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Network competence: Its impact on innovation success and its antecedents

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Abstract

Past research has consistently shown that companies, which have close relationships with customers, suppliers, research institutions, and competitors are more likely to have higher product and process innovation success. But why and how are these firms able to build up and use technology-oriented interorganizational relationships, which give them a competitive advantage? The authors postulate that the underlying reason is a company-specific ability to handle, use, and exploit interorganizational relationships. We call this skill network competence. Drawing upon a sample of 308 German mechanical and electrical engineering companies, results of a LISREL analysis reveal that network competence has a strong positive influence on the extent of interorganizational technological collaborations and on a firm's product and process innovation success. Furthermore, four organizational antecedents have an impact on a company's network competence: access to resources, network orientation of human resource management, integration of intraorganizational communication, and openness of corporate culture.

1. Introduction

In the 1980s and 1990s, scholars developed scales to measure the market orientation of firms in order to empirically test some of the claims about the effects of marketing orientation on firm performance (Jaworski and Kohli, 1993; Kohli and Jaworski, 1990; Narver and Slater, 1990). This was a way of going beyond the rational marketing planning approach in which a company decides on four P's based on market research. However, business models have moved even further and nowadays, the fact is acknowledged that firms are embedded in networks of cooperative and competitive relations with other organizations (Achrol, 1997; Achrol and Kotler, 1999; Anderson et al., 1994; Ford et al., 1998). Thus, the concept of market orientation is one measure that addresses the firm's operation but now, understanding firm's behavior and performance depends on important ways on how the firm manages its relations with other organizations within its network. Interorganizational relationships are seen as long-term oriented arrangements between organizations (firms, institutions, agencies, etc.), which are "maintained for some overall functional purpose" (Håkansson and Turnbull 1982, p.1) or — in other words — fulfill various functions (Anderson et al., 1994) and create value (Achrol, 1997; Wilson, 1995). The goals of relationships vary from increasing sales volume or profit in a relationship, gaining access to new markets or third parties, or jointly developing innovations (Walter et al., 2001). The purpose of a relationship is not necessarily found within the relationship itself but may be found in a network of connected relationships (Anderson et al., 1994), e.g., when a relationship with one actor allows access to other organizations (reference effect). As we move into the networked economy of the next millennium (Achrol and Kotler, 1999), a firm's ability to initiate, handle, use, and terminate interorganizational relationships becomes of central importance.

However, there is a problem with managing networks. "The inherent complexity of intercompany relationships and networks means that it is unrealistic to imagine that they can be wholly 'designed' by any one party, still less that their evolution can be solely the result of conscious one-sided plans" (Ford, 1997, p. 559). Very often, network management is more about "being manageable" (Wilkinson and Young, 1994, p.76), i.e., being able to respond to the opportunities presented and created by others. Even though individual companies may be limited in their actions, each actor in a network has some influence on the network,

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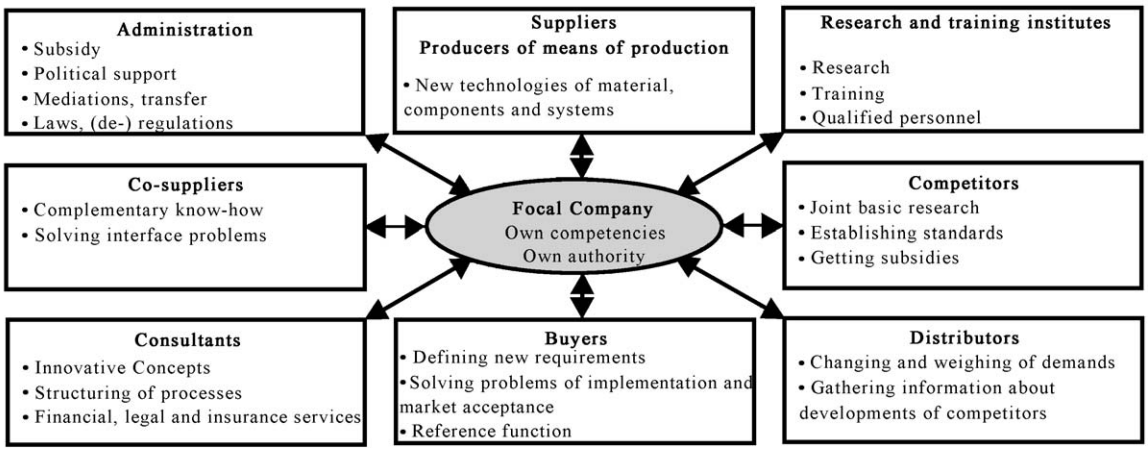

