social media channels including: The Web, Email, Facebook, Twitter, Wikipedia, and more, all in a single visualization. It runs on a Mac, a Windows PC, Linux, and in the Cloud. Condor 3 is menu driven and requires no programming expertise and exports data easily to other software packages for additional analysis, graphing or mapping. Condor is free for academic use.

For a quick overview of Condor watch the Welcome to Condor 3 by Peter Gloor (13:51) http://youtu.be/vfWfeywCskQ

Linguistic Inquiry and Word Count (LIWC) http://www.liwc.net

Linguistic Inquiry and Word Count (LIWC) reads a text file, one word at a time. As each word is processed, the selected dictionary file is searched, looking for a dictionary match for that word. If a match is found, the appropriate word category scale(s) for that word is/are incremented. As the target text file is being processed, counts for various structural composition elements (e.g., word count and sentence punctuation) are also incremented. The software runs on a Mac and PC. There are 64 standard linguistic categories and dictionaires are available in Arabic, Chinese, Dutch, English, French, German, Italian, Portuguese, Russian, Serbian, Spanish, and Turkish.

NetDraw http://www.analytictech.com

NetDraw is a free program written by Steve Borgatti for visualizing both 1-mode and 2-mode social network data. It can handle multiple relations at the same time, and can use node attributes to set colors, shapes, and sizes of nodes.

Pictures can be saved in metafile, jpg, gif and bitmap formats. The program reads UCINET system files, UCINET DL files, Pajek files, and its own VNA format (which allows saving network and attribute data together, along with layout information like spatial coordinates, colors, etc.).

IMPORTANT: If you format data as a VNA file, NETDRAW can handle *very* large files. For example, sparse networks of 3500 nodes are very practical on a machine with 1GB of RAM (more is better). 10,000 nodes works fine with 2GB of RAM (assuming it is very sparse, of course).

UCINET http://www.analytictech.com

UCINET was created by Steve Bogatti, M.G. Everett, and L.C. Freeman. It is a comprehensive package for the analysis of social network data as well as other 1-mode and 2-mode data. Can read and write a multitude of differently formatted text files, as well as Excel files. Can handle a maximum of 32,767 nodes (with some exceptions) although practically speaking many procedures get too slow around 5000–10,000 nodes.

Social network analysis methods include centrality measures, subgroup identification, role analysis, elementary graph theory, and permutation-based statistical analysis. In addition, the package has strong matrix analysis routines, such as matrix algebra and multivariate statistics.

Integrated with UCINET is the NetDraw program for drawing diagrams of social networks. In addition, the program can export data to Mage and Pajek.

UCINET is one of the most popular Social Network Software Programs.

WORDij http://wordij.net

WORDij is a text analysis program that treats words as nodes and word pairs as links for network analysis and other statistical analysis. The software runs on a PC, Mac and Linux system and is free for academic use.

WORDij has seven modules:

1. Wordlink: this is the base module which counts words and word pairs and the results are used by other modules.
2. QAPNet: calculates an overall measure of the similarity of two whole networks using a correlation coefficient from -1 to $+1$.
3. Z-Utilities: compares two text files and determine what the significant differences there are for either the words or the word pairs.
4. VISij: a graphic visualization of words (nodes) and links. If multiple files are included an animation will play a network sequence change from one file to another.
5. OptiComm: produce messages that could be used to either promote change to move two words closer, move them further apart, or to reinforce aspects of the semantic networks.
6. Utilities: A proper noun extraction and a TimeSegs program for over time analysis using input from Lexis/Nexis or NewsBank.
7. Conversions: converts WORDij files for use with MultiNet/Negopy UCINET, NetDraw and Pajek.

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Part IV

Conclusions

Networked Governance: A New Research Perspective

Betina Hollstein, Wenzel Matiaske, Kai-Uwe Schnapp, and Michael Schnegg

The social sciences should have known better. *Social action*, *inter-* and *transaction*, *social relation*, and so forth have always belonged to the basic terminological stock that all branches of social sciences have in common. For a considerable time, however, our disciplines—sociology as well as political science and economics—were preoccupied with contextual factors on the one hand and characteristics or attributes pertaining to the individual level on the other. It was, one might say with hindsight, only after this 'sociology of variables' (Esser 1987) failed to produce any substantial new insights that many scholars of the social sciences remembered their origins and rediscovered social relations and their figuration: social networks.

Moreno's (1934) sociometry, for instance, which drew upon gestalt psychology as well as Simmel's sociological concept of social circles (Simmel 1908), was readily applied in the now-famous Hawthorne studies. On the recommendation of W. Lloyd Warner, a disciple of A. Radcliffe-Brown, E. Mayo and his team resorted

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to sociometric methods to describe informal relationships within their experimental groups (Roethlisberger and Dickson 1939, S. 500). The sociometric analysis of informal relationships later gained prominence owing to Homans' reanalysis, which addressed the interaction between group structure and individual behavior (Homans 1950, S. 72). Although sociometric methods have since become a part of the standard toolbox utilized to analyze informal processes within groups and organizations, organizational research in general has, it seems, remained largely ignorant of those instruments, at best conceding them relevance only to the small world of group research.

Organizational research instead set out to tackle the big questions: the determinants of strategies und structures. Towards the end of the twentieth century, however, when emerging information technologies, new logistic possibilities, and favorable national, regional, and international regulatory frameworks helped business processes transcend the boundaries of the firm, networks turned up in the literature as a metaphor characterizing production and service value chains that extended beyond organizational and national borders (Wigand et al. 1997). Accordingly, both sociological and economic organizational research turned towards alliances, value-added chains, clusters, and so forth. That is to say, research turned towards hybrid forms of organization, in the parlance of new institutional economics (Williamson 1985), a discipline that played a pivotal role in the development of this field of research. However, in sociology and political science especially, it was not only the market–firm or market–organization dichotomy that received increased attention but also the market–bureaucracy or market–state dichotomy. Into the focus stepped specific forms of self-organization such as the provision of public goods, quasi-governmental and non-governmental organizations, and—at least since the dawn of new public management—governance networks. Ever since, the governance *of* networks and governance *through* networks have been among the central research issues in the social sciences.

