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Bringing Structure to Interfirm Interaction – The Influence Nested Formal Organizations on Knowledge Transfer Patterns in Interorganizational Networks

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Abstract. This study examines how managerial interventions impact structures of knowledge transfer. The work thereby focuses on one form of network management, the implementation of nested organizations. I develop a theoretical framework discerning two forms of nested organizations, namely platforms and projects, and propose distinct effects from these forms' unique features. I test the research hypotheses based network data from the biggest association of small and medium municipal utilities in Germany using exponential random graph models (ERGM). The results largely support the proposed hypotheses and indicate that platforms induce structural mechanisms of social embeddedness whereas projects induce mechanisms of task interdependence.

Key words: Interorganizational Networks, Knowledge Transfer, Network Management, ERGM

1 Introduction

Networks such as strategic alliances, regional clusters or industrial associations bear huge potential to provide firms with opportunities to share costs and risks of research and development, access complementary assets or profit from knowledge spillover. Hence, especially for small and medium firms for which innovation opportunities may exceed their own resource base, interorganizational networks represent an important strategic element in innovation management [17].

One essential mechanism through which interorganizational networks increase member firms' performance is knowledge transfer. Consequentially, in order for

interorganizational networks to fulfill their innovation-enhancing effects, high levels of knowledge mobility – i.e., the "ease with which knowledge is shared, acquired, and deployed within the network" [10, p. 660] – are indispensable. As such, establishing, supporting and steering knowledge flows is a key task in network management [10,17]. As such, managerial intervention mechanisms need to be applied to ensure knowledge "transfer to other points in the network where it is needed" [10, p. 660]. One type of such interventions is the implementation of nested formal organizations within the broader scope of interorganizational networks. These nested organizations represent subsets of member firms which are formally constituted by clear membership boundaries and a defined purpose [34]. By establishing such formal structures, network management sets a frame for arranging encounters and as a consequence channeling knowledge flows between member firms [9]. Hence, nested formal organizations are likely to represent a mean to substantially shape the structure of knowledge flows. Thus, they represent a valuable element in the toolbox of interorganizational network management.

However, up to now little to no research examined managerial interventions in interorganizational networks, let alone providing empirical evidence on these interventions' effectiveness [30]. Network management thus represents a clearly underresearched topic that demands for deeper investigation [25]. Accordingly, also the effects of nested formal organizations on knowledge transfer in interorganizational networks remain somewhat unclear. Within this work, I therefore aim to explain how the installment of nested organizations within interorganizational networks shapes the structure of interfirm knowledge transfer. More specifically, I develop and test a theoretical model outlining the effects of two distinct types of nested organizations – platforms [1] and projects [36]. In all, this paper sheds light on the following research question: "How do nested formal organizations impact structural patterns of knowledge transfer and how do the effects of projects and platforms differ?".

2 Nested Organizations and their Effect on Knowledge Network Development

Network management which Provan and Kenis [30] describe as monitoring and controlling member firms' behaviour and aligning them towards an overarching network-level goal by definition aims to impact the "natural" endogenous tenden-

cies in a network's development [33]. Accordingly, initiatives of network management represent exogenous interventionist forces that may impact interorganizational networks directly by establishing new structural logics as well as indirectly by enforcing, altering or diminishing the causal mechanisms endogenous to the network [6]. In doing so, network management steers network development towards new structural patterns [13].

By implementing nested organizations in a network of firms, network management may alter a network's structure substantially. Nested organizations comprise a certain number of formally associated member firms that group together to accomplish a specific goal [34]. In practice, especially two different types of nested organizations are prevalent: platforms and projects [15]. On the one hand, platforms represent communities of firms which collaboratively address a certain field of business or innovation [1]. On the other hand, projects are temporal forms of organization with the goal of producing a clearly specified outcome, e.g. the development of a new technology or product [34]. Both forms of nested organizations differ in two dimensions: temporal scope and functional scope. While platforms combine long-term interaction with a rather broad goal, projects are temporal and deal with a narrowly specified issue.

