J PROD INNOV MANAG 2012;29(6):••–••

DOI: 10.1111/j.1540-5885.2012.00973.x

Open Innovation in Practice: Goal Complementarity and Closed NPD Networks to Explain Differences in Innovation Performance for SMEs in the Medical Devices Sector

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Cooperation with other organizations increases the innovation performance of organization, especially for small and medium-sized enterprises (SMEs) as they encounter liabilities of "smallness" (e.g., limited financial resources, and manpower). In the medical devices sector, collaboration with external partners for NPD becomes increasingly important due to the complexity of the products and the development process. About 80% of companies in this sector are SMEs. These companies operate in a highly regulated sector, which affects the organization of the external network required for the new product development (NPD) process. SMEs are practicing extensively open innovation activities, but in practice face a number of barriers in trying to apply open innovation. This paper examines multiple network characteristics simultaneously in relation to innovation performance and thereby aligns with and builds further on configuration theory. Configuration theory posits that for each set of network characteristics, there exists an ideal set of organizational characteristics that yields superior performance. In this research, the systems approach to fit is used. Fit is high to the extent that an organization is similar to an ideal profile along multiple dimensions. This ideal profile represents the network profile that the 15% highest performing companies use. It is argued that the smaller the distance between the ideal profile and the network profile that is used, the higher the performance.

The objective of this research is (1) to examine the relation between the ideal profile and innovation performance and (2) to examine which organization of the network profile is related to high innovation performance. Quantitative survey data (n = 60, response rate 61.9%) form the core of this research. The quantitative results are clarified and have been triangulated with qualitative interview data (n = 50).

Our findings suggest the presence of an "ideal" NPD network profile (in terms of goal complementarity, resource complementarity, fairness trust, reliability trust, and network position strength): the more a company's NPD network profile differs from this ideal profile, the lower the innovation performance. In addition, the results of our study indicate that the NPD network profiles of successful and less successful SMEs in the medical devices sector significantly differ in terms of "goal complementarity," while this is less the case for trust and resource complementarity labeled distinctive by previous research. Finally, results show that a relatively closed, focused, and consistent "business-like" NPD networking approach, which is characterized by result orientation and professionalism, is related to high innovation performance. It is recommended that SMEs in the medical devices sector aiming to distinguish themselves from competitors in terms of innovation performance focus on goal complementarity while adopting such a business-like attitude toward their NPD network partners.

Introduction

This paper addresses the question "How to organize the interaction pattern between SMEs and their external partners in an NPD network, in order to achieve high innovation performance." For successful new product development (NPD), small and medium-sized enterprises (SMEs)[1] see themselves confronted with the need to collaborate (Karlsson and Olsson, 1998; Rogers, 2004). This need is caused by the fact that on the one hand, SMEs need to innovate to compete (Hanna and Walsh, 2002; O'Regan, Ghobadian, and Sims, 2006), but on the other hand, they also need to focus on their core competences for efficiency matters.

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[1] According to European standards, SMEs are defined as companies that have 250 or fewer full-time employees (Commission of the European Communities, 2003).

This focus on core competences (Penrose, 1959) inherently means that SMEs cannot do everything themselves.

Previous research showed that collaboration in NPD positively influences the innovation performance. Scholars have concluded that diverse networks increase the positive payoffs of internal innovation capabilities (Branzei and Thornhill, 2006). Furthermore, earlier research states that the successful commercialization of technology often requires collaboration among horizontal competitors that have different capabilities (Teece, 1989). Especially in the field of NPD, networking activity becomes more and more popular as cooperation with other organizations increases the innovation performance of organizations (Chang, 2003; Hanna and Walsh, 2002; Ritter and Gemünden, 2003, 2004; Rothwell, 1991; Salman and Saives, 2005).

SMEs are practicing extensively open innovation activities, and are increasingly doing so (Van de Vrande, De Jong, Vanhaverbeke, and De Rochemont, 2009). There is an ongoing debate about the practical applicability of open innovation. The concept was originally defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively" (Chesbrough, 2006), but in practice, companies face a number of barriers in trying to apply open innovation. Examples are organizational and cultural issues which arise when SMEs start to interact and collaborate with external partners (Van de Vrande et al., 2009), the risk of losing R&D as a core competence (Carpay, Hang, and Yu, 2007), and the loss of key technologies to third parties through know-how leakages and brain drain (Carpay et al., 2007). However, firms that are relatively closed also appear to realize that sufficient openness is necessary to keep up with their competitors (Lichtenthaler, 2008). Therefore, firms implementing open innovation require the establishment of extensive networks of interorganizational relationships with a number of external actors (Chiaroni, Chiesa, and Frattini, 2010).

From alliance literature, we know that many external alliances fail in practice (Duysters, Kok, and Vaandrager, 1999; Faems, VanLooy, and Debackere, 2005; Sadowski and Duysters, 2008; Spekman, Lynn, MacAvoy, and Forbes, 1996), mainly due to negative prospects and negative perceptions (Sadowski and Duysters, 2008), differences in cognition, conflicting interests, differences in timing of contributions (Mahnke and Overby, 2008), opportunistic hazards, and managerial complexity and uncertainty (Park and Ungson, 2001). Since alliances are a type of collaboration, it is assumed that the high alliance failure rate also has its effect on the failure rates of collaboration in innovation and NPD networks. However, up to this moment, research has not yet clearly demonstrated which combination of network variables most affect innovation in particular contexts (Pittaway, Robertson, Munir, Denyer, and Neely, 2004). Therefore, the objective of this research is to examine which combination of network characteristics leads to high innovation performance.

This research addresses *multiple* NPD network characteristics simultaneously in relation to innovation performance instead of focusing on single, individual network characteristics. It thereby aligns with, and builds further on, configuration theory.

BIOGRAPHICAL SKETCHES

Dr. Annemien J. J. Pullen is affiliated as a researcher at the School of Management and Governance of the University of Twente. She holds a master's degree (2006) in Industrial Engineering and Management. She obtained her Ph.D. (2010) on the organization of medical product development. Her current research is focused on organizational aspects of the development of new medical devices in networks.

Dr. Petra C. de Weerd-Nederhof holds the chair of Organization Studies and Innovation and is Program Director of Graduate Studies, as well as Educational Advisor for Twente Graduate School, at the University of Twente, the Netherlands. Her current research is focused on organizational aspects of R&D, NPD, and Innovation Management. In 2010, de Weerd-Nederhof implemented a double diploma M.Sc. Innovation Management and Entrepreneurship with TU Berlin. In addition to her positions at the University of Twente, de Weerd-Nederhof coordinates the yearly Doctoral Summer School in Technology Management for Ph.D. students and is board member of the International Product Development Management Conference, both under the auspices of EIASM. She also is Editor of the academic journal *Creativity and Innovation Management* published by Wiley, and she was recently appointed as the new president of the European Institute for Technology and Innovation Management.

