Challenging CSCW in an innovation network context

Damien Hanser, Anne Rousseau

Centre d'Innovation par les Technologies de l'Information
Centre de Recherche Public Henri Tudor
Avenue JF Kennedy, 29
L – 1855 Luxembourg
damien.hanser@tudor.lu, anne.rousseau@tudor.lu

Abstract: Today, innovation networks are economically and technologically accessible [VBE04]; however, managers and members of such organizations notice that success and performance are not automatically given. More to this, practitioners point out that the collaboration processes are the actual challenge in the management of a networked organization. This paper summarizes the results of a research project that addresses these issues. The project aims to identify a set of indicators, leverage factors and software functionalities, which facilitate the management of the collaboration related processes in networks. The outcome is a framework for the analysis of networked organisations that helps to take the right strategic choices.

1 Introduction

After establishing the concept of collaboration and innovation networks, we identify the recurring difficulties that the latter encounter in their daily practice. Given the structural duality of these networks, the nature of their needs is twofold: the first, inherent to the network as the form of collaboration, relate to its infrastructure, while the second relate more to the interaction dynamics (such as the group's cohesion and sustainability). Therefore, only the first type of need is liable to be answered in terms of tools (method, software tool function, etc.), while the needs of the second type are seen rather as resulting from the management practices devoted to establishing community dynamics in the network. In this case, tools can clearly not provide a direct answer but rather a series of facilitators, increasing the visibility of the group's life and the capacity for action of the members contributing to the life of the network.

Faced with these varied needs, we propose five levers specific to network management: information sharing and regulation of the collective activity in response to the first family of needs; while collective awareness, involvement development and network sustainability are dedicated to the second family. On this basis, the relevant question for managing innovation networks becomes: how do we know which lever to use? To answer this, we propose indicators for identifying the relative pertinence of these levers for any given network.

Finally, as for the software tools capable of supporting network management, we have opted for an approach based on functionalities in order to abstract our proposals from any existing commercial offer and so remain focussed on the user's need, with our search for the tool taking place in a later phase. This approach is in line with the research carried out internationally in the IT field [Lo03] and is organised into three categories:

- communication support functionalities that enable direct interaction or later information sharing.

- coordination support functionalities that enable group regulation mechanisms to be represented and diffused through the network.

- collective production support functionalities that enable joint handling of a set of shared objects (text, graphics, etc.)

In conclusion, we would stress the fact that the conditions for implementing a tool for CSCW are technical, economic and social.

2 The structural duality of collaboration and innovation networks

The second Ferrare Conference, *Rethinking Management for Innovation* 1999, concluded that the key to innovation resides now less in the capital investment than in access to the networks. More recently, the first EBN-IASP congress (2005) that brought together representatives of the *Association Internationale des Parcs Technologiques* (IASP) and the *Centres Européens d'entreprises et d'innovation* (CEEI) underlined the relevance of this form of organisation to innovation support. However, as stated by Christian Kettels, Professor at Harvard[1] there is as yet no evaluation method for estimating the return on investment of this type of skills grouping for a given region.

Already in 2003, the final report of the *European Seminar on Cluster Policy* showed that concerns in the matter had evolved from that of the effectiveness of policies in this area to the question of defining mechanisms suitable to improving these policies in the future, examples of their successful applications being numerous (www.ebst.dk/cluster_papers). At the same time, this report highlighted the dynamic nature of the networks: these forms of organisation evolve organically, hence the importance of an in depth understanding of the operating methods and their critical factors from a management standpoint. In a structurationist perspective [Gi94], we understand the innovation network both as a form of organisation and as a set of interactions [SW96] thereby demonstrating its structural duality. Developed from the work of Giddens [Gi94][Gi87], the structuration theory is a framework for understanding the dualities, like routinisation and institutionalisation, action and structure, action and reflection, and continuity and emergence. It is an action meta-theory [AW00].

