

SME Network Practice

A qualitative study of network management practice and design implications for ICT-support

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Abstract

This paper presents the results of an investigation of network practice among European Small and Medium-sized Enterprises (SME's). The purpose is to assess network management practice and design implications for Information Communication Technology (ICT) support. The investigation consisted of 49 interviews with individuals employed by 19 SME's that either were or had been involved in a network co-operation with another separate juridical entity. This was complemented by a questionnaire answered by 121 respondents fitting the same criteria as the individuals interviewed. We provide a rich description of the vast diversity in SME network management practice and ICT use. From the collected data, three generic network profiles are identified ("Supply-chain networks" (SN), "R&D Networks" (RN) and "Business Networks" (BN)). The three network profiles are structured and analyzed through use of an established IS architecture framework. This provides a holistic view of ICT design implications for the network profiles structured in three architectural levels namely, scope, enterprise and systems level.

Keywords

SME, network, practice, architecture.

1. Introduction

With the emergence of a novel way of organizing and perhaps foremost *conceptualizing* the enterprise, the notions of network organizations become relevant for further study and investigation. In identifying the network organization as a possible field of study, we conclude that the management of the network organization or the *network management* becomes a relevant area for investigation.

On the basis of this, the purpose of this paper is to investigate network practice as a first step towards designing network management ICT-support. The industry focus on this paper lies on European Small and Medium-sized Enterprise (SME) networks (see Meyer & Skak (2002) for further argumentation on the relevance on SME's as an object of analysis) and their knowledge management. We base our findings on a pan-European investigation of industry-practice executed during the spring of 2002 as a part of a project sponsored by the European Council. The objective of the project (Plexus) is to develop decision support tools for the management and measurement of intellectual assets across co-operative networks.

This paper covers a brief introduction to the concept of network organization, the research methodology employed in this research, the findings and a discussion subsequently followed by the drawing of conclusions.

1.1. Background

“Network analysis corrects a tendency in organizational theory to focus on the trees rather than the forest, on the actions of individual organizations rather than on the organization of their actions.”

(Salancik, 1995, p.345)

The emergence of a network-based view of the firm has been eminent since the early 80's (Black & Edwards, 2000). With work by scholars such as Henry Mintzberg (Ad-hocracy) (Mintzberg, 1983) and Charles Handy (Virtual organization) (Handy, 1995), the subject of an organizational form with an increased internal dynamic has been contemplated through what appears to be an endless stream of scientific articles.

With a steady growing theoretical foundation for the application of network theory in organizational theory, we now begin to see the emergence of a network paradigm (Black & Edwards, 2000; Cravens, Shipp & Cravens, 1994; Cravens, Piercy & Shipp, 1996; Gulati, 1998; Handy, 1995; Möller & Halinen, 1999; Chase, 1998), or in the words of John Sculley, “*The network is the paradigm, not the catholic church or the military.*”

(Cravens, Shipp & Cravens, 1994, p.22).

The shift in focus towards encompassing an image of the virtual organization as being comprised of a number of semi- to fully-autonomous entities instead of being limited to full ownership of the organizational resources visualizes a change in perspective that needs to be addressed through further research (See Das & Teng (2000) and Nesheim (2001) for a resource-based perspective on network collaboration).

The change in perspective discussed above can manifest itself in more pragmatic effects on for instance management and therefore also the design of management support systems (Kumar, 1996). The specific role of ICT-based support (for f.i. management decision making) is further elaborated upon by researchers (see f.i. Andreu & Ciborra, 1996), stating that a strategic use of IT-support is feasible as a means to support the creation of firm

capabilities. With the relationships that the network is comprised of being possible sources of strategic capability (Das & Teng, 2000; Godbout, 2000; Gulati, 1999), the study of ICT-support for network management becomes a relevant field of inquiry.

2. Research methodology

The research methodology comprised of two parallel investigations gathering empirical data from practitioners involved in or having been involved in network co-operation.

In a series of semi-structured interviews with a total of 49 individuals considered as highly experienced within the networking field, a wide range of cases (19) describing network practice in Europe were collected. The selection of respondents was based on criteria stating that the individual had to be employed by an enterprise involved in some sort of explicit networking. Networking was thereby defined as the co-operation of separate juridical entities with a clearly stated purpose for the co-operation. Furthermore the individual at hand had to have had substantial insight into the management of the said co-operation.

Having identified individuals fitting these criteria they (the individuals) were contacted by local representatives. They were asked to participate in a one hour interview with the purpose of describing a network that the enterprise was or had been part of. The documentation of the 49 interviews resulted in 19 case-descriptions of current European network-practice among SME's.