Dr. Aard J. Groen is Professor of Innovative Entrepreneurship and Scientific Director of NIKOS, the Dutch Institute for Knowledge Intensive Entrepreneurship at the University of Twente, the Netherlands. Groen's research interest is focusing on knowledge intensive entrepreneurship in networks. He has published in journals and books, e.g., *Journal of Management*, *International Journal of Small Business*, *Creativity and Innovation Management*. Topics are positioned in entrepreneurship, marketing, university-industry interaction, and innovation and technology dynamics. NIKOS research contributes to the IGS, Institute for Innovation and Governance Studies. Groen received his master's degree in public administration from the University of Twente, and his Ph.D. in business administration from the University of Groningen.

Dr. Olaf A. M. Fisscher has been at the University of Twente since 1989. He holds a master's degree in Industrial Engineering Management. He obtained his Ph.D. in Social Sciences at the University of Groningen in 1986 on the management and organization of R&D laboratories. His research is focused on organizing for innovation and organizing for corporate social responsibility. Currently, he is Professor of Organization Studies and Business Ethics and Director Continuing Education at the School of Management and Governance, University of Twente.

Configuration theory posits that for each *set* of network characteristics, there exists an "ideal" set of organizational characteristics dynamically fitting with the organizations' context that yields superior performance (Van de Ven and Drazin, 1985). The conceptualization of fit that is most consistent with the logical arguments of configuration theories is the *systems approach* to fit (Doty, Glick, and Huber, 1993), which is the methodological approach used in this research. The systems approach defines "fit" in terms of consistency across multiple dimensions of organizational design and context (Drazin and Van de Ven, 1985). Fit is high to the extent that an organization is similar to an *ideal profile* along multiple dimensions (Van de Ven and Drazin, 1985). Interpreting the organizational forms as ideal profiles rather than as categories of organizations means that each real organization in a sample need not be classified into one of the nominal groups identified in the theory. Instead, the degree of deviation between each real organization and the ideal profile is measured (Doty et al., 1993). Ideal profiles are defined as combinations of network characteristics that fit together (i.e., are internally consistent) and are related to high performance. By enabling multiple variables to be assessed simultaneously, this approach also enables researchers to more closely represent the complex constructs and multiple contingencies faced by managers in the "real world" (Gresov, 1989). This paper contributes to theory by addressing multiple network characteristics simultaneously in relation to innovation performance in particular contexts by using Van de Ven and Drazin's (1985) systems approach. This paper provides clarity on which network characteristics are relevant for SMEs in NPD. Finally, the systems approach with profile deviation used in our study and the results that are obtained may be useful to managers from a benchmarking perspective.

To answer the research question "how to organize the interaction between SMEs and their external NPD network partners, in order to achieve high innovation performance," hypotheses are constructed based on theory, which is described in the next section of this paper. Next, the methodology, which includes the research context and sample, the research method of the social systems approach, and the operationalization of variables is presented. The results of the quantitative data analysis, which are complemented by a qualitative data analysis, are described in the results section, after which the research results are discussed and research limitations and suggestions for further research are presented. This is followed by some concluding remarks.

Toward a Theoretical Framework and Hypotheses on Network Characteristics in Relation to Innovation Performance

The theoretical framework is inspired by the social systems perspective (Parsons, 1964) and the multidimensional framework of Groen (2005). In the framework of Groen (2005), it is assumed that each of the four dimensions of the social system produces its own type of capital: social capital, strategic capital, economic capital, and cultural capital. Sufficient capital is needed on each of the four dimensions to create sustainable enterprises (Groen, 2005). An in-depth literature review (Pullen, Groen, Fisscher, and de Weerd-Nederhof, 2010) indicated that the network characteristics "Goal Complementarity" (relates to *strategic capital*), "Resource Complementarity" (relates to *economic capital*), "Trust" (relates to *cultural capital*), and "Network Position Strength" (relates to *social capital*) are most closely related to innovation performance for SMEs in the medical devices sector. This section defines these network characteristics and their relation to innovation performance. Based on literature the research hypothesis is formulated.

Innovation Performance

The definition of innovation as proposed by Afuah (1998) is used, which states that in the field of high technology innovation is invention + commercialization. Garcia and Calantone (2002) align with this definition as they state that innovation is "an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention which leads to development, production, and marketing tasks striving for the commercial success of the invention" (Garcia and Calantone, 2002).

The performance that is achieved as a result of NPD is the innovation performance (Salomo, Strecker, and Talke, 2007). For this research, a measure of innovation performance which is not bound to a certain time span and which is also applicable at the project level is needed. Such a measure is developed by Atuahene-Gima, Slater, and Olsen (2005) who present a measure for product innovation performance which focuses on whether the product development objectives were achieved (Atuahene-Gima et al., 2005). Therefore, the innovation performance measure of Atuahene-Gima et al. (2005) is used.

Goal Complementarity

Value, in terms of innovation performance, can be created through cooperation and knowledge sharing (Inkpen and

Tsang, 2005). When the objectives and strategies of an alliance are clearly stated, a foundation of common understanding and the means to achieve the collaborative purpose is established among the partners. The correspondence of goals and motivations is a necessary condition to ensure the flow of information necessary for successful product co-development (Emden, Calantone, and Droge, 2006). Cooperation between partners is increasingly based upon well-aligned objectives and goals (Duysters and Man, 2003).

The greater the complementarity in goals and objectives between the partners, the greater the effectiveness of the relationship (Bucklin and Sengupta, 1993). This doesn't necessarily mean that partners have exactly the same goals. However, the goals are noncompeting, complementary, and can be achieved through the same business model (Emden et al., 2006). When partners have contradicting or inconsistent goals, interpartner conflicts may arise. This is not conducive to the flow of knowledge between the partners and the alliance. To describe the level of correspondence in goals between partners, Bourgeois (1980) uses the term goal consensus. In his research on goal consensus, Bourgeois (1980) concludes that a coalition of strategy makers cannot focus on alternative means without a clearly conceived set of goals in mind. Dess (1987) builds on the research and questionnaire of Bourgeois (1980). In this paper, we use the method of Dess (1987) to measure the extent to which goals of the partners complement each other. It is expected that a high level of goal complementarity is related to high innovation performance.