Fig. 1. Innovation partners and their contributions (adapted from Gemünden et al., 1996, p. 450).

which can be managed more or less efficiently. "Our empirical studies have convinced us that there are substantial differences between companies in their ability to handle networks. Some become highly talented and stable practitioners while others are quite simple 'amateurs'" (Håkansson, 1987, p. 124). Håkansson (1987, p. 124) briefly introduces the notion of networking ability mentioning two aspects: a firm's ability to improve its overall position in a network (with regard to resources and activities) and its ability to handle individual relationships. However, this concept has not received further development.

In this paper, we analyze the factors underlying a firm's ability to manage their network of relationships effectively. We have chosen to call this ability a firm's "network competence" and we will define the concept in more detail in the following chapter. With this approach, we will extend the literature by moving from a relationship management focus to a network perspective. The basic research questions are: (1) What is a firm's network competence? (2) What impact does a firm's network competence have on its degree of technological interweavement and its product and process innovation success? (3) Which organizational characteristics of the company have an impact on network competence?

In order to achieve this, we focus on the role of interorganizational relationships in innovation development. Nowadays, most companies face major problems related to new product and process development due to the shortening of the innovation cycle, the higher complexity and interconnectedness of technologies, and the higher costs of innovations. One solution to these (and other) problems is seen in using interorganizational relationships through which the "burden" of innovation can be shared between several organizations.

We will use the term technological interweavement to "describe the totality of a firm's technology-oriented relationships aimed at acquiring, jointly developing or diffusing of technological know-how and resources" (Gemünden et al., 1992, 1996, p. 451). Many authors have highlighted potential contributions of external partners to a company's innovation efforts and the positive impact of technological interweavement on a firm's innovation success has received almost universal support in a wide range of studies (e.g., Biemans 1992; Deeds and Hill 1996; Gemünden et al., 1996; Hagedoorn and Schakenraad, 1994; Håkansson, 1987, 1989; Powell et al., 1996; Shan et al., 1994; von Hippel, 1986, 1988). Fig. 1 indicates the variety of actors that can offer valuable contributions to any given firm under question, i.e., the focal company.

Technological-oriented relationships (i.e., a company's degree of technological interweavement) are not without costs. These costs relate to the investment of time, effort, and resources a firm must make to gain access to external partners' resources (cf. Mattsson, 1988; Plinke, 1989; Valla, 1986; Williamson, 1979). As with all investments, choices have to be made regarding the set of partners a firm works with in product and process development. Also, technological-oriented relationships need to be managed effectively and efficiently by a company. Therefore, the management of a firm's innovation network becomes a critical task in order to achieve competitive advantages. In the following sections, we introduce the concept of network competence. Then we derive hypotheses about the impact of network competence and the organizational antecedents of network competence. Next, the results of a study designed to test these hypotheses are described. Finally, we discuss the results and their implications for research and practice.

2. Network competence

Highlighting the importance not to think in physical assets but in the roots of competitiveness, Prahalad and Hamel (1990) proposed the concept of a firm's "core competence." Core competencies "provide potential access to a wide variety of market, ... make a significant contribution to the perceived customer benefits ... and are

difficult to imitate" (Prahalad and Hamel, 1990, pp. 83–84). Since then, increasing attention has been paid to a firm's competencies by both academia and managers. While the focus traditionally has been on technological competencies and their impact on corporate success, more recent studies have included managerial competencies (Day, 1994; Dosi and Teece, 1993; Malerba and Marengo, 1995).

The term competence is used by some to describe resources and preconditions, i.e., qualifications, skills, or knowledge, necessary to perform certain tasks without considering the actual execution of the task. But, competence has been defined also as a process of activities (Day, 1994; Drucker, 1985; Li and Calantone, 1998). We incorporate both aspects in our concept of network competence including both having the necessary knowledge, skills, and qualifications as well as using them effectively. With regard to network competence, we distinguish between the tasks that need to be performed in order to manage a company's technological network and the qualifications, skills, and knowledge that are needed in order to perform these tasks (see also Gemünden and Ritter, 1997; Ritter, 1999). [We will use the term "qualifications" in the remainder of the text as an umbrella for skills, knowledge, and formal qualifications (such as certificates). Those qualifications are resources and preconditions for effective task execution, as well as task execution is a precondition for the (further) development of those qualifications. This mutual dependence manifests another reason why we combine both elements into our concept of network competence.] These elements are discussed below.