The arcs of development sketched above resemble those in social anthropology, a discipline that has received due credit in the literature for fostering the emergence of social network analysis as a methodology in its own right that addresses specific fields of research and has increasingly produced substantial research results. In the 1950s, members of the 'Manchester school' of British social anthropology—for instance, Barnes (1954), Bott (1957), and especially Mitchell (1969)—encountered in their field studies the limitations of the then-dominant structural functionalism. The expansion of research interests from rural areas in Africa to urban regions showed that structural variables like kinship and social norms, passed down from generation to generation, did not suffice to explain (social) behavior. Rather, emphasis was placed on the roles played by ethnic and regional affiliation as well as ties between colleagues, neighbors, friends, and acquaintances. While formulating their theoretical framework, the aforementioned scholars turned away from structural-functionalistic theories and developed, with Nadel (1957) as a point of departure, an analytical network concept that aimed at better descriptions and explanations of social interaction.

However, as stated in the introduction to this volume, the term *network* has mostly been used in a mere metaphorical sense in governance research. There, networks have been perceived as totalities. This neglects both their internal structure and the insights we might gain from a structural analysis of the (inter-) connections within these networks (Hollstein et al. 2017). It is this analytical approach of social networks and social network analysis, an ensemble of specific concepts and methods to collect and analyze relational data (e.g., Wasserman and Faust Wasserman and Faust 1994; Scott and Carrington 2011; Dominguez and Hollstein 2014), that we want bring to the fore in governance research.

Our main argument in this volume is that the analysis of the network (ed) structure of old as well as new forms of organization and governance can provide a deeper understanding of their functioning, success, and failure.

To elaborate this position in more detail and to relate this perspective to network governance research, we will first recap the discussion of governance and network governance as it has developed over the last three decades. Second, we will present a classification of networks as institutions and discuss the relations between actors and networks. We will then invert the perspective by putting networks (and not governance) at the focal point. Next, we will introduce the concept of *networked governance* and summarize the most salient points of the contributions in this volume.

1 Two Notions of *Governance*

The meaning of the term *governance* varies with the level of abstraction and the context in which it is used. As an abstract concept, governance refers to the multitude of ways, mechanisms, and processes in which individuals, companies, organizations, societies, as well as states and even supra-national or supra-state forms of interaction coordinate themselves and reach and implement decisions. Governance in this usage describes patterns of rules and mechanisms of social coordination and decision making in which a group of actors regulates collective issues and interests (Mayntz 2009, S. 9).

As a less abstract concept, governance is not just any but a particular mode of coordinating action, one that relies on cooperation in a network structure. The terms *governance* and *network*(*ed*) *governance* refer to mechanisms of reaching and implementing decisions cooperatively, as opposed to coordination mechanisms like hierarchy and command or markets and prices. Whereas government always entails a hierarchical component, governance does not even need to entail government (sensu stricto) or state actors (Fuster 1998, S. 68) at all. This notion was formed between the 1980s and the 1990s as a result of the perception that the structure of polities and of many societal interactions was about to change from hierarchical or market-like relations towards a more cooperative kind of relationship. This cooperative way of interacting was soon dubbed *governance*, and its network-like character was to be its hallmark (Börzel 2011, S. 59; Mayntz 1993).

With these two notions of governance in mind, governance research has emerged from two distinct disciplinary traditions: economics and political science (Benz 2004). Both disciplines have approached the concept from distinct points of departure. Economics focused on markets until Coase pointed out that markets can be inefficient and demonstrated that the existence of transaction costs and the attenuation of property rights can explain their inefficiencies to a large degree (Coase 1937). Williamson followed his lead and put institutions at the core of his theoretical thinking. Adhering to the market as a point of reference, he argued that the term *governance* denotes the rules that structure economic interactions more generally (Williamson 1985) and emphasized the importance of assessing forms of governance that are alternatives to the market as a governance structure (Williamson 1981). For the economist, this means differentiating at least between the market and the firm. Markets are understood as a set of rules that govern interaction and economic exchange between economic actors whose choices are guided first and foremost through prices. The market in this understanding is conceived of as an institution. The same holds true for the firm. The firm is an organization, a hierarchy and again a set of rules that governs interaction and exchange—and consequently, from this point of view, firms or organizations in general also show the characteristics of institutions. In this understanding, networks are located between markets at one end of a continuum and hierarchies at the other as a hybrid form of organization—for example, strategic alliances, franchise systems, and lateral collaborations between firms, regions, or clusters (Powell 1990; Sydow 2001).

Market governance is thus an institutionalist concept that is concerned with the design and provision of rules and guarantees that ensure the proper functioning of the market. The entity guaranteeing this functioning is the state. However, the governance of firms, better known to business administration as corporate governance, concerns processes of decision making and implementation inside a hierarchical organization—namely, the firm.

In political science, governance initially referred to ruling via hierarchies (Bevir 2007, S. 364–365). Through bureaucratic organizations, the state was thought to be able to direct or plan with efficiency and accuracy. These idealized expectations were put into question in the 1970s and 1980s both empirically and theoretically. Empirically, the failure of planning became increasingly evident; theoretically, doubt was cast on the assertion that social processes can be regulated through politics at all (Mayntz 1987; Pressman and Wildavsky 1973; Scharpf 1975). These shortcomings, drawn into the spotlight by both theoretical considerations and empirical research, have led some political scientists to call for a greater reliance on markets as a more efficient mode of regulation (Bevir 2007, S. 365–366). The neoliberal politics of the 1980s and 1990s mirrored those developments (Benz et al. 2007, S. 12; Mayntz 1996, 1998). Then, at the beginning of the 1990s, political science as well as public administration increasingly associated the term *governance* with

> a formal as well as informal interaction between public and private actors, competent and knowledge-based decision making, creative problem solving and innovative policy solutions, flexible and well-coordinated policy implementation, the realization of democratic ideals about inclusion, empowerment and ownership, and a more realistic account of the actual forms of governing society and the economy (Torfing and Sørensen 2014, S. 330).