Resource Complementarity

In relationships between companies, the physical and organizational resources of the company are exchanged and combined with those of its counterparts in order to achieve the set goals (Haythornthwaite, 1996; Tichy, Tushman, and Fombrun, 1979). Firms are encouraged to innovate by searching out new resources, or new ways of using existing resources, as the basis for future organizational rents (Galunic and Rodan, 1998; Håkansson, 1989; Oerlemans, Meeus, and Boekema, 1998). Such resources will fuel the firm's innovative activities by providing the external information necessary to generate new ideas. Equally, the innovative work of the firm will benefit from access to new knowledge necessary to resolve design and manufacturing problems (Tsai, 2001). Simply having resources is not enough to produce innovative output. It is also the way these resources are utilized in the innovation process that determines whether innovative outputs are produced in an effective and efficient way (Oerlemans, Meeus, and Boekema, 2001). In fact, the innovation effects of resource exchange in NPD collaborations can be located at two levels. First, the adaptation of external resources leads to an extension of firms' technological capabilities of developing new products. Second, the implementation of additional capacities from outside raises the probability of realizing innovations (Becker and Dietz, 2004).

The resources of the companies are affected, both in terms of how they are used and how they develop (Gadde and Håkansson, 1994). Lambe, Spekman, and Hunt (2002) distinguish between resources that are developed and resources that are used in external collaboration: idiosyncratic and complementary resources. Idiosyncratic resources are developed during the life of the collaboration, are unique, and facilitate the combining of resources contributed by the partner firms. Complementary resources are defined as the degree to which firms in an alliance are able to eliminate deficiencies in each other's portfolio of resources by supplying distinct capabilities, knowledge, and other entities (Lambe et al., 2002). Since both resource types should be present as they affect the success of the external collaboration (Lambe et al., 2002), the measure for complementary and idiosyncratic resources of Lambe et al. (2002) is used.

Trust

Trust is defined as the belief that the results of somebody's intended action will be appropriate from our point of view (Nahapiet and Ghoshal, 1998). Trust is necessary for people to work together on common projects, even if only to the extent that all parties believe they will be compensated in full and on time (Leana and Van Buren, 1999). Faems, Janssens, Madhok, and Van Looy (2008) distinguish between competence trust, which is defined as encompassing positive expectations about a partner's ability to perform according to an agreement; and goodwill trust, which is defined as the partner's intention to perform according to an agreement. They find that competence trust is a crucial condition for subsequent transactions, and goodwill trust is found to be a condition that determines how contracts are applied (Faems et al., 2008). Trust that builds up over time may in itself lead to unforeseen benefits, even when the expected gains are not fully realized over a given time period. Trust is an important factor in determining commitment, over and above any strict cost-benefit accounting, particularly among small and medium-sized producers (Suarez-Villa, 1998). Some form of trust will be required for any transaction in which simultaneous exchange is indispensable to the parties (Ring and Van de Ven, 1992) as in NPD.

Rempel and Holmes (1986) were among the first researchers that focused on trust and that developed a measurement for trust. They distinguish between cognitive, behavioral, and emotional trust (Rempel and Holmes, 1986). In studying the relation of interpersonal and interorganizational trust on performance, Zaheer, McEvily, and Perrone (1998) build on the research of Rempel and Holmes (1986) and define trust as follows: "Trust is the expectation that an actor (1) can be relied on to fulfill obligations, (2) will behave in a predictable manner, and (3) will act and negotiate fairly when the possibility for opportunism is present" (Zaheer et al., 1998). They distinguish between reliability, predictability, and fairness as dimensions of trust. More recently, Gulati and Sytch (2008) investigated the formation of trust between firms, as we do. They specifically focus on relational trust, which is the expectation that another organization can be relied on to fulfill its obligations, to behave in a predictable manner, and to act and negotiate fairly, even when the possibility of opportunism is present (Gulati, 1995; Zaheer et al., 1998). To measure interorganizational trust, they adapted the trust measures of Zaheer et al. (1998) (who, in turn, based their measures on the research of Rempel and Holmes [1986]). In this paper, the trust measures of Gulati and Sytch (2008) are used, since their measurement specifically focuses on interorganizational trust. In addition, their measurement is the most recent measurement of trust, which is based on, and which is tested and improved over time by acknowledged scholars in the field of research on trust. In contrast to Gulati and Sytch (2008), we consider trust as being two-dimensional as empirical testing of the trust measure indicated (Pullen et al., 2010). These two dimensions are: "fairness trust" (i.e., the expectation that a partner will negotiate fairly), and "reliability trust" (i.e., the expectation that a partner can be relied on to fulfill its obligations). In line with earlier research as described above, it is expected that both high-fairness and reliability trust are related to high-innovation performance.

Network Position Strength

Even though the extensive body of literature concerning network characteristics repeatedly indicates the importance of the structure of the network in terms of the presence of structural holes (Burt, 1992b) and the density of the network (Burt, 1992b; Gilsing and Nooteboom, 2005) in relation to innovation performance, until recently it lacked a solid measure to measure the structure of the ego network. Pullen et al. (2010) developed a network structure measure: "network position strength" incorporating item "density" and "structural holes."

Density is the number of actual links in the network as a ratio of the number of possible links in the network (Borgatti, Jones, and Everett, 1998; Burt, 1992a; Haythornthwaite, 1996; Inkpen and Tsang, 2005; Kerssens-VanDrongelen and Groen, 2004; Liao and Welsch, 2005; Nahapiet and Ghoshal, 1998; Rowley, 1997; Tichy et al., 1979). As density increases, communication across the network becomes more efficient. Furthermore, as interorganizational linkages become more dense, behaviors become more similar across the network, and the likelihood that shared behavioral expectations will be established increases (Rowley, 1997). Irrespective of one's position, high density inhibits the existence and utilization of diversity, and hence of novelty value, while at low levels it does not support absorption sufficiently (Gilsing, Nooteboom, Vanhaverbeke, Duysters, and Van den Oord, 2008).

When ego occupies a structural holes position in the network, ego is able to broker connections between alters in the network (Burt, 1992b; Haythornthwaite, 1996). In an ego network, ego is connected to every other actor (by definition). If these others are not connected directly to one another, ego may be a "broker" if ego falls on the paths between the others (Hanneman and Riddle, 2005). Firms occupying the favored network position of bridging structural holes are likely to perform better because of their superior access to information (Burt, 1992a; Zaheer and Bell, 2005). Actors in a network rich with structural holes will be able to access novel information from remote parts of the network and exploit that information to their advantage (Burt, 1992a, 2001, 2004). Consequently, networks rich with structural holes are more likely to yield new information, which can lead then to the discovery of entrepreneurial opportunities (Arenius and De Clerq, 2005).