2.1. Network management tasks

A distinction may be made between tasks which are relevant to managing a single relationship (a dyad) and tasks which are necessary to manage a portfolio of relationships or a network as a whole (Ford, 1980; Mattsson, 1985; Möller and Halinen, 1999; Wilkinson and Young, 1994).

2.1.1. Relationship-specific tasks

Relationship-specific tasks refer to activities to establish and maintain a single relationship. The literature on relationship management suggests three different types of relationship-specific tasks:

2.1.1.1. Initiation. Interorganizational relationships do not start on their own. They are the result of specific investments. Changing political, social, economic, and technological circumstances may necessitate the break-up of existing relationships and the initiation of new ones. Typical activities to identify potential partners are visits to trade shows, monitoring industry-related journals, and exploiting hints from existing partners. Company visits and the distribution of information about the firm to potential partners are also initiation activities.

2.1.1.2. Exchange. Exchange of products, services, money, information, know-how, and personnel can be seen as an essential part of an interorganizational relationship (Anderson and Narus, 1984, 1990; Bagozzi, 1975; Dwyer et al., 1987; Homans, 1958; Thibaut and Kelly, 1959). Focusing on technology-oriented relationships, we distinguish between technology-related exchange (transfer of technological information, technological needs and requirements), person-related exchange (knowledge of personal needs, requirements, and preferences to establish social bonds), and organization-related exchange (information on partner's strategy, organizational structure and culture) activities.

2.1.1.3. Coordination. Normally, a simple exchange between organizations is not sufficient for a relationship. The two organizations involved need to synchronize their activities so that the activities of both organizations are in tune with each other (Mohr and Nevin, 1990). Such coordination includes the establishment and use of formal roles and procedures and the utilization of constructive conflict resolution mechanisms (cf. Helfert and Vith, 1999; Ruekert and Walker, 1987).

2.1.2. Cross-relational tasks

Drawing on a subdivision of managerial tasks widely used in general management literature (Carroll and Gillen, 1987), four different cross-relational tasks can be identified.

2.1.2.1. Planning. The targeting of a desirable state in the future involves internal analysis (resources, strength, and weaknesses within the company), network analysis (quality of external contributions, fit to internal resources, strategic and resource fit within the network), and environmental analysis (competitors, general technological and market developments). These generate a better understanding of a company's internal resource situation as well as more realistic expectations concerning partners' contributions.

2.1.2.2. Organizing. The contributions of each party to achieving the plans must be assigned to specific partners. Also, resource allocation to specific relationships needs to be specified as well as the ways of communicating between people dealing with relationships inside the firm. Furthermore, adaptation issues need to be addressed, i.e., the degree to which the focal company is able and willing to meet an individual partner's needs. It is necessary to evaluate this from a network perspective because adaptation to one partner's requirements may mean not being able to adapt to other (potential) partners' requirements.

2.1.2.3. Staffing. Personnel need to be allocated to specific relationships in tune with planning and organizational needs. This network management task involves guidance and coordination of employees involved in relationship

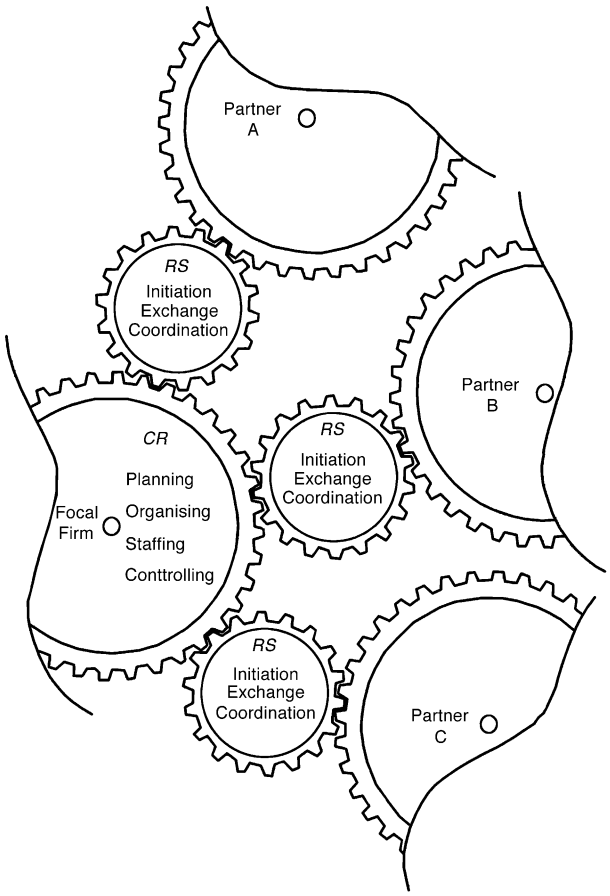

Fig. 2. Cross-relational (CR) and relationship-specific (RS) network management tasks.

