32 THE FORMATION AND DISSOLUTION OF ORGANIZATIONAL NETWORKS: A KNOWLEDGE MANAGEMENT PERSPECTIVE

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This paper reviews relevant aspects of the formation and dissolution of inter-organizational networks (ION) aiming at define requirements for systems managing knowledge networks in such environments. Firstly, the concept of networking and virtual organizing is reviewed. Then a major work on formation of ION is analysed and some conclusions are drawn regarding the design of ION. Finally, the requirements for knowledge management systems in the formation and dissolution of ION are discussed.

1. INTRODUCTION

Business networking has become one of the most powerful strategic business trends, involving a move from vertically integrated hierarchies towards flexible network organizations, and the ability to quickly and efficiently form, maintain and dissolve partnerships – networkability – is a critical success factor (Österle et al., 2000).

To innovate in technological infrastructures, organizational models, supporting tools, it is necessary to understand past and present patterns of inter-organizational cooperation: how and when firms do involve in such patters, with whom, what they do to organize and control that cooperation, what makes them to chose one form of cooperation over another and in which circumstances, which are the results and implications for the networked firms and for the rest of the world in general (Ebers, 2002).

Our main research goal, whose general ideas are presented here, is to build a theoretical foundation and design principles for information systems supporting evolving knowledge networks as a facet of the process of "inter-organizational networking". In this paper we approach also the process of "virtual organizing" as a particular case of inter-organizational networking (ION).

We start by considering the results of several empirical studies regarding the formation of networks of enterprises (it is planned that we collect our own empirical results through a study on collaboration patterns in a number of portuguese SME's)

and interpret them to derive general requirements for systems supporting knowledge management in the formation and dissolution processes.

Although the focus is on knowledge management, we share de view of Swan et al. (1999) that "knowledge cannot simply be processed; rather it must be continuously re-created and re-constituted through dynamic, interactive and social networking activity". This direct us to types of systems that previligiate sense-making and community building instead of relying mostly on negotiation and brokering functionalities.

2. NETWORKING AND VIRTUAL ORGANIZING

An Inter-Organizational Network[i] is an organizational form that institutionalizes recurrent exchange relationships between a limited set of actors. These actors retain a residual control over their resources although some times negotiate and divide collectively those resources. ION are diverse from markets in the sense where the transactions between actors involve coordination plans and activities essentially bilateral; they are also diverse from firms because they don't establish a corporative actor but retain control and decision unilaterally viewing their resources and to sustain some residual risk (Ebers, 2002).

A virtual organization can be seen as a particular type of ION. Basically, a "virtual organization" is a partnership network. Since Mowshowitz (1986) used the term for the first time, many others authors have created different terms and definitions to describe this new form of network organization. The concept of *"virtualness",* as applied to organizations is defined as "the ability of the organization to consistently obtain and coordinate critical competencies through its design of value-adding business processes and governance mechanisms involving external and internal constituencies to deliver differential, superior value in the market place" (Venkatraman and Henderson, 1998). Consequently, they defined *"virtual organizing"* as "a strategic approach that is singularly focused on creating, nurturing, and deploying key intellectual and knowledge assets while sourcing tangible, physical assets in a complex network of relationships". This concept of "virtual organizing" is central for the analysis framework presented in this paper. In terms of research we are interested in the knowledge management support to the processes of "virtual organizing" as well as "virtual de-organizing".

To understand the motivations that drive organizations to participate in a network, the starting point is to understand the advantages of this form of organization face to the others[ii]. There is a great extent of research literature on this subject and we will only summarize some relevant issues from Franke (2000) and Ebers (2002).

IONs have a competitive advantage over other firms that vertically integrate identical exchange relationships (e.g. supply chains) because the link between the distribution of results, risks and rewards that reduce the costs of coordination. Moreover, the *high degree and scope of information sharing, mutual obligations and the links for decision making of the connected firms,* lead to better coordination and inter-organizational control (Ebers, 2002 (our emphasis)).

IONs are advantageous over markets or hierarchies forms (e.g. joint ventures, strategic alliances, etc.) because it provides the network participants with a *stable trustworthy organizational environment* where the members work together to optimize its competitiveness using *shared resources and experiences.* Organizations in an ION are able to create *core know-how and competencies* due the *rich resource and knowledge base* the virtual web provides to form unique and difficult to imitate value chains. This organizational form is also a partnership of specialized enterprises operating in *pre-determined trust culture* with a pre-defined set of rules and regulations about knowledge ownership, security and protection, which facilitate the quick formation of the temporary partnerships (Franke, 2000 (our emphasis)).