Hypotheses

The literature on network characteristics as described above states that all these network characteristics when considered separately are related to innovation performance. At the same time, considering network characteristics in isolation implies a form of reductionism (Van de Ven and Drazin, 1985) as (1) real-life organizations and networks consist of multiple characteristics simultaneously; and (2) the combined effect of these characteristics might be to some extent different from analyzing characteristics separately. Notably, the work of Pullen,

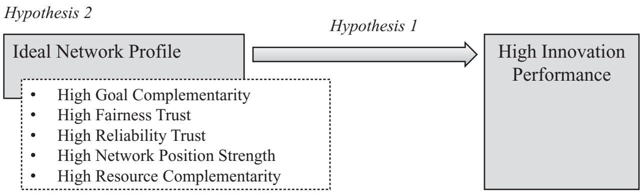

Figure 1. Research Model

Groen, de Weerd-Nederhof, and Fisscher (2012) reveals that while isolated network characteristics do not display a direct main effect on innovation performance, combined one does observe a significant effect on innovation performance (Pullen et al., 2012). Within the analysis, both approaches are considered and examine (1) to what extent innovation performance is associated with (deviations from) an "ideal" profile (Pittaway et al., 2004) and (2) to what extent innovation performance is related to the different characteristics which constitute the profile (goal complementarity, resource complementarity, "fairness" trust and "reliability" trust, and network position strength). This leads to the following hypotheses:

H1: The more the network profile differs from the ideal profile, the lower the innovation performance.

H2: The network profile of SMEs that is related to high innovation performance in the medical devices sector combines high levels of goal complementarity, resource complementarity, "fairness" trust, and "reliability" trust with a strong network position.

The variables that are included in the hypotheses and their hypothesized relations are illustrated in Figure 1.

Methodology

This methodology section first explains more in-depth why the medical devices sector was selected as research context. Second, it describes the sampling and data gathering process. Third, the research method of the systems approach is described as well as the validity tests of the operationalization of variables that are used in the self-administered questionnaire.

Research Context

In examining fit-performance relationships, the configuration theory literature advocates the use of single industry studies to control for industry effects and isolate more effectively the relationships of interest (Vorhies and Morgan, 2003). As context for this research a sector in which both collaboration and NPD are of high importance is needed. A sector that meets these requirements is the (Dutch) medical devices sector.[2] In this sector, collaboration with external partners for NPD becomes increasingly important due to the complexity of the products and the fragmentation of the market. The sector is characterized by very strict regulations (Atun, Shah, and Bosanquet, 2002; Kaplan et al., 2004; MacPherson, 2002; Prabhakar, 2006). Mainly due to these regulations, which are an important cause of the very time- and cost-consuming NPD process (Atun et al., 2002; Kaplan et al., 2004; Nieto and Santamaría, 2010), SMEs in the medical devices sector face the problem of a lack of financial resources and a lack of qualified personnel in their NPD process. This makes it necessary for them to cooperate (Kaufmann and Tödtling, 2002; Rogers, 2004). In addition, the intense competition, high rate of growth, continuing technological innovation, and customer sophistication suggest a significantly above average level of NPD activity (Rochford and Rudelius, 1997). Finally, 80% of the companies in this sector are SMEs. These characteristics make the medical devices sector a suitable context for this research.

Data Gathering and Sample

The data gathering took place during the autumn and winter of 2009. Through a telephone presurvey in the complete population of 751 Dutch medical devices companies, companies that actively participate in the development of new medical devices and that have less than or equal to 250 full-time equivalents (FTEs) were identified as suitable companies to participate in the research. In this telephone presurvey key respondents were also identified, the purpose of the research was explained, and the potential respondents were asked to participate in the research. A total population of 105 suitable companies was identified. Ninety-seven of these companies indicated that they were willing to cooperate with the research. They received a personalized letter explaining the purpose of the study, along with a questionnaire by e-mail. The questionnaire could be filled in electronically

[2] According to medical device directive 93/42/EEC, a medical device is: ". . . any instrument, apparatus, appliance, material, or other article, whether used alone or in combination, including the software necessary for its proper application, intended by the manufacturer to be used for human beings for the purpose of a) Diagnosis, prevention, monitoring, treatment or alleviation of a disease, b) Diagnosis, monitoring, treatment or alleviation of or compensation for an injury or handicap, c) Investigation or modification of the anatomy or of a physiological process, or, d) Control of conception. And which does not achieve its principal intended action in or on the human body by a) Pharmacological, b) Immunological or c) Metabolic means, but which may be assisted in its function by such means."

Table 1. Response Rate of the Sample

		Frequency	Percent	Cumulative Percent
Valid	Filled-in questionnaire	13	13.4	13.4
	Filled-in questionnaire + interview	47	48.5	61.9
	Withdrawn participation	37	38.1	100.0
	Total	97	100.0	

and returned by e-mail. Nonrespondents received reminder telephone calls and a second questionnaire. Respondents were NPD managers, R&D managers, CTOs, and CEOs. These efforts yielded $n = 60$ usable responses, giving a response rate of 61.9% (see Table 1).

In triangulation with quantitative survey data, qualitative data were also gathered to provide additional insight and understanding of the organization of NPD networks. This was done through semi-structured interviews in 50 of these same companies. Gathering both quantitative and qualitative data enriches the data to a large extent.

Research Method

To examine which combination of network characteristics leads to high-innovation performance, the triangulation approach in which both quantitative and qualitative data are used was applied. By doing so, the quantitative results are enriched and verified by qualitative insights. This leads to a more in-depth understanding of the phenomenon under study than when either quantitative or qualitative data are used.

In this paper, the systems approach of Drazin and Van de Ven (1985) is used to analyze the quantitative data. This approach enables us to consider multiple network characteristics simultaneously even when samples are relatively small. Other approaches to simultaneously measure multiple organization characteristics, like for instance regression or cluster analysis, can include numerous organizational characteristics, but the results are only reliable in large samples. The systems approach presents reliable results even when samples are relatively small.

The systems approach examines the impact of the combined network characteristics on innovation performance by calculating the distance from an ideal profile (Govindarajan, 1988). This ideal (network) profile is in the context of this research the combination of network characteristics that is related to high-innovation performance. The ideal network profile of design variables can be generated either theoretically or empirically. In line with Drazin and Van de Ven (1985), the empirical-based ideal network profile is used in which the 15% highest performing businesses in terms of innovation performance were identified.

Based on the quantitative results, semi-structured interviews were conducted in 78% of the case companies to verify and complement the quantitative data results. The first question we asked respondents considered the position of the company in the supply chain, because we expect this to have its effect on goal complementarity and network position strength. Second, we were interested in where the NPD project was initiated, because this might explain differences in for instance the concepts of goal complementarity and network position strength. Third, we were interested in the attitude of the company toward its NPD partners, since this might explain differences in both "fairness" and "reliability" trust.