management activities. Conflicts between employees can occur and must be solved when several relationships compete for the same resources within a company.

2.1.2.4. Controlling. Controlling is both the final and (through a feedback loop) the first stage of the management cycle. Control activities can be internally oriented (e.g., contribution of personnel, quantity and quality of communication activities) as well as externally oriented (e.g., contributions of external partners or performance of the network as a whole).

Fig. 2 is a schematic diagram that illustrates the interplay between cross-relational and relationship-specific tasks. It highlights that effective network management requires both elements.

2.2. Network management qualifications

The execution of the network management tasks is a complex process and, as such, it requires various types of qualifications (Jackson et al., 1993, p. 63). A distinction can be made between specialist and social qualifications.

2.2.1. Specialist qualifications

Specialist qualifications include those, which are necessary to handle "the technical side" of relationships: Technical skills are important to understand partners in terms of their technical needs, requirements, and capabilities. Economic skills are required to define inputs and set prices. This is of particular interest in collaborative innovation as the division of rewards can be a source of some conflict between partners. This also leads to the importance of skills in legal matters. These are of interest for setting up contracts but are also critical in collaborative innovation developments where it is hard to define the outcome from the beginning. Knowledge about the other actors is an important resource. This knowledge includes information about the operations of partners, their personnel and resources, which are important for understanding their behavior and the development of the network. In addition, experiential knowledge resulting from interactions with external partners is crucial. Such knowledge can be used to anticipate and evaluate critical situations and to select appropriate action (Helfert, 1998, p. 29).

2.2.2. Social qualification

Social qualifications are the extent to which a person is able to exhibit independent, prudent, and useful behavior in social settings (Helfert, 1998, p. 29). It includes several dimensions such as communication ability, extraversion, conflict management skills, empathy, emotional stability, self-reflectiveness, sense of justice, and cooperativeness. Social qualifications are of special interest because of the importance of interpersonal interactions and relationships in business relations.

2.3. Degree of network competence

From the foregoing discussion, we can see that a company's degree of network competence is a two-dimensional construct that can be defined as (a) the degree of network management task execution and (b) the extent of network management qualifications possessed by the people handling a company's relationships. Fig. 3 provides a summary of the components of network competence.

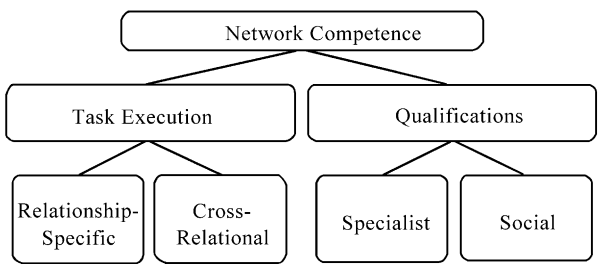

Fig. 3. Elements of a company's network competence (Source: Ritter, 1999, p. 471).

3. The impact of network competence on a company's technological interweavement and its innovation success

"The role, development, and performance of companies will be explained by their ability to develop relationships" (Håkansson and Snehota, 1995, p. 4). We will verify this statement by considering the impact of network competence, i.e., the ability to develop relationships, on technological interweavement and innovation success.

There are several relationship barriers that may weaken the existence and the effectiveness of cooperative relationships (cf. Walter, 1998, pp. 31–60). Network management activities reduce these barriers and also ensure that new partners for technological exchange will be effectively found and may be convinced of the advantages of collaboration. Through more intensive initiation activities, firms may be able to realize first-mover advantages in tying up relationships with important partners. Furthermore, other organizations will have a greater interest in cooperating with a network-competent firm because the likelihood of a successful relationship is higher. Network competence also leads to the exploration and exploitation of new areas of cooperation in existing relationships as a result of increased trust and commitment.

> *Hypothesis 1:* A firm's degree of network competence has a positive impact on its degree of technological interweavement.