We highlight two issues here: the *trust environment* provided (ideally) by an ION and sharing of resources, information and knowledge (ordered by complexity level). These are enabling aspects of the main (although vague in formulation) advantage of an ION: to provide competitive advantage to their members. We will discuss below that sharing is just one component of the process of virtual (de)organizing: creating and dismissing information and knowledge in the context of the ION are fundamental issues.

3. FORMATION AND DISSOLUTION OF ORGANIZATIONAL NETWORKS

3.1 Explaining the formation of ION[iii]

ION formation has been explained by several perspectives. There are two of them that seem to be the most disseminated: one anchored in the strategic management perspective and the other on the resource dependency or transaction costs theory. The first one tries to explain networked organizational forms by considering the characteristics, intentions, aspirations and situations of the several actors involved. The later is focused on the attributes of the links between resources (Franke, 2000; Ebers, 2002). These broad perspectives can be used to explain almost everything (generically) about the formation of ION but are not enough to explain the dynamics of current and future ION formations. IONs such as virtual enterprises or collaborative networks (Camarinha-Matos and Afsarmanesh, 1999) are examples of networks whose dynamics is complex enough to be explained with further theories, namely social networking.

Horizontal to the above theoretical perspectives are the analysis levels (Soares and Sousa 2002; Ebers, 2002). An institutional level of analysis of the formation of ION is centered on the idiosyncrasies of the environment and in the characteristics of the society within which the network is formed. It identifies and characterizes the attributes of the institutional system under research. A relational level tends to study the particular aspects of the several links and inter-dependencies that exist between the actors involved (individuals, groups, firms). It identifies and explains the attributes that characterize the content of the links.

Nevertheless, Ebers (2002) suggests that it is possible to better understand the ION formation by analyzing the three fundamental flows where the relationships existing between the organizations of an ION rely:

- *flows of resources and activities linkages* that are related with those types of inter-dependencies between organizations that are better managed through specific forms of inter-organizational networking;
- *flows of mutual expectations* that influence the perceptions of the actors about the opportunities and risks of the collaboration and as such mould the organization of the emerging network;
- *flows of information* that influence the perceptions of the actors and guide their decisions influencing the form and content of the ION.

The conceptualization of ION based on the coordination mechanisms (instead of market or hierarchies governing mechanisms) is useful in the cases where the goal is to evaluate and preview which forms of network connections can produce which results and in which circumstances. The degree of control and decision making centralization, the degree of centralization of property rights, the degree of formalization, the degree of routine and institutionalization of coordination are examples of those circumstances. This generic organizational knowledge can be applied to the analysis and design of inter-organizational relationships if structures and linking processes are defined in an adequate theoretical form. This conceptualization can also help to understand and predict the emergence of new ION. The generic question is: which flows of resources, expectations and information can be effectively governed by which configurations of coordination mechanisms?

Another perspective within a relational level of analysis is based on the belief, supported by empirical studies, that pre-existing social relations between the several actors in a geographical region accelerate and support the development of more relationships in more formal business networks. The rationale is that family and friendship relationships, common members in local associations (commercial, industrial, professional) and political institutions, create and support social relations of mutual obligation, loyalty and trust. In this case, business relationships are not only governed and monitored by formal contracts but also through those social relationships. Viewing this, there are arguments that support that social relationships in ION have a greater probability of being formed when the actors can rely on social networks dense and spatially restricted (Ebers, 2002). This finding is very relevant for our research, in particular for the case we are setting up involving mostly SME's (see section 3.3 below).

3.2 The dynamics for change and dissolution

IONs evolve, transform and eventually dissolve. Several authors suggest that process oriented studies are fundamental to understand these transformations. Processes of re-evaluation, learning and adaptation can take to adjustments and some times to the termination of links and the forms of ION originally implemented. Furthermore, some relationships are explicitly designed as temporary e.g. the development of a new product or to take advantage of a market opportunity limited in time. After the objectives being achieved the inter-organizational arrangement is dissolved. Even sometimes the formation of a ION can make part of a broader strategy, being only an intermediary form of organization.

The transformations naturally occurring in ION can be viewed as changes in the three fundamental network flows, as suggested by Ebers (2002) in its analysis framework.

Changes in the actors' *resource base.* Resources such as competencies, contacts, or technology can be acquired by the network partner changing the way exchange relationships where founded.

Changes in the actors' *information base.* Better knowledge of the partner's resources and capacity makes easier to detect links of activities more or less effective, being able that way to restructure accordingly those links and to learn about opportunities to establish new ones. We can verify that in network partnerships actors acquire gradually better information about competencies, capabilities, intentions, needs and limits of the partners. Furthermore, due to the interaction between partners, their information base changes as a result of the relationship influencing the structuration and functioning of the inter-organizational relationship.