Operationalization of Variables

This section describes the operationalization and validity of the dependent variable "innovation performance" and the independent variables (network characteristics) "goal complementarity," "fairness trust," "reliability trust," "resource complementarity," and "network position strength."

Innovation performance. The measure of Atuahene-Gima et al. (2005) to measure innovation performance was used. Innovation performance was measured through five items on a 7-point Likert scale. The 15% of companies with the highest mean scores for innovation performance together formed the "successful sample (top 15%)" ($n = 7$). The other 85% of companies together formed the "calibration sample (bottom 85%)."

Network characteristics. From the literature, five network characteristics (a total of 17 items) were extracted and operationalized that are suggested to have a relation to the companies' innovation performance. Since the measures were not previously tested in combination, an exploratory factor analysis was conducted. Factor analysis on the network characteristics showed that the 17 items in the questionnaire build five constructs (see Table 2) that together explain 76.38% of the variance. Items with loadings greater than .40 on a factor are considered significant. As can be seen in Table 2, there are three items (Q20.1, Q20.2, and Q20.3) that load on more than one factor. There is some disagreement in the literature about what to do when items load on multiple factors. Kline (2000) suggests to drop the items that load on multiple factors, because they are difficult to interpret. However, Hair, Anderson, Tatham, and Black (1995) argue that the meaning of an item must be taken into account when assigning labels to a factor. In line with Hair et al. (1995), Pett, Lackey, and Sullivan (2003) suggest placing the item with the factor it is most closely related to conceptually instead of dropping the item. They argue that reliability tests of the factors will show the internal consistency of a factor and will also indicate whether or not reliability of a factor will increase by dropping an item (Pett et al., 2003). As did Hair et al. (1995) and Pett et al. (2003), we do not drop the items with multiple (significant) factor loadings, rather we assign the item to the factor it is most closely related to and use reliability test for internal consistency. All constructs had high reliabilities and high Eigenvalues.

In line with Drazin and Van de Ven (1985), the mean scores of the network characteristics for each case company have been calculated and used in the analyses. When a company achieved a mean score on a network characteristic that is higher than the mean network characteristics score of the full sample, the company score was considered "high." Vice versa, a mean score below the sample mean was considered "low."

The factor analysis also showed interesting findings considering the empirical applicability of theoretical concepts. First, when measured in combination with other network characteristics, the measures for idiosyncratic and complementary resources (Lambe et al., 2002) are not two separate measures as suggested in literature. Rather, they together form one construct: resource complementarity. Second, the two network variables "density" and "structural holes position" were found to be forming one network characteristic "Network Position Strength." Prior research considered these items as individual constructs, but this research showed that in fact they belong to a higher level construct. Third, trust is not a one-dimensional construct as suggested in earlier research (Gulati and Sytch, 2008; Zaheer et al., 1998), but is a two-dimensional construct. The first dimension labeled "fairness trust" focuses on the expectation that an actor will act and negotiate fairly, which aligns with the "fairness" dimension of Zaheer et al. (1998). This second dimension labeled "reliability trust" focuses on the expectation that an actor can be relied on to fulfill obligations, which aligns with the "reliability" dimension of Zaheer et al. (1998). This means that in practice, companies can have both trust in terms of fairness and distrust in terms of reliability or vice versa toward their collaboration partners.

Results

This section describes the research results of both the quantitative data analysis (social systems approach) which tests our hypothesis and the qualitative data analysis which is used to complement and clarify the quantitative data results.

Quantitative Data Analysis

The empirical-based successful (ideal) network profile consists of the best performing 15% of companies (top 15%) in terms of innovation performance. The other 85% of companies in the sample is the calibration sample. Table 3 shows the mean scores of the five network characteristics for both the successful (high performing) sample and the calibration sample. The mean scores of the top 15% best performing companies is considered as the empirical-based successful network profile.

We tested our first hypothesis (i.e., the network profile of the top 15% best performing companies is related to high innovation performance) by (1) calculating the Euclidean distance for each case company; and by (2) correlating this distance measure with innovation performance. The Euclidean distance is the difference between the successful (ideal) network profile and the network profile of an individual case company. The Euclidean distance was calculated as follows: Euclidean Distance $= \sqrt{\Sigma}(X_{is} - X_{js}),^2$ where X_{is} is the score of the successful network profile on the s_{th} network characteristic and where X_{js} is the score of the j_{th} case company on s_{th} network characteristic (Van de Ven and Drazin, 1985).

Table 4 shows the correlation between the Euclidean distance and the Innovation performance. The Euclidean distance correlates −.444 ($p < .01$) with innovation performance. The results indicate that when the network profile (i.e., the combination of network characteristics) of a company differs more from the ideal network profile (i.e., the Euclidean distance increases), the innovation performance will decrease. In other words, the more the combination of network characteristics is similar to the successful (ideal) network profile of the top 15% best performing companies, the higher the innovation performance of the company will be, which supports H1.

Table 2. Rotated Component Matrix (for the Independent Variables)

	Component				
	1	2	3	4	5
	Resource Complementarity	"Fairness" Trust	"Reliability" Trust	Network Position Strength	Goal Complementarity
Q19.1_CreatedUniqueCapabilities	.807				
Q19.2_TogetherDevelopedKnowledge	.784				
Q19.3_TogetherInvestedInBuildingBusiness	.810				
Q19.4_TogetherInvestedInRelationship	.798				
Q19.5_IfEndedKnowledgeWasted	.735				
Q19.6_IfPartnerSwitchInvestmentsWasted	.836				
Q20.1_ContributeDifferentResources	.683				.505
Q20.2_ComplementaryStrengths	.590	.439			
Q20.3_SeparateAbilitiesCombined	.695	.418			
Goal_Complementarity					.861
Q25.1_TreatYouFairly		.897			
Q25.2_ConfidentialityOfInformation		.933			
Q25.4_Inv_ProfitAtYourExpense			.797		
Q25.5_Inv_CannotCompletelyRelyOnPromises			.857		
Q25.6_Inv_HesitantVagueSpecifications			.771		
Inv_Density				.934	
Ties_brokered_normalized				.942	
Eigenvalue	6.39	2.16	1.95	1.47	1.01
% Variance explained	37.61	12.71	11.49	8.63	5.93
Cronbach's α	.922	.928	.749	.906	X
# items	9	2	3	2	1

Extraction method: Principal component analysis.
Rotation method: Varimax with Kaiser normalization.