Performing network management tasks with the necessary qualifications is likely to result in internal innovation processes that are more market-oriented because information about the market is available within the company through interorganizational relationships (Han et al., 1998). Due to the increasing importance of relationship marketing (Grönross, 1994; Mattsson, 1997), networking activities may serve as a basis for selling innovative products to customers with whom the company is not collaborating technologically. Thus, network competence contributes to a company's innovation success directly; not only through increasing the degree of technological interweavement. Furthermore, network management qualifications are useful for successful completion of internal innovation processes as those require social interaction and managerial skills as well.

> *Hypothesis 2:* A firm's degree of network competence has a positive impact on its innovation success.

A positive impact of technological interweavement on innovation success is suggested by several studies (e.g., Biemans, 1992; Deeds and Hill, 1996; Gemünden et al., 1996; Hagedoorn and Schakenraad, 1994; Håkansson, 1987, 1989; Powell et al., 1996; Shan et al., 1994; von Hippel, 1986, 1988). The rational behind the positive impact is that through collaboration, more resources can be utilized in the development process, i.e., more person power, a larger pool of technological facilities, larger quantity, and increased quality of information and ideas. Also, more innovation projects can be carried out due to more resources, which reduces the negative impact of failing individual developments. We summarize these arguments in the following hypothesis:

> *Hypothesis 3:* A firm's degree of technological interweavement has a positive impact on its product and process innovation success.

3.1. Organizational antecedents of network competence

Four antecedents of a company's network competence are distinguished (Ritter, 1999) (The selection of these four antecedents is based on market and customer orientation literature; Homburg, 1998, pp. 174–199; Jaworski and

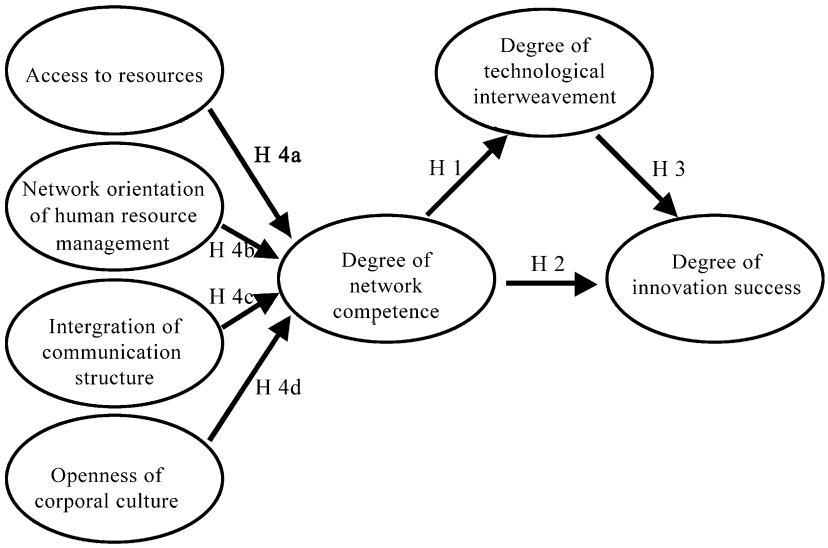

Fig. 4. Antecedents and impacts of network competence.

Kohli, 1993, pp. 54–57; Kohli and Jaworski, 1990, pp. 6–12; Narver and Slater, 1990, pp. 25–26). Access to resources (financial, physical, personnel, and informational) enables people to execute the network management tasks intensively in a goal-oriented manner and helps them develop their qualifications. Through a high degree of network orientation of human resource management in terms of personnel selection, development, and assessment, a firm is able to enhance their network competence by hiring and developing necessary human resources. A high integration of formal and informal communication structure makes important information available to those dealing with an external partner. That information may support task execution and qualification development. Finally, openness of corporate culture increases network competence by giving employees the necessary flexibility, spontaneity, and responsibility to develop interorganizational relationships. We, therefore, hypothesize:

> *Hypothesis 4:* A company's degree of network competence is positively influenced by: (a) the degree of access to resources, (b) the extent of network orientation taken by a company's human resource management, (c) the integration of a company's communication structure, (d) and the openness of its corporate culture.

A model of the relationships between network competence and its antecedents and consequences is summarized in Fig. 4.

4. Empirical results

4.1. Data collection and sample

The sample is 741 German companies operating in the fields of mechanical and electrical engineering, measurement technology and control engineering who were contacted and asked to participate in the study. Data were collected between August and December 1997 via personal interviews using a standardized questionnaire. We obtained data from 308 companies, which is a response rate of 43%.