Changes in the actors' *expectations,* regarding the behaviour and actions of the network partners. As a result of new information, and revised (or confirmed) expectations between actors, the structuration and functioning of a relationship will change as well. Depending on the results of the interaction, the added experience of the actors can lead to a growing mutual trust or to result in mistrust between partners. In this case, the continued application of classical instruments based on contracts and monitoring can induce mistrust and possibly opportunistic behaviour.

3.3 Consequences for the design of ION relationships

One direct conclusion of the Ebers analysis is that the design of network relationships depends, among other issues, on the characteristics of the flows of resources, of the information processes and of the expectations of partners. Also, we should recognize the importance of intermediaries for coordination functions in the formation of ION. This has been researched for a longtime in the Virtual Enterprise community (Hatch, 1995; Flores and Molina, 2000; Franke and Hickman, 1999; Franke, 2000; Kanet et al., 1999; Saabeel et al., 2002; Katzy and Löh, 2003).

ION forms of organization require permanent attention and management action. It is necessary that managers and the members of the organizations in general be ready to analyze and (re)evaluate the inter-organizational links and existing relationships. Only this way it is possible to achieve a high level of flexibility and responsibility, effective and quick decision making, learning and innovation (Ebers, 2002).

Ebers (2002) concludes that until now research on the formation of ION has been focused on the motives and contingencies of network structures. There is much less knowledge created about how ION relationships are created, developed and dissolved. There are few results about intermediate processes, phases and activities that convert motives in particular network structures and about the contingencies that facilitate or hinder those processes.

These processes of creation and dissolution are nowadays being much influenced by inter-organizational information systems and associated technologies. We believe that in the future they will be the fundamental instrument to support ION formation

(at several levels: supporting infrastructures, protocols, formats, information and knowledge management, negotiation).

Nevertheless, research on the technological support to processes of creation and dissolution has been mostly concentrated on the former and approaching it from a resource management point of view, i.e. trying to satisfy the generic switching principle of Mowshowitz (1986, 1999) - identification of the best and more appropriate resources to satisfy the network needs (Klueber et al., 2000; Petersen et al., 2002; Petersen et al., 2003; Saabeel et al., 2002; Ruhi, 2003).

From the written above and from previous work on virtual enterprises life-cycle management (Katzy, 1998; Faisst 1997; Mowshowitz, 1999; Camarinha-Matos, 2003; Saabeel et al. 2002; Zaidat et al., 2003) it is clear that ION need to implement functionalities supporting formation as an integral part of the functionalities supporting the management of the ION. This also means that the role normally assigned to brokering functionalities are not enough if the goal is to relationship centered management of the ION. To build such tools there is the need of network-centric theoretical and conceptual models that enable to relate adequately information and knowledge managed in these processes (Soares and Sousa, 2004).

4. KNOWLEDGE MANAGEMENT IN THE FORMATION AND DISSOLUTION OF ORGANIZATIONAL NETWORKS

Besides other commitments and expectations, an organization entering an ION invests part of its knowledge capital through sharing, and it is natural to expect a return on that investment. The processes of formation and dissolution of organizational networks generate new knowledge and consolidate of the existing one. These processes are the way which the organization delivers and collects dividends on the invested knowledge.

There is a significant body of research work regarding knowledge management in organizational networks (for a comprehensive review see (Archer and Wang, 2002). In a more managerial perspective, relevant contributions focus on empirical studies to find how organizational factors (economic, social and systemic) influence the effectiveness of knowledge management in improving organizational networks and their members. In a more technological perspective the some relevant work is being developed in applying ontologies as the semantic infrastructure to knowledge sharing between the members of a ION. Particularly the work on the integration and mapping of distributed and heterogeneous ontologies (Maedche *et al.,* 2003) seems to be promising as is more in line with the degree of autonomy of the organizations participating in an ION.

Swan et al. (1999) opposes two types of knowledge networks: "cognitive networking" - based on linear information flows where IT systems are "information routers" - and "community-networking" - based in a process of "sense-making" where IT systems are facilitators. We support the "community view" as it is the only adequate to understand and exploit formation and dissolution in ION as strongly coupled technical and social processes (the ION is thus viewed as a socio-technical network). In a certain way this is also in line with the high level view of managing knowledge as a process (as opposed to product) (Abecker *et al.,* 2001).

4.1 Generic requirements for knowledge management systems supporting formation and dissolution phases in ION

Analyzing this specific literature we can conclude that there is not significant research work along the lines described in previous sections i.e., supporting explicitly the formation and dissolution of ION by providing, making evolve, consolidate, provide access and dismiss specific and relevant knowledge.