Table 3. Descriptive Statistics for the Ideal Profile (Top 15%) and the Calibration Sample (Bottom 15%)

	Sample	*n*	Mean	Standard Deviation
Goal_complementarity	Calibration sample (bottom 85%)	52	8.46	4.41
	Successful sample (top 15%)	7	13.74	3.98
	Total	59	9.09	4.66
Resource_complementarity	Calibration sample (bottom 85%)	52	4.85	1.38
	Successful sample (top 15%)	7	5.38	1.07
	Total	59	4.91	1.35
Fairness_trust	Calibration sample (bottom 85%)	52	5.37	1.67
	Successful sample (top 15%)	7	6.07	.73
	Total	59	5.45	1.60
Reliability_trust	Calibration sample (bottom 85%)	52	4.21	1.61
	Successful sample (top 15%)	7	5.29	1.47
	Total	59	4.60	1.54
Network_position_strength	Calibration sample (bottom 85%)	51	.63	.38
	Successful sample (top 15%)	7	.50	.50
	Total	58	.61	.39

Table 5 shows the mean scores of the top 15% performing companies on the network characteristics. In line with Drazin and Van de Ven (1985), scores above the mean of the full sample are considered "high," and scores below this mean are considered "low." As the last column in Table 5 shows, can the successful network profile be described as displaying high levels of "goal complementarity," "resource complementarity," "fairness trust," "reliability trust," and low "network position strength?"

The network profile of the calibration sample (the bottom 85%) is the inverse of the successful (ideal) network profile (see Table 6). This network profile that is related to a lower level of innovation performance, has low levels of "goal complementarity," "resource complementarity," "fairness trust," "reliability trust," and high "network position strength."

If the mean represents the data well, then most of the scores will cluster close to the mean, and the resulting standard deviation is small relative to the mean. Considering the range of scores of both the ideal profile and calibration sample, the standard deviations are small to modest in size, indicating a good representation of the data.

Table 4. Correlations

		Innovation_Performance	EuclideanDistance_means
Innovation_Performance	Pearson correlation	1.000	−.444**
	Sig. (2-tailed)		.001
	n	55.000	55
EuclideanDistance_means	Pearson correlation	−.444**	1.000
	Sig. (2-tailed)	.001	
	n	55	55.000

** Correlation is significant at the .01 level (2-tailed).

Table 5. Successful Network Profile (Top 15%)

	n	Minimum	Maximum	Mean	Std. Deviation	**Level**
Goal_Complementarity	7	8.49	19.80	13.74	3.98	**high**
Resource_Complementarity	7	4.42	7.00	5.38	1.07	**high**
Fairness_Trust	7	5.00	7.00	6.07	.73	**high**
Reliability_Trust	7	3.00	7.00	5.29	1.47	**high**
Network_Position_Strength	7	.00	1.00	.50	.50	**low**
Valid *n* (listwise)	7					

Table 6. Network Profile of the Calibration Sample (Bottom 85%)

	n	Minimum	Maximum	Mean	Standard Deviation	**Level**
Goal_Complementarity	52	.00	21.92	8.46	4.41	**low**
Resource_Complementarity	52	.00	6.58	4.85	1.38	**low**
Fairness_Trust	52	.00	7.00	5.37	1.67	**low**
Reliability_Trust	52	.00	7.00	4.21	1.61	**low**
Network_Position_Strength	51	.00	1.00	.63	.38	**high**
Valid N (listwise)	51					

To examine if both network profiles are significantly different, a *t*-test was executed. The results can be found in Table 7. As can be seen from Table 7, both profiles significantly differ in terms of goal complementarity. In addition, a regression analysis was performed to assess the relationship between innovation performance and the distinctive characteristics. Within this analysis, the #FTE in the company, total number of partners in the project, and length of the project (in years) was controlled for. The results of the regression can be found in Appendix A. This analysis reveals that only goal complementarity is significantly related to innovation performance. So, in sum, while differences in network profiles can be distinguished, goal complementarity is the most distinctive differentiator. In our second hypothesis, it was assumed that all network variables (that are combined) in the network profile are significantly related to innovation performance. However, this finding shows that only part of the variables that are included in the profile significantly relate to innovation performance.

Even though goal complementarity is the most distinctive differentiator, the other characteristics give an indication of the network profile that is related to high-innovation performance. The found network profiles (Tables 5 and 6) point in the direction that the top 15% best performing companies have a clear focus and are functional when it comes to collaboration with other companies. They collaborate only when the mutual goals complement each other, which leads to maximum gains (Bucklin and Sengupta, 1993; Emden et al., 2006). In addition, the partner firm is able to offer the resources that the company initially lacks. They trust their partner to negotiate fairly (i.e., fairness trust), and the company also has a high level of trust toward the partner firm when it comes to fulfilling obligations. Partners are not only trusted based on “face-to-face” fairness trust. The network position strength is low due to the low density of the network. These companies are very focused, functional, and consistent in collaborating for NPD. The successful companies have a “business-like,” more objective, and relatively closed approach toward collaboration.

In contrast, the lower performing companies have low levels of goal complementarity in collaborating for NPD. In addition, they do not trust their partners to negotiate fairly (i.e., fairness trust), neither do they trust their partners to fulfill obligations (i.e., low reliability trust). In addition, partners in the network know each other quite well and informally. It seems that these companies are less focused on objective selection criteria like the complementarity of resources in selecting collaboration partners. These lower performing companies are far more shifty and devious than the straight and focused high-performing companies. It seems these companies have a more “soft and friendly,” maybe even idealistic, approach toward collaboration.

These findings partially support our second hypothesis that stated that the successful network profile combines high levels of goal complementarity, resource complementarity, “fairness” trust, “reliability” trust, and a strong network position.

Qualitative Data Analysis

To complement and clarify these quantitative results and provide additional understanding of the successful organization of networks, we conducted semi-structured interviews with companies in both the top 15% sample and the bottom 85% sample. Important to note: these interviews were purely intended to provide clarification on the findings of quantitative study, which is the core of this research.