To identify key informants (cf. Philipps, 1981; John and Reve, 1982), we asked for respondents with an overview of the company, the firm's technological network, and its innovation success. Our respondents were CEOs (in 50% of the cases), heads of the R&D department (25%) or (in all other cases), we interviewed the person responsible for (interorganizational) innovation development.

Our sample consists mainly of medium-sized companies: 41% of the companies have between 50 and 249 employees and 25% have between 250 and 999 employees. The remaining companies are either very small (24% with less than 50 employees) or larger corporations with more than 1000 employees (10%). Companies in our sample operate in mechanical and electrical engineering, measurement technology and control engineering. Most of the interviewed companies have been established for between 10 and 50 years (63%).

4.2. Operationalization and measurement

All indicators of constructs were measured using seven-point multi-item scales. Multi-item measures were developed based on Cronbach's α and item-to-total correlations exceeding appropriate levels (Cronbach's $\alpha > .60$, cf. Mc-Allister, 1995, p. 36; item-to-total correlation >.30, cf. Ku-mar et al., 1995). Convergent validity was checked through exploratory factor analyses. In all cases, only one factor was extracted by the Kaiser criterion (eigenvalue above 1, cf. Table 1).

Four indicators were used to measure the overall access to network management resources: (1) access to financial resources for, e.g., communication, adaptation, development, R&D investment, relationship initiation, and maintenance (nine items, Cronbach's α=.86); (2) access to physical resources such as meeting facilities, computers, telephones, and fax machines (five items, Cronbach's α=.81); (3) access to personal resources as extent to which staff for network management is available and as available time for collaborative R&D projects and initiation and maintenance of relationships (four items, Cronbach's α=.77); and (4) access to information measured as the existence and availability of information about buying and selling markets in general and about partners (six items, Cronbach's α=.82). Network orientation of human resource management was measured in terms of personnel selection (e.g., importance of collaborative skills and experience for selection, three items, Cronbach's α=.74), personnel development (e.g., technical training and communication seminars, five items, Cronbach's α=.72), and assessment (e.g., importance of successful relationship engagement for internal promotion and benefits, four items, Cronbach's α=.77). Regarding integration of communication structure, we examined formal channels and informal channels. Formal channels included the extent of cross-departmental project or task groups and cross-functional seminars and workshops (three items, Cronbach's α=.80). Informal channels represent the extent of cross-departmental social contacts and actual day-to-day collaboration (four items, Cronbach's α=.80). The only exception in the use of a seven-point multi-item scale is openness of corporate culture which was measured using the sum-scale suggested by Deshpandé et al. (1993). The two dimensions of openness are adhocracy culture and hierarchy culture (the latter was reversed, four items each, Cronbach's α=.70 and .79).

For each of the seven network management tasks, multi-item scales were used describing typical activities of the task in question. Planning referred to activities like analyzing the quality of technological know-how, assessing the capabilities of partners, and monitoring technological developments (17 items, Cronbach's α=.87). Allocation of available financial resources to and discussion of specific

Table 1
Results of the confirmatory factor analysis using LISREL

Construct	Indicator (number of items for sum-scale)	Standard factor loading	Item-to-total correlation	Cronbach's α	Explained variance by one factor (%)	Construct reliability	Average explained variance
Access to resources	Financial resources (9)	.69	.61	.73	56	.73	.41
	Physical resources (5)	.55	.44				
	Personnel resources (4)	.60	.55				
	Informational resources (6)	.70	.50				
Network orientation of human resource management	Personnel selection (3)	.54	.54	.69	62	.70	.44
	Personnel development (5)	.81	.51				
	Personnel assessment (4)	.62	.48				
Integration of communication structure	Formal communication structure (3)	.80	.52	.67	76	.69	.53
	Informal communication structure (4)	.65	.52				
Openness of corporate culture	Adhocracy culture (4)	.64	.54	.68	77	.72	.56
	Hierarchy culture (4)	.85	.54				
Degree of network competence	Task performance (7)	.87	.60	.72	80	.76	.61
	Qualifications (2)	.69	.60				
Degree of technological nterweavement	Technological interweavement with customers (5)	.66	.54	.75	57	.75	.43
	Technological interweavement with suppliers (5)	.69	.60				
	Technological interweavement with competitors (5)	.53	.53				
	Technological interweavement with research institutions (5)	.73	.52				
Degree of innovation success	Product innovation success (3)	.78	.62	.74	81	.77	.62
	Process innovation success (3)	.80	.62				