4.1.1 ION formation and dissolution should be managed as socio-technical network processes

ION formation encompasses structural (re)arrangements in the participating organizations, as result of relationships (re)definition. These changes imply social changes as well at levels such as the work environment and content, autonomy and responsibility, competencies. These are social changes and as such cannot be road mapped through formalization in a well structured method or approach. It is thus of utmost importance that descriptions of past socio-technical configurations annotated with related and specific problems, solutions, suggestions, etc., can be easily stored, retrieved and correlated.

A holistic management view also requires managing the relationships and interactions of individuals and groups with technology, by adequately positioning the technological artifacts, such as a knowledge management system, in the social context of human action. In fact, today, information technology and systems have so strong an influence in human actors' relationships that it is interesting to conceptualize them as social actors on their own.

Through a "multi-perspective model" underpinning knowledge management support functionalities, each person or group is expected to be able to fully explore webs of relationships that are important in the scope of his responsibilities in the process of formation or dissolution. Relationships can be analyzed, "designed" and managed at different levels and from several perspectives. Levels and perspectives are intertwined, linking the network of social actors in a hyper-web of relationships.

4.1.2 Management of ION formation and dissolution should be focused on the network of relationships

The management of a network of enterprises (in particular the processes of formation and dissolution), can be viewed as the management of relationships and interactions between the different actors, directly and indirectly involved in the activities. Relationships involve operations, processes, resources, knowledge, social interaction, trust, power, etc. Relationships can be related with other relationships. For example, an operational relationship between a procurement manager and one of its suppliers is related (or is influenced) by his relationship with the other suppliers, by the relationship of the supplier with other clients, etc. This can be considered an evolution of the concept of meta-management (Mowshowitz, 1999) in virtual organizations, going from the management of distributed tasks linked to some previously agreed overall goals, to the management of a web of relationships linked not only to a complex web of overall goals but also to individual goals and expectations.

The way a manager (which can be any node in a network) moves from one subject or issue to another strongly depends on the linkages (relationships) he actually perceives and on his goals and objectives at the moment. Therefore, there can be several levels of relationships. For example, depending on the level of aggregation of the actors (e.g. nodes in a collaborative network) we can explore the relationships between companies, between teams, between roles, etc.

4.1.3 Knowledge support to ION formation and dissolution should start in the "breeding environment"

As already described in section 3.1, social relationships in ION have a greater probability of being formed when the actors can rely on social networks dense and spatially restricted. This also characterizes the so called "breeding environments" (Camarinha-Matos, 2003). It is very important that organizations acknowledge a trustworthy organizational environment where the formation and dissolution of a ION (or e.g. a virtual enterprise) can be agile, overcoming long negotiations and contractual setups. To support network formation and dissolution within a breeding environment this, a "knowledge" level should be added to an ION aiming to create community based dynamics rather than negotiation and transaction based dynamics (although the later should be present anyway but with the possibility of being simpler).

5. CONCLUSIONS AND FUTURE WORK

The formation and dissolution processes of a ION are two sides of the same coin from a knowledge management perspective. Knowledge shared in the formation process will be capitalized with interests in the dissolution process.

The results from empirical studies, in particular the ones focusing on the ION processes, are a fundamental source of requirements and inspiration to build inter-organizational information systems, particularly knowledge management systems. In this paper we started from a comprehensive work analyzing the formation of ION to derive generic requirements for systems supporting knowledge management in such networks. We interpret the social processes involved as fundamental (within a socio-technical network perspective) and this implies social knowledge being considered in such systems. This also gives preference to a community-networking view over a cognitive-networking view as sense-making processes are enablers of trust.

The ideas presented here are being developed in two projects. CODEwork@vo - COllaborative and DEmocratic work design and management in virtual organizations - has as main objective to create a framework for the design of work in virtual organizations (VO), integrating distributed business processes design with work task design. Furthermore, this framework will be supported by a computer application that will enable the management of the web of relationships resulting from the design process. More specifically, this project will deliver (1) a social actors network based model that will enable the description and analysis of the relationships established within the VO; the relational characterization of social actors in the VO will be used to inform and mediate between the design of the VO business processes and individual and group work tasks and (2) a prototype of a web

based collaboration tool to support both the information management in the design process and the structuring of important information for the management of relationships in the VO.

The second project aims at developing specific tools to structure distributed and heterogeneous knowledge in a socio-technical network. The focus is on the formation and dissolution processes.

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[i] "Network" (Fombrun, 1982) is an abstract enough notion that can be used to characterize any type of recurrent links (e.g. resources, friendship, information) between a set of nodes (individuals, groups, organizations, information systems).

[ii] The framework of analysis of Ebers (2002) studies ION as a form of organization at the same level as markets and hierarchies

[iii] The review in this section is mostly based on the work of Ebers (2002).