The first question considered the position of the company in the supply chain. Companies in the medical devices sector that deliver to the end-market have to negotiate with (among others) hospitals and insurance companies, which is time and cost consuming. Companies that do not deliver to the end-market also have to deal with this partner, but indirectly and to a far lesser

Table 7. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Goal_Complementarity	Equal variances assumed	.032	.860	−3.001	57	.004	−5.27953	1.75952	−8.80290	−1.75616
	Equal variances not assumed			−3.254	8.131	.011	−5.27953	1.62249	−9.01054	−1.54853
Resource_Complementarity	Equal variances assumed	.053	.819	−.972	57	.335	−.52941	.54446	−1.61967	.56086
	Equal variances not assumed			−1.181	8.929	.268	−.52941	.44828	−1.54471	.48589
Fairness_Trust	Equal variances assumed	1.838	.181	−1.099	57	.277	−.70604	.64273	−1.99309	.58100
	Equal variances not assumed			−1.957	16.394	.068	−.70604	.36069	−1.46918	.05709
Reliability_Trust	Equal variances assumed	.016	.901	−1.253	57	.215	−.77289	.61672	−2.00786	.46207
	Equal variances not assumed			−1.298	7.878	.231	−.77289	.59555	−2.14996	.60418
Network_Position_Strength	Equal variances assumed	1.872	.177	.819	56	.416	.12971	.15830	−.18741	.44682
	Equal variances not assumed			.661	6.972	.530	.12971	.19625	−.33472	.59414

F, F-ratio; Sig., significance; df, degrees of freedom; Std. Error, standard error.

extent. It was expected that this might affect the network profile in terms of goal complementarity: aligning with the goals of the health insurance company is a necessity for approval and commercialization of the product.

In general, 83.3% of the top 15% best performing companies do not deliver their products to the end-market, whereas a considerably lesser 50% of the calibration sample does not deliver to the end-market. In the case of the medical devices industry, this end-market most of the time consists of hospitals and other healthcare institutions. The majority of the high performing firms thus deliver their products to distributors. Instead of the company having to deal with the difficult commercialization of medical devices to the end-market, the distributor deals with these difficulties. For the company, this is a more efficient sales strategy than direct sales to healthcare institutions. It may be that in this "B-to-B"-setting it is relatively easier to achieve goal complementarity, but it must be noted that the position of the respondent only is probably not the sole explanation—the position-combination in the dyad has to be taken into account.

Second, we were interested in where the NPD project was initiated, because this might explain differences in the concepts of goal complementarity and network position strength of the network profile. For the majority of companies in the calibration sample (59.5%), the NPD project is initiated by the company itself. In contrast, in only 33.3% of the top 15% best performing companies, the project is initiated internally. In the majority of the top 15% best performing companies, the company is approached by an external company who is not able or not willing to execute the NPD process itself. By not internally initiating the NPD project but by executing the NPD project "on demand," the top 15% best performing companies guarantee their external revenues from the NPD project.

Third, the interview focused on the attitude of the company toward its NPD network partners. The attitude that these companies have toward their partners in the NPD project is far more business-like than the attitude that the lower performing companies have. Sixty percent of the top 15% best performers use a focused strategy in contacting their partners with specific resource requests. It is rather a customer–supplier relationship than a collaborative relationship. The lower performing companies are more collaborative toward their NPD partners (56.4%). Not only are partners consulted, they also share ideas in NPD and are developing the new product together. Often intellectual property is shared.

Even though these qualitative results are modest in size and significance,[3] they help to interpret the differences in goal complementarity and the other network characteristics. As explained above, the successful companies use a focused strategy and pose specific resource requests to their partners. The fact that the partner has complementary goals is most important. Contracts have to insure that agreements are met. In addition, posing a specific resource request to a partner instead of collaborating to build the necessary resources together, makes it unnecessary for partners to know one another in the network. This explains the rather modest network size and low density in the network, which lead to low network position strength.

Discussion

We began by observing that cooperation with other organizations increases the innovation performance of organizations (Chang, 2003; Hanna and Walsh, 2002; Ritter and Gemünden, 2003, 2004; Rothwell, 1991; Salman and Saives, 2005), especially for SMEs, as they are bounded by a lack of financial resources, manpower, and substitutes for lack of sales (Hanna and Walsh, 2002; Kaufmann and Tödtling, 2002). We examined which combination of network characteristics is related to high innovation performance and thereby addressed the issue raised by Pittaway et al. (2004) who state that research has not yet clearly demonstrated which network profiles most affect innovation in particular contexts.

The systems approach (Drazin and Van de Ven, 1985) was used to examine which network profile is related to high innovation performance. Using the systems approach enabled the research to address multiple network characteristics simultaneously and showed that the more a company's network differs from the ideal network profile, the lower the innovation performance. This led to new insights in the successful external organization of NPD.

Using the systems approach, a successful ("ideal") NPD network profile was identified that is related to high innovation performance for SMEs in the medical devices sector. This profile is heavily carried by the network characteristic "goal complementarity." The level of goal complementarity makes, in this research context, the difference when high innovation performance is pursued. While differences in network profiles can be distinguished, goal complementarity is the most distinctive differentiator. This does not imply that the other network characteristics can be neglected; they are only overshadowed by goal complementarity. An explanation for this remarkable finding might be that resource complementarity, fairness trust, reliability trust, and network position strength are prerequisites (or "qualifiers") for collaboration in NPD networks in general and that for SMEs in the medical devices sector, goal complementarity fulfills the role of "order winner."

Another, more probable explanation would be that due to the extensive amount of attention that has been paid to resource complementarity, trust, and network structure in both research and practice, most companies have become aware of the role and importance of these characteristics, meaning that their levels of resource complementarity, trust, and network position strength are quite similar and equally well organized. Significant differences in innovation performance are explained through differences in goal complementarity.

Partially contrary to what was predicted, our results indicate that the successful network profile includes high levels of goal complementarity, resource complementarity, "fairness" trust and "reliability" trust, and low network position strength. High levels of goal complementarity, resource complementarity, "fairness" trust, "reliability" trust, and network position strength were hypothesized. The high-performing companies have a more "business-like" mentality and are very focused and consistent in how they collaborate in NPD and who they select as being their partner(s).

In contrast, the lower performing companies are searching for partners with whom they can collaborate and build resources. Their approach to collaboration in NPD is more soft and subjective in comparison to the approach of the high-performing companies. These results are in line with the findings of Lindman (2002) who finds that NPD can be highly successful regardless of the degree of cooperation. In contrast to past research that argues that a social way of networking is related to high innovation performance, this paper contributes by demonstrating, both quantitatively as well as qualitatively, that a business-like way of networking and a rather closed approach toward open innovation is related to high innovation performance. SMEs acknowledge the necessity of open innovation, since they often lack resources to develop and commercialize new products in-house. Open innovation will be a necessity rather than an option to keep up with the firm's competitors (Lichtenthaler,

[3] Fifty interviews with NPD managers or CEOs of the sample companies were conducted. Chi-square analyses of the interview results indicated no significant differences between the successful sample and the calibration sample in terms of position in the value chain, initiation source of the project, and attitude toward the partner.