Governance thus came to be understood as something that transcended the traditional organization, either government or firm, as well as traditional forms of inter-organizational cooperation. Research on governance then turned towards cooperation and networks, something that consisted of and connected people and organizations (O'Toole 2014). With this perspective came the understanding of governance networks as organisms for which there seemed to be an implicit unitary actor assumption. Hence, they were mostly understood as entities with a dense, cooperative, almost peer-like structure that was not meant to be thoroughly analyzed but treated as a totality (O'Toole 2014). The discussion then moved on towards a generic definition of the term *governance* "as the process of steering society and the economy through collective action" (Torfing and Sørensen 2014, S. 333). Notwithstanding these developments, the holistic and metaphorical use of the term remained unabated while only rarely being used with an analytical intent (see Koliba et al. 2011, S. 46–55).

To better differentiate between the various forms of governance as a non-hierarchical cooperative process of coordinating action, some authors started using the term *governance* with the adjective *network*. What they wanted to achieve was a clear and workable definition of governance, and the "network" attribute was intended to accomplish just that (Torfing and Sørensen 2014, S. 329/344). Whereas large parts of the network governance literature shared (and still share) a positive image of governance as a mode of coordinating action in politics and society political processes and society, the emphasis on networked governance drew some authors towards a more critical perspective. This seems to be due to the fact that governance networks came to be related to policy networks (Blanco et al. 2011). This in turn fed the discussion on governance back into the discussion on corporatist decision making in the 1970s and 1980s (Torfing and Sørensen 2014, S. 331–332). As a consequence, governance networks have been perceived not only as cooperative and therefore normatively desirable but also as a problematic mode of coordinating action as well. It was stated that network governance defies democratic values because governance networks are an elite-driven, exclusive type of network structure with only limited public access and control. Network governance was then described as a mechanism for actors rich in resources to steer society in directions to their liking (Papadopoulos 2004, 2005; Torfing 2005, 2006; Torfing and Sørensen 2014). In a similar vein, Mayntz (2004, S. 74–75) warned that too positive a view of governance networks could neglect power as one of the major categories in the scientific analysis of politics. The ubiquitous references to cooperation and consensus could obscure the fact that large parts of the population are excluded from those cooperative mechanisms. The consensus reached inside

governance networks, as she argued, is a consensus of the already powerful elites. Yet, even among this more critical group of authors, governance networks were still perceived as ontological entities that acted as a whole. Their internal structures still were widely neglected.

To sum up the discussion so far: In the dominant conception of *network governance*, the term *governance* is the core concept, whereas the term *network* is little more than a modifying attribute. It is there only to highlight that governance is understood in a very specific way. The joint term *network governance* describes decision-making structures as cooperative, non-hierarchical, and communicative. Its use, however, is merely metaphorical for the most part. The networks as such have not been given due credit as social structures that are worth analyzing. By building on the recent theoretical and empirical work of various scholars (e.g., Wald and Jansen 2007; O'Toole 2014; Mayntz 2017) and by adopting our specific point of view, we open up a new perspective and arrive at a more general analytical framework of network*ed* governance. For us, taking networks seriously in the research on networked governance means inverting the focus, making *network* the focal term and leaving *governance* with the auxiliary function, if only to sharpen our comprehension of the network structures and their effects on all kinds of social, economic, and political conglomerates and organizations.

2 Networks as Institutions

Before we extend upon the contributions of social network analysis to the investigation of governance processes, it is worth taking a second look at networks as entities in their own right. It is hard to overlook that far-reaching transformations have taken place—not only in economic and political organizations but in virtually every social system—that give rise to the use of the term *network* as a metaphor. Most worthy of note are the fundamental reorganizations in the economic system that have swept through economic organizations since the mid-1980s. During this period, concepts and processes have gained popularity that Drumm (1996) has subsumed under the paradigmatic term "new decentralization." Especially prominent in this respect is so-called outsourcing, which epitomizes some core issues in the decisions on how economic organizations are structured. In the eighties, the question of make (internally) or buy (externally) staged a comeback in light of the advancements in information technology, which allowed for the introduction of new organizational forms. Classical examples are General Motors' move to outsource its IT services to the previously acquired IT service provider EDS in 1984–1985 and, most notably, Eastman Kodak's decision in 1989 to transfer its data-processing infrastructure and communication networks to IBM and DEC (Hirschheim and Dibbern 2002, S. 5). However, it is not only the sheer dynamics of the advancements in information technology that have subsequently challenged the economic wisdom of vertically integrated hierarchies and encouraged experimentations with new and innovative organizational forms. Innovations in traditional infrastructures such as transport and logistics have given way to a

reduction in stockholding costs and to the introduction of just-in-time production (Ohno 1988), whereas innovations in the laws governing world trade have accelerated global production processes and service provision processes (Wigand et al. 1997).

From a business administration perspective and referring to some classical terminology, one might state that the relationship between organizational structure and process organization has been *inverted*. Whereas organizational practice and organization theory used to address the structural dimension of organizational issues, nowadays both are primarily concerned with process organization in the sense of the management of value-added chains (Brown et al. 2010; Porter 1985). These developments, largely rooted in organizational practice, provide a point of departure for the discussions about lean organizations, flat hierarchies, and core competences as well as about network organizations, implicit contracts, and trust, a key term of contemporary economic reasoning.