aims of individual relationships as well as setting up regular meetings were used to capture the extent of organizing network management (eight items, Cronbach's α=.83). Staffing was measured by looking at allocating staff to relationships, matching activities between them, and handling conflicts between personnel (eight items, Cronbach's α=.85). The degree of executing the controlling task was judged by looking at staff and partner monitoring (seven items, Cronbach's α=.85). Initiation was measured as the extent to which a firm performs activities such as attending trade shows and using partners or public sources to look for potential collaborators (eight items, Cronbach's α=.82). Exchange activities include the degree of effort to communicate, inform, and visit partners (nine items, Cronbach's α=.87). Activities to synchronize the companies, to solve conflicts, and to incorporate partners' demands were measured for coordination (10 items, Cronbach's α=.87). These task measures where combined into an overall task execution measure.

Specialist qualifications were measured assessing level of technical, economic, and collaborative expertise as well as knowledge about the firm and its partners (12 items, Cronbach's α=.77). Social qualifications were captured by looking at staffs' ability to communicate, interact, and collaborate with other persons (14 items, Cronbach's α=.89). These two scales were merged together into one measure of qualifications.

Technological interweavement was measured as the extent to which external partners are integrated into a firm's idea generation, conceptualization, development, and testing (four items for each type of partner, Cronbach's α between .80 and .87).

For both product and process innovation success, separate scales were used capturing the position of the company in relation to competitors and the technological state-of-the-art (three items each, Cronbach's α=.72 and .78). Given the debate about different measurements of innovation success (Cooper, 1984, 1985; Hauschildt, 1991; Smith, 1992), respondents were additionally asked about product and process innovation rates (sales of products less than 3 years old, percentage of production on facilities less than three years old) in order to validate our measurement. In both cases, innovation rates correlate significantly with the scales. Thus, our measures appear to be reliable.

The measurement model was tested for validity and reliability following the procedure suggested by Anderson and Gerbing (1988) and Homburg (1998). The results of a confirmatory factor analysis using LISREL showed that the measurement model meets the widely employed guidelines (cf. Homburg and Baumgartner, 1995; p. 363; Homburg and Giering, 1996, p. 13). The global fit criteria indicate a good fit between the data and the proposed model ($\chi^2_{(131)} = 166.47$; $P = .000$; GFI = 0.973; AGFI = 0.961; NFI = 0.949; CFI = 0.989; RMR = 0.053). Regarding detail fit criteria (cf. Table 1), very few measures fall short of desired thresholds, which is regarded as acceptable (Homburg and Baumgartner, 1995, pp. 363–364; Homburg and Giering, 1996, p. 85).

4.3. Data analysis

Data were analyzed using LISREL 8 (Jöreskog and Sörbom, 1996). The polychoric correlation matrix of the 19 first-order constructs was entered into an Unweighted Least Squares analysis ($\chi^2_{(139)} = 178.95$; $P = .013$; GFI = 0.971; AGFI = 0.961; NFI = 0.946; CFI = 0.987; RMR = 0.055). The results show good fit with the model. The Fornell/Larcker criterion (cf. Fornell and Larcker, 1981) for discriminant validity was met in all cases for the

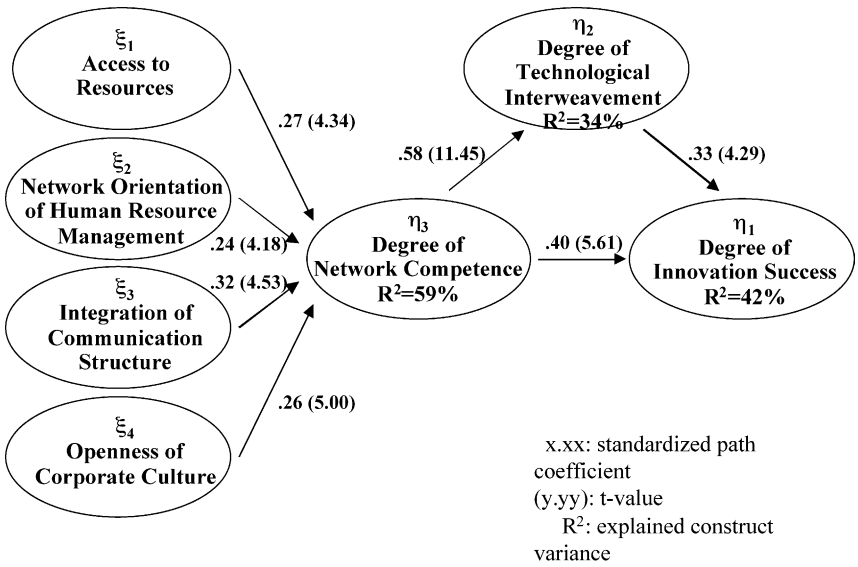

Fig. 5. Empirical results.