2008). However, in practice, companies have a rather hesitant attitude toward using an open business model because of the risk of core competences becoming noncore. In addition, as shown in this research, openness is not always beneficial. For SMEs that focus on incremental innovation projects, a relatively closed approach to open innovation is most beneficial in terms of innovation performance.

If SMEs in the medical devices sector want to distinguish themselves from competitors in terms of innovation performance, they are recommended to focus on goal complementarity while keeping a business-like attitude toward the partner.

The fact that the business-like, objective NPD network approach of the high performers is related to high innovation performance can be explained by the fact that these high performers face less risk in the NPD process. The NPD projects are more often initiated outside the company: the high performers develop new products "on demand," which secures their NPD revenues. In addition, by not trusting their partners blindfolded and by maintaining a business-like relationship toward partners, the risk of being deceived is minimized. As Duysters et al. (1999) concluded, effective technology partnering selection should involve an evaluation of the potential partner on the basis of that partner's competitive and technological position and access to business networks but also on its track record of successful partnerships and the transferability of desired resources (licenses, patents, etc.).

An explanation for the fact that the successful network profile (in this context) assumes a business-like, more closed attitude toward innovation collaboration seems to also be caused by the fact that companies in our data set mainly focus on low (incremental) and moderately innovative new products. It is assumed that this is due to the strict sector regulations. The average development time for medical devices ranges from one to two years for incremental devices and five to seven years for radical devices, dependent on the product type, complexity, and degree of risk to the patient that dictates their regulatory defined conformance and approval route (Hourd and Williams, 2008). Since the developed products are not highly innovative, the SME can focus more on efficiency and routines instead of focusing on the early research and development stages. There is less need for the company to involve the partner in the development project. Rather, goal complementarity is more important, which is in line with research of Oerlemans et al. (2001), Becker and Dietz (2004), Inkpen and Tsang (2005), and Suarez-Villa (1998).

Limitations and Further Research

This study has some limitations that suggest a number of directions for further research. A limitation of this study is the sample size. For the purpose of generalizability, additional data could be gathered. A suggestion is to include additional European countries in the sample because medical devices companies in these countries have to comply to the same regulations as Dutch medical devices companies.

Furthermore, in this research, the number of radically new development projects was limited. We expect that companies that focus on highly innovative development projects in this sector face even more difficulties in achieving high-innovation performance due to stricter sector specific regulations. For further research, it might be interesting to focus on this type of NPD projects by also including large companies and examining whether or not a business-like approach is in this context also related to high innovation performance.

Another suggestion for further research is to conduct a cross-industry study in multiple highly regulated sectors for generalizability of the research findings. Nowadays, health-related sectors like the medical devices sector are of interest to many initially nonhealth sectors. More and more sectors are embracing health related issues and start operating on the border of their main industry and the health industry. For instance, companies in the food sector tend to include biotechnology concepts in their new products. This means that companies increasingly have to deal with regulations and that sectors are becoming more and more regulated. Therefore, it is expected that our research findings are applicable in a wide array of sectors. Further research might focus on the relation between organization of the network and innovation performance in other highly regulated sectors.

Furthermore, in studying the organization of NPD ego-networks in relation to innovation performance, the current focus was on the social capital approach. However, another approach for studying network-innovation performance issues is the absorptive capacity approach. The ability to recognize the value of new information, assimilate it, and apply it to commercial ends is what is called a firm's "absorptive capacity." The ability to exploit external knowledge is a critical component of innovative capabilities. Absorptive capacity refers not only to the acquisition or assimilation of information by an organization but also to the organization's ability to exploit it. Absorptive capacity does not simply depend on the organization's direct interface with the external environment. It also depends on transfers of knowledge across and within subunits (Cohen and Levinthal, 1990). Studying the relationship between NPD ego-networks and innovation performance from an absorptive capacity approach and combining these results with our findings from the social capital approach might present an even more complete understanding of successful network organization in terms of innovation performance.

The NPD network configuration and innovation performance were considered at one point in time. However, NPD is a dynamic process that changes over time. Longitudinal research is expected to shed more light on this issue. It would be interesting to study how companies change their network configurations over time to also achieve high future innovation performance.

A final suggestion for further research is to examine the interaction between the network characteristics in relation to the innovation performance. Earlier research showed that the interaction between network characteristics (the network configuration) is directly related to innovation performance (Pullen et al., 2012). This research demonstrates which configuration of network characteristics is related to high innovation performance for SMEs in the medical devices and thereby addressed the issue of Pittaway et al. (2004). It was out of the scope of this research to also examine how the different network characteristics are related to each other and how they interact. Further research might address this issue.

Concluding Remarks

This paper argued that the successful network profile of SMEs in the medical devices sector consists of high levels of goal complementarity, resource complementarity, trust, and network position strength. Using the context of SMEs in the Dutch medical devices sector, this research shows that for SMEs in the medical devices sector, goal complementarity makes the difference in achieving high innovation performance. Furthermore, the paper shows that high innovation performance is related to high levels of goal complementarity, resource complementarity, fairness trust, and reliability trust, with a below average level of network position strength.

Based on both our quantitative and qualitative research findings, a more "business-like" approach that is focused and consistent was found to be related to high innovation performance. If SMEs in the medical devices sector want to distinguish themselves from competitors in terms of innovation performance, they are recommended to focus on goal complementarity while keeping a business-like attitude toward the partner. We argue that open innovation with a closed business model is the key to success for small and medium-sized companies in a highly regulated sector.

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Appendix A

Regression Results

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.494[a]	.244	.110	1.335

[a] Predictors: (Constant), Length of project (years), Network_Position_Strength, Goal_Differences, #FTE in the location, Resource_Complementarity, Total # external partners, Reliability_Trust, Fairness_Trust.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	25.862	8	3.233	1.815	.099[a]
	Residual	80.163	45	1.781		
	Total	106.025	53			

[a] Predictors: (Constant), Length of project (years), Network_Position_Strength, Goal_Differences, #FTE in the location, Resource_Complementarity, Total # external partners, Reliability_Trust, Fairness_Trust.
[b] Dependent Variable: Innovation_Performance.

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.345	.869		2.699	.010
	Goal_Complementarity	.097	.047	.305	2.043	.047
	Resource_Complementarity	.041	.167	.041	.247	.806
	Fairness_Trust	.013	.212	.013	.061	.952
	Reliability_Trust	.223	.184	.246	1.211	.232
	Network_Position_Strength	−.221	.592	−.060	−.374	.710
	# FTE in the location	.001	.005	.034	.243	.809
	Total # external partners	−.023	.093	−.042	−.249	.804
	Length of project (years)	−.093	.100	−.141	−.928	.358