Parallel to this, a questionnaire consisting of 21 questions ranging from multiple-choice to open questions was distributed to a total of 121 respondents (fitting the same criteria as for the interviews).

Due to local differences in conducting the survey, the total population is unknown, whereby the response-rate of the investigation is impossible to calculate. The final number of responses was 121.

The data from the interviews was qualitatively analyzed as case-descriptions by researchers at the University of Gothenburg in accordance with the previously stated purpose of the investigation.

When analyzing design implications for network management ICT-support, the architectural framework proposed by Zachman (1987) has been applied (See Pessi & Magnoulas (1998) for further discussion concerning the pro's and con's of this model). With the framework originally spanning the entire life-cycle of the development of an information system (encompassing the roles of planner, owner, designer, builder and subcontractor), we have focused on the first three roles described in the framework. Table 1 gives a brief overview of the revised framework.

	Data	Function	Network
Scope Planner	Lists of things important to the business	List of business-processes	Lists of locations in which the business operates
Enterprise model Owner	Entity/ relationship diagram	Process flow diagram	Logistics network
System model Designer	Data model	Data flow diagram	Distributed system architecture

Table 1. A revised version of Zachmans architectural framework (Zachman , 1987).

Both the series of interviews and the questionnaire were based on a bilateral approach investigating the structure and the management of the SME-networks in parallel. As an effect of this, the results in this paper are structured accordingly.

3. Results

3.1. Network taxonomy and profiles

The networks that we have investigated can be categorized into a network taxonomy consisting of three states of networks, namely Supply-chain Networks (SN), R&D Networks (RN) and Business Networks (BN).

The network profiles were differentiated by degree of knowledge integration, in this paper defined as the degree of actively sharing and communicating of knowledge across organizational legal boundaries within the network. The network is defined as the constellation of separate legal entities involved in intra-firm collaboration with an explicit purpose for the collaboration. Throughout the presentation of our results we further separate the management of the participating companies from the management of the network, entitling the latter of these network management and defining it as the management of the activities that are conducted in, by and as an effect of the network constellation.

The textual structure of the results is based on the approach regarding network practice underlying the original investigation, namely a bilateral approach studying the structure and management of the network collaboration in parallel. Each description of the different profiles is initiated by an example of that specific network profile.

3.2. Profile 1: Supply-chain Network

Company A is a successful German medium-sized company working as a supplier of complex aluminum parts for the automotive industry. The company bases its business on the successful utilization of its relationships with other companies and the collaboration in business ventures across organizational boundaries that these relationships foster. By co-ordinating a number of other highly specialized companies' efforts in the pre-refinement of company A's product, the end-product is produced with great efficiency. By efficient

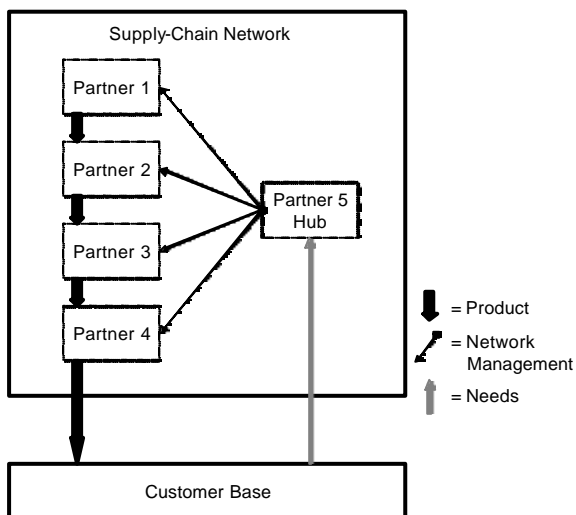
networking practice, company A can control the complete production process, assuring a high quality-level in the end product.

3.2.1. General Structure

The Supply-chain Network, SN, is comprised of a set of companies whose main motives for participating in the network are cost reduction related. The collaboration achieves cost reduction mainly through a strong focus on optimizing the interfaces between the participating companies.

The difference between an SN and a traditional supply-chain is the special attention that the interfaces between the participating companies are given. In addition to this, there is also a general understanding of the whole chain, primarily expressed through an explicit common goal. Companies in traditional supply-chains tend to focus on the individual tasks at hand and show less interest in the overview of the supply-chain. The overview and understanding of the whole chain gives the SN-hub a substantial advantage compared to a traditional supply-chain when something becomes amiss in the product flow. By understanding the complete process, the SN-management can take appropriate action immediately and minimize problems along the product line.