Both sociological organization theory and its business administration counterpart have—at a fairly early stage, but at least since Weberian ideas had started to feature prominently in the contingency approach—illuminated theoretically as well as empirically the relationship between the organization and its environment (Pfeffer and Salancik 1978). This, however, did not fully resonate with economic theory, which came to acknowledge the relevance of the developments sketched above only when dealing with some issues of applied research. A central point of reference for the new institutional economics was a long-overlooked paper by Coase (1937). Without actually using the term, Coase nevertheless described firms as a closed network of contracts that comes into existence if its associated transaction costs are lower than those of the alternative 'market' allocation mechanism. The concept of transaction costs comes with various implications, especially as far as the conception of the economic actor is concerned. This is a crucial issue in the given context and will be addressed once again below. Beyond that, it is important to note that this concept points our attention towards the external relations collective actors maintain, relations that are no longer restricted to market transactions. Rather, the fundamental decision between make or buy is now mapped to a continuum between two extremes, 'market' and 'hierarchy' (Williamson 1975).

The top of Fig. 1 depicts the oft-cited (and slightly modified) market–hierarchy continuum. In the domain of hierarchies, highly integrated firms combine up- and downstream processes and the manufacturing of core products into an all-encompassing system. Of course, the above model simplifies the reality of traditional enterprises, which form trusts, conglomerates, or, given slightly different social and economic circumstances, collective combines. Whereas strategic alliances or franchises still exhibit formally defined focal firms, entities like these no longer appear in company networks. Traditionally, relatively long-lasting consortia have existed in industries such as the construction sector or shipbuilding for quite some time (Piore and Sabel 1984). Regarding clusters, which are much discussed at present, the ties between the entities involved become even weaker as such ties involve little more than consultations on specific joint activities—and there are no tightly knit interrelations with the goal of joint production of a specific

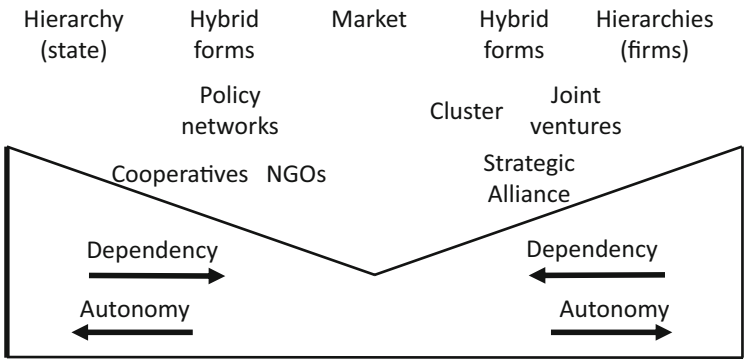

Fig. 1 Markets and hierarchies

good or service (Saxenian 1994). At least insofar as these weak forms of cooperation between collective actors are concerned, the assumption of a unitary actor appears to be overly simplistic. Instead, the interrelations and interdependencies between different actors should be explored on a network-analytical basis in order to appropriately reflect the existence and dissolution of hybrid structures as well as to assess the consequences of unintended behavior or the failure to achieve commonly agreed goals.

These deliberations have radiated far beyond the realm of the organization in the economic subsystem of society. Whereas traditional organizational theory in business administration was deeply influenced by the conception of state bureaucracy in the vein of Max Weber (1972), organizational reasoning in new public management has instead developed along the lines of business economics. Public organizations, according to the perspective of new institutional economics, provide public goods that can nevertheless be produced and allocated by alternative institutions (Coase 1960). Inspired not least by public choice theory (Downs 1957) and new public management, the basic idea in this debate was to transfer the production of public goods from the state to the market. The works of Olson (1971) and Ostrom (1990) demonstrate, however, that decentralized forms of producing public goods can be accessed both practically and theoretically from the opposite direction as well—that is, from the public domain. Regardless of whether theory construction works in a top-down or bottom-up fashion, many forms of intensive state involvement in the production of public goods have to be distinguished. Figure 1 arranges policy networks, associations such as unions, cooperatives, or political parties, and NGOs along the spectrum.

It may come as a surprise that we locate policy networks—basically the nexus between the public and politics—closer to market coordination than, for example, cooperatives that frequently pursue nothing other than economic goals on behalf of their members. Yet one must still bear in mind that new institutional economics conceptualizes markets in the same way as it does most general institutions, which allows for the exchange of more than economic goods. In this respect, economic theory is [currently] moving closer to a general sociological theory of exchange

(Matiaske 2013). Furubotn and Richter (1997, S. 310) define markets as "social institutions of recurrent exchange" and reiterate—albeit with no mind to the traditions of thought in the realm of sociology—a definition Homans (1958) used much earlier to define social exchange as being distinct from economic exchange. In sociological research on exchange, various models have long since been devised that are in accord with the concept of constraints on transactions, goods, and exchange partners, as developed in microeconomic market theory (see, e.g., Braun 1998; Coleman 1972; Skvoretz 2015).

Figure 1 could give the impression that we interpret state institutions and economic institutions on the same continuum as markets and hierarchies. However, this interpretation would miss our main point. Even if the reader were to follow those authors who adhere to Granovetter's (1985) prominent argument of the embeddedness of economic action in social structures, it is fair to concede that both in the political as well as the social realm a variety of entities exist that are more or less hierarchically structured. Their inner constitution, and consequently their governance structure, can be approached by means of social network analysis—without the risk of a 'normative prejudice' that confuses collective forms of organization and governance with collective actors.

3 Networks and Actors

The perspective outlined in this contribution carries far-reaching implications for the conceptualization of actors. These implications should be given a brief look because, in our opinion, strict macro-sociological and structuralist positions in the governance-related research fields provide only modest insights.