These types of nested formal organizations are likely to induce framing mechanisms shaping knowledge network structures. Framing describes the "behaviors used to arrange and integrate a network structure by facilitating agreement on participants' roles, operating rules, and network values." [23, p. 603]. By establishing nested formal structures, network management sets a task frame respectively a reference point to which network members can align their efforts [9]. With the creation of an organization with particular goals, interdependencies are created leading to a stimulation of knowledge transfer. Hence, network management facilitates the creation of internal structure in the knowledge network as well as the positioning of network members within this structure [27]. I argue that based on the features of the particular task frame that is created by the implementation of platforms and projects, the corresponding framing mechanisms will differ. As a consequence, platforms and projects will stimulate different structural tendencies in the knowledge network which I will outline in the following.

2.1 Platforms

A platform describes a form of nested formal organizations on which a number of firms comes together to make sense of a new field of technology respectively to create new visions and blueprints on how to set up commercial systems that address future trends in the industry [26]. Hence, their scope is rather targeting long-term developments in the particular market [1]. Firms that engage in innovation platforms are thus mostly focused on staying in touch with general technological developments and exchanging experiences with their peers in the industry. Still, such a platform creates a community of firms that are willing to learn about new knowledge in the market and enlarge their own knowledge base [22]. The firms engaging in it thus signal openness to external knowledge and interorganizational knowledge transfer in general. Hence, firms participating in the platform will probably be more likely to perceive other platform participants as accessible and willing to share their expertise.

In general, platforms possess a rather large temporal and functional scope. Concerning the former, platforms do not aim to address immediate problems for which a solution might be developed in the near future, but provide firms with a forum to discuss macrotrends within the particular industry [1]. Hence, rather than providing a closed time frame with clear points of beginning and ending, platforms enforce a rather cyclical time frame in which loops of learning and continuous development dominate [2]. Accordingly, the task frame of a platform includes a rather broad and open temporal scope, without deadlines or time restrictions. Concerning the latter, platforms also possess a rather broad and open functional scope. Their goal statement normally is vague so that participating firms jointly may shape the agenda to issues of interest and topicality [23]. Rather than projecting a clear vision of the future, these platforms provide an opportunity for firms to exchange experiences with other companies that face similar long-term challenges. Hence, platforms set the frame for firms jointly honing their own base of expertise and capabilities by the help of their peers [28].

Due to these broad scopes of time and function, I expect structural logics that depict social coordination mechanisms to be more prevalent than structural logics that might be induced by task characteristics. As the task frame is broad and ambiguous, there is no clear immediate goal to be achieved. In turn however, firms participating in a platform commit broadly to an overarching longterm vision [5].

This special context should account for the increased occurrence of a number of structural logics. First, I propose that firms will be more likely to accept indirect reciprocity within the platform. The long-term horizon and commitment to a broad vision could diminish potential source firms' need to be incentivized by counteroffer of relevant and new information as they may rely on generalized exchange in the platform. Second, firms might be less likely to acquire knowledge from other firms in the platform based on tendencies of homophily. Whereas in networks, firms tend to generally find similar others to be more accessible and their knowledge to be more valuable [24], the context of a platform is likely to reduce these tendencies. When two firms similar to each other commit to a nested organization with a broad overarching vision, they indicate similar preferences and worldviews thus altering the perception of accessibility. With the lack of a clear immediate goal, firms moreover possess the freedom to explore diverse areas of knowledge leading to a diminished preference towards similar firms [7]. Third and finally, transitive triads will be more likely to occur within platforms. All three logics behind the existence of transitive triads, namely clustering, bypassing and countering may be stimulated by a platform [21,19]. Clustering will be enhanced because of the common long-term vision of platforms members, bypassing might be more likely because of the social proximity created by the platform facilitating the formation of forming ties to third actors, and countering will be induced by short term self-interest. As a consequence, I propose the following hypotheses:

Hypothesis 1a: Firms in a platform are less likely to form reciprocal knowledge ties between each other and more likely to form cyclic triads.