An SN is successful when cost-saving goals are reached and all participants see their participation in the network as profitable. When this is not the case, discontent partners will exit causing instability. This does not however mean that the profit generated by the network as a whole gets directly distributed to the contributing partners through monetary transactions. Instead it is more common for the hub/initiator to invest the profit in the network infrastructure, mainly through specific investments in Information and Communication Technology (ICT) acting to further support and augment the optimization of



the company interfaces.

Figure 1. Visualization of a Supply-Chain Network

3.2.2. Management

The general management practice can be described as a management aimed at optimizing the processes in the supply chain through a high degree of managerial control. Given the nature of the network as encompassing a distribution of the processes geographically and culturally, there is also a focus on creating a good communicative culture. This communicative culture is clearly functionalistic, which is highlighted by the communication often focusing exclusively on the product or the orders involved in the process at hand. Regardless of the functionalistic communicative culture of the SN, the use of formalized EDI- or XML-based communication between the involved network partners was not omni-present, but clearly complemented by the less formalized communication more emphasizing inter-personal rather than inter-firm communication.

The management of the SN is highly limited to the participating partners own management and only a limited amount of mandate is given to a more centralized network management. With the main objective for the network management of the SN being cost reduction through optimization of joint processes, the usage of goals, checkpoints, forecasting and follow-ups are important instruments.

With the output of each partner in the network being the primary focal point in the collaboration, it is possible to assess that the company transparency in the SN is relatively low. This is also emphasized by the clear differentiation of the contributing partner's different efforts, and the fact that reliability is the most important partner characteristic in an SN.

The management of knowledge in the SN strictly focuses on product relevant knowledge. Questions raised and focused on by the network management of the SN are for instance:

- What does each company need to know and do in order for the supply-chain to run smoothly?
- What information is required in order to place the partners after each other in the chain?
- What implications does a partner's change-in-procedure cause up or down the line?

When regarding the collaboration of the firms involved in the SN the knowledge integration is fairly limited (low). However, it is important for each partner to have the ability to identify and describe her product relevant knowledge, in order for the SN-management to respond successfully to external events.

3.2.3. Foundation

The SN is a former "regular" supply-chain that has transgressed (or evolved) into an SN. The values and ways of working still remain basically unchanged and resemble the old way of working. Successful utilization of ICT together with a modern view of organizations and collaboration cross-fertilizes the traditional supply-chain and creates a highly profitable and efficient collaborative form.

The history shared by the participators (often having been involved in previous relationships with each other) facilitates a sense of trust and thus acts as a step towards the creation of a common ground to build the enhanced collaboration on.

3.3. Profile 2: R&D Network

Company B is a medium-sized Swedish research institute continually working with an ever-changing set of different partners on different projects. Each project requires a number of highly specialized participants with the common ability to reach the stated project-objectives. In order for management to be able to meet the customer's demands with a correct and appropriate project-constellation, they must constantly be aware of the current state of competence in the base of networking researchers tied to the institute. When the projects are up and running, it is the role of the managers to facilitate knowledge creation through ascertainment of a knowledge enhancing environment.

3.3.1. General Structure

The R&D network, RN, is comprised of a set of companies whose main motivation for participating in a network is that of enhancing their knowledge by joint research and development ventures. With the main motivation for the individual partner being personal knowledge creation or enhancement, the synergic effects of the network are of great importance for whether or not the RN's existence is justified or not.

The RN is successful when research goals are achieved and the contributing partners experience a feeling of having enhanced their own knowledge. Success often lies in the ability to set up and execute contractual research in complex areas without losing control, overview and manageability of the task at hand.

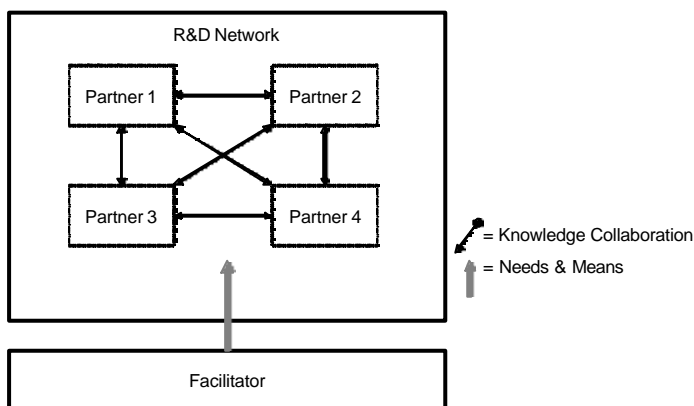


Figure 2. Visualization of a R&D Network

3.3.2. Management

The main activity of the network management in the RN is the creation of an environment where knowledge can be cross-fertilized and grow and where the individual contributions of the partner's knowledge can be surpassed by the joint output of the network.