The fundamental ideas of the imperfections of markets and hierarchies immediately impose restrictions on the strong assumptions about rationality that are usually implied in with the figure of *homo oeconomicus*. The crucial problem of the 'old,' 'under-socialized' *homo oeconomicus* is not, at least from an institutional economics perspective, that this coldhearted, calculating machine would not hesitate to sell its own mother provided this move were to be utility-maximizing (which, incidentally, is the reason why economists with an inclination to rational thinking are largely unwilling to accept a fellow of this rational type as a son-in-law, as Boulding 1969 once noted). For economic theory, the core problem with this figure is rooted in the fact that it could, given its characteristics, only survive in those perfect markets which neoclassical standard theory has introduced. The concept of transaction costs brings with it the idea that another type of cost enters the vector of optimization calculus, and indeed, many proponents of the new institutional economics operate in that fashion. Furthermore, economic usage can hardly conceal the fact that these transaction costs are associated with a lack of information and that the costs of information-gathering can be either uncertain or prohibitively high. In other words, it does not suffice to excel in utility calculus and utility maximization. One also needs to be prepared to deal with the risk and uncertainty that transactions entail. Williamson (1985) therefore 'equipped' the new *homo*

oeconomics with bounded rationality on the one hand and opportunistic inclinations on the other.

Bounded rationality, following Simon (1959), suggests that an actor no longer optimizes in the strictest sense but rather strives for satisfactory solutions to problems. Putting aside the problems that come along with a weaker concept of rationality (Elster 2009), it is worth noting that the relaxation of some assumptions have opened up a window of opportunity for behavioral sciences to enter those research fields previously associated with rationality. Outside the economic community—and especially in (social) psychology—some might wonder why economists all of a sudden began carrying out experimental studies to investigate those anomalies and deficiencies exhibited by *homo oeconomicus* both old and new (it would be much easier to take note of the findings of the human sciences), but this trend comes with the advantage that the gap between reality-oriented behavioral sciences and economic theorizing does not seem as insurmountable as it once did (Matiaske 2004). It should be kept in mind, however, that social science usually does not try to understand and explain human behavior but instead the reasons for actions taken by social actors in specific situational settings and their consequences. To this end, they expediently apply simplified actor models that reflect the respective behavioral assumptions. In the enlightened models of rationality in contemporary microsociology, it is the rule of diminishing abstraction that exercises control in a given subject area over the appropriate level of complexity of the behavioral assumptions (Wippler and Lindenberg 1987).

The assumption of opportunism (i.e., the inclination to deceive and to devise stratagems in addition to rational calculus) does little to make the rational actor more likable but does enable such actors to retain their ability to act in imperfect markets. It is this assumption in particular that exposed the rabble of (new) *homines oeconomici* to harsh criticism (Pfeffer 1994). No matter how valid the criticism of this standard assumption—real human beings are, of course, capable of empathy and altruism as contemporary behavioral economics does not grow tired of emphasizing (Fehr and Fischbacher 2003)—one should still bear in mind that we frequently encounter not just individual but also corporate actors in the economic as well as the political, social, and cultural subsystems of society. Even if the notion holds true that individuals build relationships of trust with organizations or enter into psychological contracts, organizations, at the end of the day, enter contracts that are based on established law, include provisions protecting themselves from opportunism, and usually conclude with some form of escape clause. In governance-related research, it frequently seems appropriate to operate with behavioral assumptions that are applicable to both individual and corporate actors.

In this context, networks play an important role. They are constraints, yet they also enable social interaction—an issue that will be addressed in more detail in the following section. With regard to individual and corporative actors, it is worth noting that social networks, in contrast to the ideal of perfect markets, constitute nothing other than a restriction on the choice sets of their members. According to classic economic understanding, participants in the market interact effortlessly and without costs on the basis of money as a means of transaction. Having money or not

constrains interactions in this setting or makes them possible. Networks assume a similar role when introduced into the socio-economic theory of exchange (Braun 1998; Coleman 1990; Skvoretz 2015; Willer 1999). They allow for transactions in the domain of normatively regulated social exchange, as highlighted by the different strands of social capital research (Bourdieu 1983; Coleman 1990; Putnam 1993). And they constrain transactions as well, just as having money or not having it does in the marketplace, because networks have rules for what kind of (social) capital can or cannot be exchanged in which ways.

4 Networked Governance as a Research Perspective

Let us now describe our *network*ed *governance* approach in more detail. By summarizing the most salient points of the chapters assembled in this volume, we want to illustrate the contributions of this new perspective to the investigation of processes and mechanisms of networked governance. We aim to advance networked governance as a more general research paradigm that focuses on the processes of coordinating, reaching, and implementing decisions that take place in network(ed) (social) structures. To analyze these processes, we propose taking social networks seriously and combining social network analysis with governance research. Whereas governance research has most often viewed networks as an alternative to markets and hierarchies, network analysis provides a methodology and—in part—a theory to analyze governance systems on the basis of the internal and external interactions through which they operate (Henning and Pappi 1998; Jansen 2002; Jones et al. 1997; Kenis and Schneider 1991; Lazer 2011; Powell 1990; Wald and Jansen 2007). We thus understand networked governance as a research perspective that focuses on those governance processes in and through networks. With this perspective, it is possible to analyze very different types of institutions—not only those discussed in the last section but also state and supra-state forms of interaction, thereby taking into account the increasingly complex forms of governance structures.[1]

Figure 2 illustrates this approach. While there are different forms of interaction, all the above forms of interactions are networks, which means that there are nodes; these nodes are actors and the edges symbolize some sort of interaction. Figure 2a shows a bureaucracy with a clear hierarchical structure. The relationships are based on instructions given from a supervisor to his or her staff. However, instructions are

[1]Many of the problems with the predominant usage of networked governance as described by Börzel (2011), among others, seem in large part to be problems of analytical perspective. Although there are organizational forms that are more cooperative than the market and less command-driven than hierarchies Börzel (2011, S. 57), analyzing all those social structures as networks helps us to understand how these structures work and how governance is exercised through them. And even the constructivist perspective Börzel (2011, S. 58) can benefit from structural network analysis, as Emirbayer (1997) and others have argued all along and as Gluesing et al. (2017) and Heath et al. (2017) demonstrate in this volume.