Hypothesis 1b: Firms in a platform are less likely to acquire knowledge from similar others in the platform as well as firms located in close geographic distance.

Hypothesis 1c: Firms in a platform are more likely to form transitive triads.

2.2 Projects

Projects, the second form of formal nested organizations in interorganizational networks aim at exploring technology fields, identifying market opportunities or developing new products, processes or business models. Project members thereby agree to fulfill a specified task in a certain amount of time [12]. Expecting an impact of projects on the likelihood of a knowledge transfer tie existing between two member firms is reasonable. First, firms engaging in the same project will be more

both visible to each other. Moreover, due to a clear collective goal, high levels of accessibility among project members as well as high motivation to share knowledge resources are likely [2]. Second, knowledge exchange among project members will be perceived as especially valuable and profitable due to task interdependencies and coordination needs [34].

In comparison to platforms, projects are nested organizations with clear temporal and functional boundaries. They group together firms in aiming to accomplish a unique, novel and complex task [29]. Though the goal of projects is most often clearly specified, the operational rules of how to achieve this goal are normally not [34]. Thereby, instead of pursuing a long-term vision, projects have immediate task and performance demands [12]. In sum, projects usually demand highly focused and fast knowledge work with specified goals and finite time horizon but ambiguity in terms of how to reach them [34]. In other words, interorganizational projects are the organizational equivalent of a one-night stand [12].

I argue that these features of projects will lead to different effects on knowledge transfer network structures than it was the case for platforms. Previous research found that the narrow temporal and functional scopes of projects lead member firms to predominantly focus on the task at hand. Due to performance and time pressures, the social system of project members is likely to immediately jump into a mode of action without first letting firms develop relationships or a common knowledge base [18,20]. This radical task focus leads to the emergence of distinct structural logics in the according knowledge exchange network [36]. First, research on social psychology has shown that in task-oriented contexts, centralized network structures tend to develop [3,16]. More recent studies support these notions in outlining the importance of lead organizations in providing for fast and easy communication linkages across interfirm networks [26]. Hence, we predict a tendency of open triadic structures occurring in project networks [12]. Second, via task focus, interdependencies in firms' activities emerge. It is likely that in a project network, knowledge network structures will reflect such interdependencies in order to minimize coordination failures [11]. As a consequence,firms might tend to not experiment with their partners and exchange knowledge more likely with similar others. Finally, due to the more transactional character of projects in comparison to platforms, firms might be less likely to rely on generalized exchange and thus to accept indirect reciprocity.

In sum, I propose the following hypotheses:

Hypothesis 2a: Firms in the same project are more likely to form reciprocal knowledge ties between each other and less likely to form cyclic triads.

Hypothesis 2b: Firms in the same project are more likely to acquire knowledge from similar others in the platform.

Hypothesis 2c: Firms in the same project are more likely to form open triads.

3 Nested Organizations and their Effect on Knowledge Network Development

In order to test the research hypotheses proposed in this paper, I collected network data from the biggest association of municipal utilities in Germany. The 84 members of this association are local energy providers from all over the country. The data collection procedure was done via cross-sectional survey. I approached at least two key informants in all the association's member firms. Managers responsible for innovation management within their respective firms as well as C-level executives were contacted. In total, I was able to obtain contact information from 314 potential sources within the 84 member organizations. These were contacted via e-mail and telephone calls. In all, I received 147 completed questionnaires. The responses came from 74 of the 84 member organizations resulting in a response rate of 88.1 percent.