For the manager to be able to create an environment where knowledge flows freely between the individual partners, it is necessary to limit the extent of managerial control. This is a direct result of a constellation with a high degree of specialization and expertise in the individual contributors and a focus on intrinsic rather than extrinsic rewards. In this case, the network management has more of a facilitating function rather than a controlling one.

A second function of the network management is the reporting of results to other stakeholders (for instance venture-capitalists). The existence of a formalized means of reporting results may in some cases also act as a substitute for more elaborate managerial control.

Thirdly, the network management's role as a gatherer and coordinator of resources for the network is strongly challenged by the explorative nature of the RN. Without the possibility of predicting the outcome of the exploration, the resource-management aspect of the network must be regarded as a possible pit-fall.

The knowledge management of the RN focuses on the cross fertilization of existing knowledge into new by creating relevant constellations and a knowledge-enhancing environment. In order for the RN to be a successful network, it has to be able to take advantage of the synergic effects attained from having experts from several fields in close collaboration. For this to take place, the transparency of the knowledge in the network must be high.

3.3.3. Foundation

The RN comprise of partners that often have a long history of research related activities. These activities have always been executed in contemporary forms such as R&D divisions of larger companies, academically tied research, research institutes tied to industries etc. The main difference from the previous, non-network form, are forms and mixes of traditional ways tied together by successful utilization of ICT. This, however, has not changed the operative research practice and culture in any major way, but simply acts as a possible means for adding further value and enhancing the output of the collaboration.

3.4. Profile 3: Business Network

Company C is a medium-sized Swedish company involved in the design of targeted, heavy-duty computer hardware. By continually balancing the constellation of sellers and producers to best meet the design-demands stated by company C, the company manages to remain highly competitive mainly through a strong focus on high quality and minimizing the production cycle-time. Company C manages to remain successful through investing a vast amount of resources into the management of the network, its internal politics and having an efficient constellation.

3.4.1. General Structure

The Business network, BN, is comprised of a set of companies whose main motivation for participating in a co-operative network is directly related to an increase in sales or acquisition of load. A BN provides a product or service produced by a set of partners, and this product or service is then sold by another set of partners in the network.

A BN usually has a strong hub-company who is the product- or service-owner, and the main source of value-creation lies in the dynamic structure of the BN and its ability to adapt to ever-changing market conditions. The BN is comprised of partners in both horizontal and vertical collaboration.

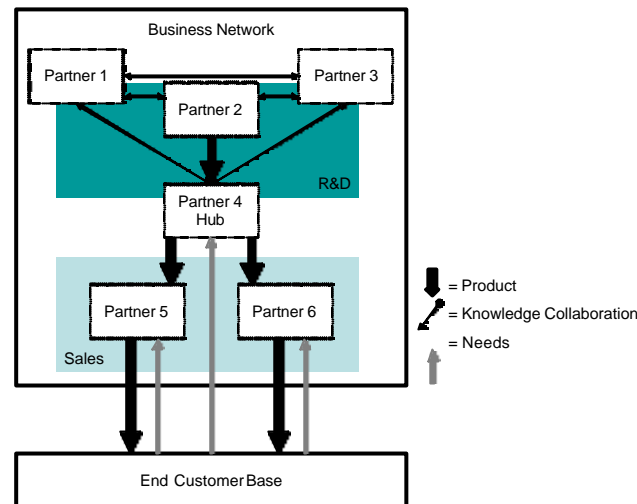


Figure 3. Visualization of a Business Network.

3.4.2. Management

Management of the BN is mostly a political game of balancing the network partners. The strength of the network derives from its flexibility, this flexibility needs continual maintenance or partners will exit the network. Management of the BN must make sure resources (the partners) stay in the network with use of minimal encouragement. This way the BN has access to resources without high costs of maintaining them or of not using them.

Since the BN hub-company acts as an initiating partner and thereby attracts other partners on the notion that their participation will lead to success, the overall responsibility over the final outcome is directly attributed to the hub-company. In stating that the hub-company takes almost full responsibility over the outcome, a high degree of managerial control is often found in the BN.

Another important role for the network manager of the BN is that of bringing in and removing contributing partners to the network. The manager must have an overview of the contributions of each partner to the total value-creation process, to be able to assess whether or not the present constellation of partners is the optimal for the goals set. In this manner one of the main goals for the network manager of a BN is to create and retain a flexible partner constellation.