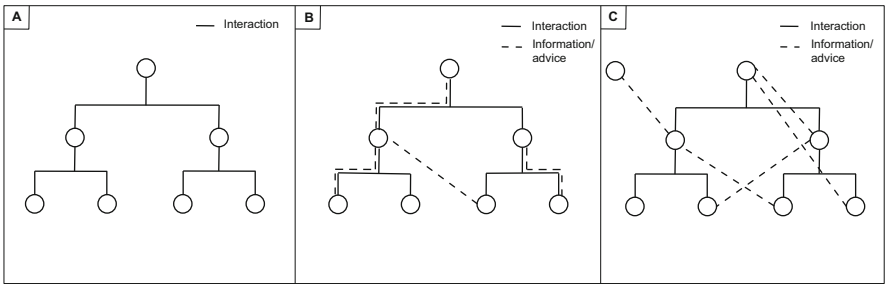

Fig. 2 Networks and hierarchies

not the only form of interaction or relationship that makes an organization work. Figure 2b adds linkages of information exchange and the seeking of advice. It shows a situation in which those two types of relationships (i.e., instructions and information- and advice-seeking) overlap in many cases but constitute new relations between actors (nodes) as well. Things become even more complex in Fig. 2c. It shows an organization in which most transactions do not follow the formal hierarchy and even include actors from outside the organization (Borgatti and Cross 2003). Although it exemplifies different kinds of relationships, the example also illustrates that networks and hierarchies are not in opposition but that hierarchies are a specific type of network.

The networked governance perspective proposed here does not make a priori assumptions about the specific nature of organizations. It starts with the observed or perceived linkages among actors. It reconstructs the networks that they form and tries to explain what a network does and how this is achieved using the very structure of the network as an explanans. Whether these structures are hierarchical (or not), egalitarian (or not), or include or encompass outside channels (or not) becomes an empirical question and not a conceptual one.

Markets are generally viewed as the second prototypical governance structure. The mechanism that structures transactions is price, and the transactions themselves have long been assumed to be without costs. However, over the last few decades, new institutional economics has shown that transaction costs matter (North 1990; Williamson 1985). Trust, a factor in social relationships and built through repeated interactions, plays an essential role in reducing those transaction costs (Platteau 2000). Figure 3 shows buyer–seller relationships in a market context (e.g., dealing used cars). The figure shows the prices for which vendors are willing to sell a good. Figure 3a shows the network of transactions that emerges if all buyers search for the lowest prices unconditionally. When we add a relationship of trust as in Fig. 3b, we see that a different network structure evolves with different monetary transactions for goods than before. This demonstrates that, while many buyers still seek the cheapest product, in some cases trust relationships cause people to shift to more expensive outlets.

This example illustrates that, from the perspective of networked governance, markets are also networks formed through transactions. As in simpler models, there

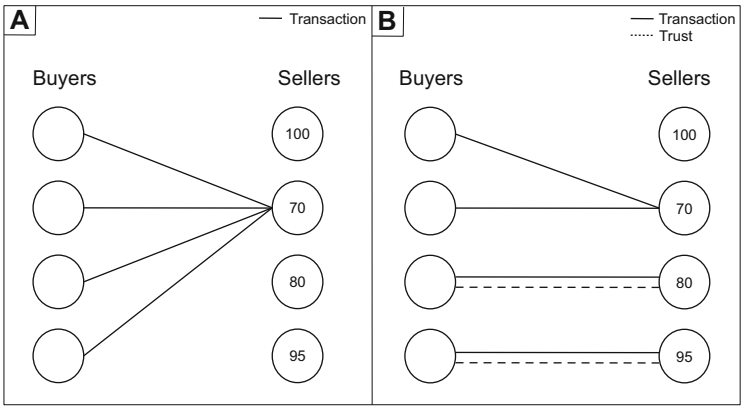

Fig. 3 Markets as networks

are different kinds of transactions such as goods and money that shape the structure of the market, but trust is a factor as well. And, once again, which concrete network structure emerges from the different types of interactions is an empirical question. As was the case in regard to bureaucracies, the hypothetical example shows that markets are not in opposition to networks either but can also be conceived as networks themselves (Beckert 2009; Diaz-Bone 2010; Furubotn and Richter 1997).

Anthropologists have long highlighted the embeddedness of transactions in social relationships. The historian Karl Polanyi laid this foundation in his theoretical work when he distinguished between pre-capitalist societies in which transactions are embedded in other social relationships (e.g., kinship, political relations) and capitalist societies in which these relationships have been substituted with market transactions (Polanyi 1944, 1957). In the anthropological literature, one of the classical examples that demonstrates the embeddedness of social transactions is the link between trade and ceremonial gift exchange among the Melanesian Kula (Malinowski 1922). Among the islanders, the ritual exchange of necklaces and bracelets establishes trust and opens the way for trade in an environment where many of the islands are hostile towards one another. And even in market situations, Plattner has observed that Mexican peasants who had to walk many miles to the marketplace were not willing to sell their fruits at very good prices to tourists they met on their way. Asked for their rationale, they insisted that this would disappoint their long-term trading partners waiting at the central marketplace (Plattner 1989). Similar observations have been made in capitalist societies: Uzzi and Lancaster (2004), for instance, have shown that customers of law firms that have longer-term relationships get better prices.