measurement and the structural model. Thus, an adequate level of fit in both the measurement model and the structural model can be assumed. Fig. 5 shows the test results regarding the structural model, including the structural equation coefficients, the *t* values, and the explained variance of endogenous constructs. All tests of hypotheses are significant, so the theoretical model may be accepted as consistent with the data.

5. Discussion and further research directions

In this study, we have identified the types of qualifications underlying network competence and the kinds of activities required using such qualifications to manage (or influence) a network. This resulted in a multi-item measure of the network competence construct and its components. With this research, we have opened the black box of why companies differ in their ability to operate in networks. It was developed in the context of technological networks in German industry. However, this is very much a starting point in understanding network management. We used around 100 items for measuring network competence. On the basis of our results and further research, we intend to refine this to a shorter instrument capable of being included in research instruments designed to explore other aspects of firm and network behavior in order to generalize the results to other contexts. We need robust measures and tests of the nature and impact of network competence on firm performance.

The empirical results presented here have shown that a strong and significant link exists between a firm's network competence and its degree of technological interweavement. Through network competence, firms are able to intensively involve others in their technological development process. Thus, companies are in a position to manage networks to the extent that they can develop the necessary network competence. Further research questions arise outside the area of technological development: Does network competence have an impact on the performance of supply networks? What role does network competence play in the internationalization of a firm? Is network competence a better way to understand channel management and channel performance? We can only speculate at this point that similar effects can be found.

The impact of network competence on innovation success was also found to be significant in our research. Through network competence, a firm is not only able to intensify its external relations but can also improve its own performance. Thus, network competence is not only improving the means but also the ends. The result also emphasizes that apart from internal technological competencies, network competence is important for achieving innovation success. Other performance measurements may be tested in order to validate these results. Potential constructs include firm survival and growth as well as sales volume and competitive position.

Our research also addressed the issue of antecedents of network competence. Four areas were identified: access to resources, network orientation of human resource management, integration of communication structure, and openness of corporate culture. Each has a positive significant impact on network competence and these impacts are all nearly on the same level. Thus, network competence is embedded within the whole company as inputs come from various angles. The ability to manage in networks is inseparable from the company itself. Networking is a company-wide responsibility and is constrained as well as supported through a firm's characteristics. Therefore, the whole company needs to be network-oriented.

Apart from the level of the individual firm, it will be challenging to evaluate the effect of network competence on a network as a whole as well as the distribution of network competence within a network. Should firms look for partners with higher, equal, or lower network competence? How do differences impact on network outcomes? And how can one measure a firm's network competence from outside the firm? We measured network competence inside a company. That is not always possible for (potential) partner firms (if not impossible at all). Thus, we need to think of ways to measure network competence form an outside perspective to give managers practicable solutions to assess their partners and potential collaborators.

6. Managerial implications

The managerial implications of this research are twofolded: Firstly, this study highlights the importance of a firm's ability to initiate, handle, and use a portfolio of interorganizational relationships. Thus, firms are advised to analyze their network competence in order to find out potential areas for improvements. This analysis can be based on the developed model, i.e., analyzing task performance and qualifications. In order to achieve competitive advantages in the network economy, firms need to build up and increase their network competence. Networking needs to move upwards on the agenda list and should not be regarded as a pure pleasure activity.

Secondly, our research shows that network management cannot be delegated to a well-defined small group within the firm. Looking at the antecedents, it becomes obvious that the whole organization is either prepared for the network economy or not. Improvements can be made by making resources available to network management, by strengthening the network orientation of the human resource management, by increasing the interdepartmental communication, and by promoting an open corporate culture.

It is not a company's choice whether relationships are there or not. Relationships and networks exist and a company is embedded into a network. However, it is a company's choice to develop network competence in order to survive in the networked economy. As our research shows,

organizations can turn the burden of relationships into competitive advantage.

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