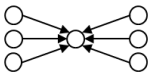
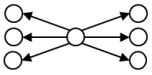
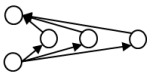
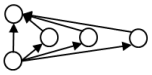
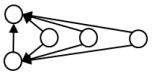
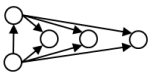
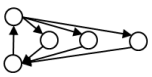
In the questionnaire I asked respondents to indicate 'flow relations' between the organizations [4]. To this end, sociometric techniques were applied [35]. These comprised a rooster-based approach to obtain data on a focal firm's knowledge sources. In addition to the surveys, the association's central management unit provided me with access to extensive archival data. I thereby obtained annual reports of all member firms, the association's quarterly magazine published to the member firms, internal newsletters, and project reports, all adding up to over 1,500 pages of text material. Based on this archival data, I was able to reconstruct the membership of firms in platforms and projects within the association's context. Concerning platforms, the central management unit installed two different long-term interest groups. The first one is dealing with the issues of digitalization and digital business models in the energy sector. In this platform 39 of the 84 association members participate. The second one addresses the future of energy production. Here, 11 member firms participate. Concerning projects, I identified 18

projects dealing with concrete tasks such as developing a rollout concept for smart meter solutions or creating an app for end users to monitor their homes energy consumption. This final list includes only projects which fell into the three year before the survey and had at least three firms participating.

In order to test my theoretical arguments with an appropriate statistical model, I consider each individual tie between two firms in the observed network as a random variable. Hence, I link my data structure to the p-star (p*) class of Exponential Random Graphs Models (ERGM) [31]. I follow usual approaches in the specification of ERGM in that I include both actor-relation effects and local dependencies in the estimation model. Concerning actor-relation effects, I used the status (measured by the firm's size [14]) and intellectual capital (measured by eight survey items based on [32] of firms for sender and receiver effects as well as organizational similarity (measured by size difference), geographical closeness (assigned if both firms are located in the same region in northern, central or southern Germany) and technology base similarity (measured by Pearson correlations between both firms' energy production mix (consisting of coal, nuclear energy, gas and renewables)) for homophily effects. As local dependencies I included popularity spread (A-in-S), activity spread (A-out-S), multiple connectivity (A2P-T), path closure (AT-T), popularity closure (AT-D), activity closure (AT-U) and cyclic closure (AT-C). For parameter estimation, Markov Chain Monte Carlo Maximum Likelihood simulations techniques were used. The model was estimated for the overall network, the platform network and the project network.

4 Results and Conclusion

The results confirm the impact of formal nested organizations on knowledge transfer structures in interorganizational networks. In general interorganizational knowledge networks seem to have a tendency towards reciprocity, status and expertise-based selection, homophily in terms of organizational similarity and geographical closeness as well as popularity-based closure ('Overall Network' in Fig. 1). In the platform network, reciprocity, status-based selection, expertise-based selection and geographic closeness effects are also existent, though the last is clearly lower than in the overall network. The effect of status similarity, the positive tendency towards popularity-based closure and the negative tendency for cyclic closure disappear whereas path closure and activity spread become significant ('Platform Net-

Parameter	Configuration	Overall Network		Platform Network		Project Network	
		Estimate	SE	Estimate	SE	Estimate	SE
Baseline Parameters							
Arc (Outdegree)		**-6.2603***	**0.6215**	**-6.3788***	**0.7784**	**-6.1053***	**0.9767**
Reciprocity		**2.0905***	**0.2105**	**2.0295***	**0.3084**	**2.3610***	**0.2952**
Actor-relation Effects							
Status (Sender)		0.0458	0.0442	0.0617	0.0611	**0.1266***	**0.0560**
Status (Receiver)		**0.1655***	**0.0475**	**0.1504***	**0.0745**	0.0893	0.0629
Intellectual Capital (Sender)		-0.0745	0.0701	-0.0408	0.0951	-0.0854	0.1145
Intellectual Capital (Receiver)		**0.2266***	**0.0827**	**0.2640***	**0.1171**	**0.2280***	**0.1128**
Status Similarity		**0.1754***	**0.0818**	0.1719	0.1378	0.1754	0.1340
Geographical Closeness		**0.6561***	**0.0901**	**0.4668***	**0.1210**	**0.5215***	**0.1254**
Technological Similarity		-0.0030	0.1057	-0.0233	0.1493	**0.1832***	**0.0919**
Local Dependencies							
Popularity Spread		0.1976	0.2140	0.0929	0.2858	**0.4960***	**0.2253**
Activity Spread		0.1985	0.2197	**0.4687***	**0.2333**	0.3096	0.2232
Multiple Connectivity		-0.0111	0.0242	0.0075	0.0456	-0.0740	0.0514
Path Closure		0.2374	0.2276	**0.7901***	**0.3003**	0.1626	0.3096
Popularity-based Closure		**0.3218***	**0.1560**	-0.0467	0.2320	0.2212	0.2097
Activity-based Closure		0.0458	0.1615	-0.3437	0.2264	0.0839	0.2150
Cyclic Closure		**-0.1383***	**0.0569**	-0.1172	0.1114	**-0.1951***	**0.0791**