Figure 4 offers a theoretical and conceptual framework of the research perspective proposed here. We understand governance structures to be both the product and the precondition of human agency. Governance structures provide actors with resources (e.g., social, political, economic) to achieve certain goals, but they can also be used to (re)shape the rules under which they interact. The figure also

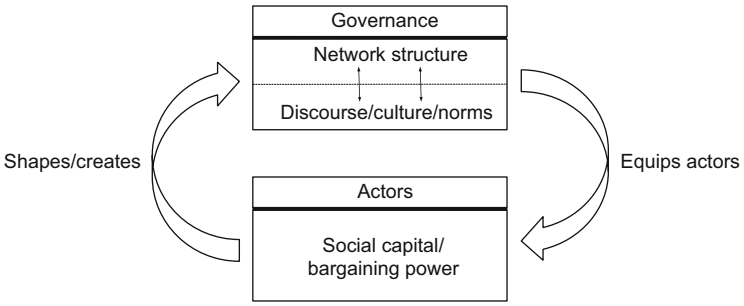

Fig. 4 Networked governance: a theoretical framework

illustrates that the concept of networked governance does not focus on structures (i.e., the ties between actors) alone. Cultural and normative aspects are also relevant in understanding the processes in those networks, especially if one seeks to actively integrate agency when discussing networks, such as White (1992), Emirbayer (1997), Hollstein (2001), Mische (2003), and Fuhse (2015) do.[2] This work aims to link the structural level to the actors involved. This particularly concerns the systematic integration of their capacity to act and actively shape their (social) environment as well as their reference to norms, symbols, and cultural practices (Emirbayer 1997; Emirbayer and Goodwin 1994; Mizruchi 1994; Schweizer 1996). In the investigation of governance processes, we consider this perspective to be especially fruitful, because strict macro-sociological and structuralist positions in governance-related research omit important aspects of human action and interaction and are thus only able to explain half the picture.

Let us give an example to illustrate this point. If kinship or trust as forms of social capital are the main mechanisms to guide transactions in a given economic system, we can expect a structure to emerge that reflects this. If markets enter the picture and some actors aim to change the rules and begin transacting on the basis of prices, in part or alone, we can expect the societal structure to change. Not only will the structure change but also the ideology, as Bohannan has shown in his analysis of the transformation of the economic system of the Tiv of central Nigeria (Bohannan 1959, 1960). Whether this transformation takes place is a question of the bargaining

[2]Following Harrison White (1992), Anthony Giddens (1984), or Georg Simmel (1908), all of these authors claim that the significance of action has been overlooked by social network analysis owing to its preoccupation with structure. Their arguments are mainly directed against approaches that are either committed to "structural determinism" Emirbayer and Goodwin (1994) or involve utilitarian models of action ("structural instrumentalism"; ibid.). As Dorothea Jansen has put it, "A significant theoretical problem [of parts of network research—added by the authors] lies in the sparsely reflected relation between concrete networks and interactions, on the one hand, and subjective attributions of meaning, norms, and institutions, [as well as] cultures and symbolic worlds, on the other. In their dispute with structural functionalism of the Parsonian kind, network researchers have possibly thrown out the baby with the bathwater in claiming absolute priority for concrete structures of interaction vis-à-vis norms and symbolic worlds of any kind" (Jansen 2003, p. 258, translated from German by the authors).

power with which networks equip their actors. Social capital is one of the main sources of power and thus links network and governance research and structures and action (Granovetter 1985, Bourdieu 1986, Coleman 1988, Portes 1998, Sewell 2005, Wald and Jansen 2007; Jansen 2017). But without an appropriate understanding of the cultural norms and values that guide a society, neither the status quo ante, the changes themselves, nor the obstacles to change can be properly understood.

The framework sketched in Fig. 4 therefore offers an approach to overcome the gap between micro- and macro-level analysis. At the same time, it offers a platform to think about the linkage between culture/discourses and structures and thus overcomes major problems identified in both governance research and network analysis (DiMaggio 1994a, b; Emirbayer and Goodwin 1996; Emirbayer and Mische 1998; Fuhse 2015; Hollstein 2001). Now is a good time to promote such an approach: Besides the extensive set of standardized methodical instruments that is already available (e.g., Wasserman and Faust 1994; Carrington et al. 2005; Scott and Carrington 2011; Snijders 2011), qualitative methods that capture network orientations, interpretations, and practices have also been integrated into the toolbox of network research, together contributing to a deeper understanding of network dynamics and network effects (Dominguez and Hollstein 2014).

The chapters in this volume all demonstrate different aspects of how this approach can advance our understanding of the processes and mechanisms that take place in network(ed) social structures. As the studies illustrate, social network analysis can help us to disentangle actors and their roles inside networks in order to detect hidden institutional details (e.g., Schneider 2004; Mayntz 2017). It helps us to identify structurally important positions such as central individuals, brokers, and so forth who are important for the functioning of the governance structure (e.g., Christopoulos 2017; Mayntz 2017; Gluesing et al. 2017). And it helps us determine key relationships as well as disconnected actors who are therefore in a weak position in any kind of social conflict (Lubell 2013). Renate Mayntz, Steffen Mohrenberg, Jürgen Pfeffer, and Momin Malik illustrate different ways in which social network analysis can help to describe and analyze how governance structures evolve and to understand the dynamics of these structures. In this regard, Jörg Sydow's contribution points to the tension between emergent features of existing inter-organizational networks and the active governance of their network structure and performance. To maintain the functionality of a network and prevent ossification, network governance needs to find a balance between path dependency, uncertainty, and necessary risk-taking. How the structure of political networks shapes policy outcomes while these networks are continuously shaped by the political process at the same time is discussed by Dimitris Christopoulos. One of the major drivers behind this constant reshaping is the existence of divergent norms in policy networks that have to be constantly reconciled by political agents. The sustainability of such networks then depends on optimizing the distribution of competences among different levels of governance, smart bridging, and clustering within those networks. In this regard, political networks seem to have similar characteristics to interstitial communities between heterogeneous actors, as both have to find language that bridges and differentiates sub-communities. As Valeska

Korff, Achim Oberg, and Walter Powell argue, the bridging capacity of interstitials is based on the power of a common language, the power of internal cohesion, and the power of external integration. Interstitials are collective organizations with access to multiple cultural repertoires that are internally integrated and have an external reach into adjoining domains. This helps their "members" to serve as bridges, potentially fusing formerly separate domains into governance networks. With regard to knowledge production, Dorothea Jansen describes how the tradeoff between dense networks and structural holes and between innovation incentive-breeding and trust-breeding institutions is solved in innovation networks. She demonstrates that a network approach can help to determine why, when, and which type of network structure and which network ties promote the process of knowledge production at the meso level of organizations.