The knowledge management of the BN focuses on a high degree of collaboration between the partners. Existing in a highly turbulent environment (acting on a turbulent market), the notion of a flexible partner-constellation is of major importance for the success of the network. This is further complemented by the need for a high level of partner transparency in order for the network manager to ascertain the optimal constellation of partners for the said objective. It is in other words necessary for the network manager to have a good understanding of the relevant knowledge of the partners in order to be able to co-ordinate the constellation.

The network management of the BN involves a strong focus on creating an effective communicative environment that facilitates the communication of customer demands to the

production/development and vice-versa. This is implemented through a culture of mutual understanding that spurs the problem solving of the identified problems in an efficient manner.

3.4.3. Foundation

The BN differs from the previously described network-models (SN and RN) on the fundamental aspect of the network not resting on a previously existing structure and culture. Instead the network is formed and constructed by a free-agent (hub-firm) that attracts the resources necessary for the objective of the co-operation to be fulfilled. This increases the volatile nature of the network and results in the need for a more elaborate and active network-management.

4. Analysis

In order to state implications regarding any design, one must be well informed of the environment one wishes to design support for. Information regarding the environment must be structured in a comprehensive manner for the intended receiver.

We have collected and presented extensive information regarding SME network practice. This information will now be restructured in to a well known (for ICT designers) reference IS architecture. By this structure, we give an organized overview of key network features for each presented network type. These key features are structured as to give direct design implications. Considering the nature of our collected data we have chosen to emphasize the top levels of Zachmans model (Zachman, 1987) i.e. Scope, Enterprise model and Systems model.

Supply-Chain Network

	Data	Function	Network
Scope [Planner]	Logistic flow Optimization	Optimization management Partner value creation Network supply chain process	Multiple enterprises Multiple sites Stable structure
Enterprise Model [Owner]	Knowledge Management Product Partner knowledge and task Supply chain structure Change within partner Management Supply chain performance Interface between partner Management control data	Knowledge Management Well defined common supply chain processes Exchange of : - product data - logistics data - Local production process Management Negotiation of interfaces Performance monitoring in supply chain	
System Model [Designer]	Logistics interface data Product data Local product and process data No specific management data	Logistics e.g order, delivery, tracking, product	

Table 2. Supply Chain Network

Research Network

	Data	Function	Network
Scope [Planner]	Knowledge Knowledge creation	Facilitating management Enhance knowledge by joint research	Multiple enterprises Common site Stable in projects
Enterprise Model [Owner]	Knowledge management Knowledge description for each partner Knowledge needs Knowledge development Management Project structure Project status	Knowledge management Research Collaborative knowledge creation projects Create transparency of partner knowledge Monitor knowledge enhancement Management Project management -time -budget -goals Facilitate project	
System Model [Designer]	Project management data	Project E.G. time budget goals	

Table 3. Research Network

Business Network

	Data	Function	Network
Scope [Planner]	Access to resources	Controlling management Flexible resource network	Multiple enterprises Multiple and common sites
Enterprise Model [Owner]	Knowledge Management Customer demand Transparency of partner resources and knowledge Management Culture of mutual understanding	Knowledge Management Coordinate knowledge and resources of network partners Monitor knowledge and resources of business partners Continually scan market needs Management Coordinate business process network Educate partners towards culture of mutual understanding	
System Model [Designer]	Only system support regarding logistics	Logistics e.g order, delivery, tracking, product	

Table 4. Business Network

Presented tables gives an overview of key SME network features.

5. Concluding remarks

At the Scope level, the strategic issues vary between optimization, knowledge creation and access to resources. This also implies different preferred application areas for ICT support.

At the Enterprise model level there is a commonality in the need for knowledge about the partners in the network. There are also differences in terms of organization of work and thus the focus of knowledge management and network management. Whilst the Supply-chain network focuses on product, interface and performance data for optimization the others focus on the resources of the partners and the integration of their work.

At the Systems model level there are clear differences as to the maturity and degree and application areas of ICT use. The Supply-chain and the business network are more mature but use ICT in differing structures (common vs centralized hub) and application areas (logistics vs control of partners). The Research network use ICT mainly for project management centralized to the facilitator.

The architecture aspects vary significantly, at all levels between the three cases presented. Thus, the nature of the network collaboration, rather than the specific content, appears to decide the form and degree of ICT use.

At an overall level the application of ICT in the network activities is still quite unexploited so there is a need for continued research in this emerging field of application.

From the description of architecture aspects presented in this paper researchers as well as practitioners can gain further insights in design implications in the current and possible future application of ICT to support management and knowledge management in networking organizations.

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