Notes: * $p < .05$

Fig. 1. ERG model estimates on the presence of knowledge network ties

work' in Fig. 1). In the project network, reciprocity, expertise-based selection and geographical closeness effects are similar to the overall network. Cyclic closure becomes even less likely, status-based selection, status similarity effects and tendencies towards popularity-based closure disappear. In turn, popularity spread, sender effects of status and technology similarity effects emerge ('Project Network' in Fig. 1).

Partial support for the proposed hypotheses and revealing several additional structural logics is displayed. H1a proposed that in platforms, indirect reciprocity is more likely. In the platform network, the estimation score for direct reciprocity is only slightly lower than in the overall network, the score for cyclic closure is still negative but insignificant in contrast to the overall network. Hence, adequate support for this hypothesis can be stated. H1b suggests lowered similarity/proximity effects. These are clearly evident for size similarity and geographic proximity, but not for technological similarity. Hence, there is partial support for H1b. As proposed in H1c, transitivity in the form of path closure occurred at a significantly higher frequency whereas estimation scores for popularity - and activity-based closure are not significant. Hence, bypassing is a prevalent network dynamic in platforms. Concerning projects, H2a is confirmed in that the probability of indirect reciprocity is diminished in a task-oriented context whereas estimation scores for reciprocity are clearly higher than in the overall network. H2b which proposes that firms participating in the same project are more likely to acquire knowledge from similar others is partially confirmed in terms of firms in a project being more likely to acquire knowledge from other firms with a similar technological knowledge base. In contrast, the tendency towards geographic proximity is reduced also in the project network. Finally, H2c is partially confirmed. On the one hand, popularity spread is significantly more likely in the context of projects. On the other hand, there is no significant tendency towards activity spread or multiple connectivity.

With these results, the paper makes some important contributions to different streams of research. First, this work contributes to previous literature knowledge transfer networks. In this context, works such as [7] outlined the existence of a range of theories and causal mechanisms explaining in which structural patterns knowledge transfer among firms emerges. Furthermore, [19] provided evidence for the notion that features of the overall context in which firms operate deter-

mine the specific structural logics in place. The results of this paper further expands these pioneering insights by supporting the notion that a formal context connecting firms through a certain type of task frame has an impact on the particular emerging structural logics in the network. Second, the paper adds to research on the management of firm networks. I am able to provide empirical evidence for the actual impact of a concrete type of management measure, namely the initiation of nested organizations. Thereby, both platforms and projects serve to foster knowledge transfer in interorganizational networks. Besides these direct effects, both platforms and project induce indirect effects on knowledge network structure. More specifically, the broad functional and temporal scope of platforms induces a long term vision task frame fostering a social MBB structure geared towards interfirm learning. In contrast, the goal-oriented task frame of projects rather stimulates structural mechanisms that allow for communication efficiency. In sum, both forms of nested organizations thus complement each other as they foster the emergence of fairly different network patterns and characteristics. Future research should further specify these differences and validate the findings across interorganizational networks in different industrial and regional settings.

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