Christopoulos describes that, in politics, governance is a product of political exchange and as such is affected by the quality of interaction between political agents (so-called governance embeddedness, Jones et al. 1997; Robins et al. 2011). At the same time, governance as a process is affected by the pattern of exchange between political actors, such as core and periphery, multiplicity of clusters, prevalence of brokers, and the skewness in the distribution of ties. Size, for example, can make political networks dysfunctional. Network growth leading to unmanageability is an aspect that is also emphasized by Gernot Grabher and Jonas König with regard to managing personal networks on social networking websites. On those websites, the authors find a generic type of performativity: Actors perceive and describe themselves and their actions through the lens (the vocabulary) of social network theory. Not only do people describe themselves in this way, they also use knowledge gained from social network theory to shape their own networks. A social networking website can therefore be seen as a kind of camera that helps individuals to observe their personal networks (virtual and real) and further develop them on the basis of their theoretical as well as their empirical knowledge.

Rather implicit influences on individual decisions are addressed by Sue Heath, Alison Fuller, and Brenda Johnston. They show how identities are formed in a personal network, how learning identities are conveyed from the parental to the filial generation, and how habits, norms, and routines within the social network shape individual preferences and decisions. With regard to governance as a process of collective decision making, this contribution is a borderline case, of course. However, the study sheds light on the complexity of social influence, the roots of normative orientations, and the unintended consequences of action, aspects that can be of the utmost importance in understanding the success or failure of governance processes. Furthermore, this study helps to understand the diffusion of attitudes and beliefs within personal networks.

Diffusion is studied by Steffen Mohrenberg as well, albeit from a very different angle. He asks how mechanisms of influence and selection help explain policy diffusion. By using stochastic actor-oriented models (SAOMs), Mohrenberg paints a complex picture of how networks change through the selection of network partners as well as through the copying of ideas and so forth. He is thus able to

show how networks evolve through the making and breaking of ties as well as through changing the characteristics of the network nodes. As demonstrated by Jürgen Pfeffer and Momin Malik, simulations can also help to understand network dynamics and hence the governance of networks and the efficacy of networked governance. One of their applications is an agent-based model of fictitious legislation in the United States that is supposed to regulate how banks are allowed to be represented on the boards of other banks. The model shows how such regulation can change the network of interlocking directorates of these banks and central characteristics (network measures) of this network.

In contrast, Renate Mayntz analyzes actual changes in international institutions of financial market regulation and describes different types of relations (e.g., recommendations, regulations). She points out that using a network approach may lead to misinterpretations by overemphasizing the network character of social reality (Davies 2011). This is an important note. Again, we should emphasize that by applying the network concept we do not need to presume, as networked governance research often does, that a certain network is organized in a non-hierarchical fashion. It is by using the tools of social network analysis that we can analyze its very structure and analyze its effects on individuals, groups, and their actions. On the basis of such insights, we can develop good practices for leveraging social influence inside networks and intervene in actual governance systems and policies in order to make them more effective at solving social problems or achieving other normative goals such as democracy, fairness, and so forth. This includes providing policy-makers with network-smart best practices (Lubell 2013). The contributions from Heath et al., Korff et al., and Gluesing et al. also address this aspect. Gluesing et al. as well as Schwaninger et al. provide promising tools that foster an understanding of the micro-mechanisms inside networks. Julia Gluesing, Ken Riopelle, and Christina Wasson present a mixed-methods toolbox for the analysis of complex communication patterns in an environmental multi-stakeholder network. On the basis of videos and e-mails, they apply proper-noun networks, text-correlation methods, word comparisons, sentiment analysis, conversation analysis, and the analysis of influence networks. Through these methods, the authors are able to understand the decision-making process by not only identifying powerful players but also by understanding what their roles are in detail, how they argue and influence people, and in what way they are ultimately successful. The authors' approach is especially useful in remedying the power blindness that has been said to be a problem of network governance research. Manuel Schwaninger, Sabine Neuhofer, and Bernhard Kittel discuss the contribution that experiments provide by allowing us to probe much deeper into the driving forces of network behavior at the individual level as well as the effects of structures that we do not find in reality but might want to implement because of their advantages. Taking both perspectives in tandem can help fill a number of lingering voids in networked governance research, strengthen the role of micro-level research, and increase our understanding of the role and formation of power in networks as well as its discursive use.

To summarize the main arguments: We understand governance as all mechanisms and processes that are used by various entities—companies, organizations, as well as states at large and even supra-national or supra-state forms of interaction—to coordinate themselves and to reach and implement decisions. The combination of social network analysis and governance research offers a promising route that can provide a deeper understanding of what governance networks do and can achieve, why they achieve it, and what the social meaning of these networks is. Hence, what is important in social network analysis are relations (not attributes), networks (not groups), the culture and meaning of networks, and the interplay between structure and agency. From this it follows that *networked governance* could adopt at least two perspectives: the governance of networks and governance in and through networks. Examining the governance *of* networks would involve focusing on the ways in which actors try to organize the coordination of action in their networks their networks—that is, for example, the way they influence the very structure of the network in which they are active or the way they intentionally change their own network position. Governance *through* networks, by contrast, would mean using existing networks to achieve the (policy) goals that one is interested in. It would involve exploiting knowledge about the inner structure and workings of a network, and its study could come much closer than the former perspective to what the established discussion on network (ed) governance has been scrutinizing. Still, the focus of study would fall much more on structural details at the individual and the aggregate network level than it has done with most networked governance research so far. Both perspectives are closely interrelated. Networks are structures within which and through which governance takes place. They are both the precondition and the product of human agency. These structures provide actors with resources (e.g., social, political, economic capital) that can then be used by those actors to shape and change the rules under which they interact. Or as Padget and Powell have recently put it: "In the short run, actors create relations; in the long run, relations create actors" (Padgett and Powell 2012, S. 2).

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