According to Porter [Po01], this form of collaboration contributes to improving business competitiveness in three ways:

[1] www.proximedia.com/mp2/mp2.asp ?id=751

- *Improve productivity through improved access to specialized suppliers, skills and information;*

- *Innovation is given more importance as the need for improvement in processes of production is highlighted. And firms working together can satisfy this need ;*

- *Once established, clusters will grow as a result of the creation of new firms and the entrance of new suppliers.*

The primary interest for this particular form of organisation stems from the fact that it represents an efficient structure for stimulating business competitiveness, productivity and innovation [VBE04]. Nevertheless, "*As for the question of whether it is the network that pre-exists and drives innovation or whether it is innovation that contributes to the creation of networks, the network effect can be seen in two different and non-exclusive ways* (…)" [Ro99]. The innovation network can be understood both as a new form of organisation structuring collaboration and as a collaborative process structuring reticular organisation. We therefore support a structurationist perspective [Gi87] highlighting the structural duality of the network: it is at once the support for collaboration and its institutionalised outcome [SW96]. In this sense, the running of a network and its performance are social constructions. This type of approach "*has the merit of stressing the social dynamics that underlie the network's activities, the situated nature of the collective learning that takes place, and the potential contradictions or non-intentional consequences that are liable to appear progressively"* [DV04]. So we set ourselves the task of identifying the nature of the problems these innovation networks are regularly faced with.

3 Major challenges of innovation networks and action levers

To identify the needs of innovation networks in management and tool terms, in 2002 we undertook semi-directive interviews with the members of ten Luxembourg and Belgian networks active in various sectors, e.g. computing, quality, e-business, SME advisory services, construction, technological industry, and information and communication systems.

These interviews enabled us to propose an inventory of practices and needs specific to innovation networks taking into account technical as well as organisational and economic dimensions. This inventory was validated by a workgroup composed of network managers.

From this there appeared three types of major concern for innovation networks:

- the definition and running of the network's strategy

- cooperation between the various partners

- knowledge management (e.g. capitalisation, distribution, production) within the network.

Thus we concur with the conclusions of De La Ville and France [DF04] who highlight network challenges in terms of:

- controlling the mechanisms of inter-institutional coordination
- identifying resources to activate synergy potentials, and
- steering emergence to anticipate blockages and avoid project depletion.

We identified five possible action levers relating to the different categories of needs inherent to innovation networks: information sharing and regulation of the collective activity in the first family of needs; collective awareness, development of involvement and network sustainability in the second family. These levers provide the means to act on innovation networks in view of supporting strategic management and also cooperative dynamics and knowledge distribution [SB94]

3.1 Lever 1: information sharing

According to different possible time and location units, we consider that information sharing meets three fundamental needs, i.e.

- to transmit information (by supporting synchronous or asynchronous interactions);
- to structure information exchanges (by managing speaking turns in a simultaneous dialogue or by facilitating the retrieval of available information);
- to locate the objects referred to in the communication and enable the subject to be described.

3.2 Lever 2: regulation of collective activity

The regulation involves the explicit definition of the collective activities that the group must produce. When the group is dispersed, it is necessary to support "remote" planning, i.e. exchanges of messages for planning an activity (e.g. meeting, document to be produced).

In parallel with these items, that may be called prescriptive, it is necessary to enable the partners to negotiate and coordinate everyone's work according to the objectives stated by the group. This entails:

- knowing what other members of the network are doing;
- knowing and making known the roles that everyone can play in the network's activities;
- documenting everyone's interventions and contributions for later use;
- making activity changes known to the members of the group.

Naturally, the need for regulation support in collective action varies considerably according to the type of activity carried out by the network [Mi01].

3.3 Lever 3: collective awareness

It is all the more important to address the issues of network members' collective identity and awareness, when their profiles and objectives are very different. In general, the main objective here will be to favour emulation and strengthen the network's image with its members. To reinforce this collective awareness and thus allowance for the collaborative context within the network, it is possible to:

- supply (using a tool) social or organisational information (e.g. role, expertise) about the members;
- enable members to get to know one another in order to facilitate the making of contacts and mutual familiarity;
- favour transparency and decision-making in the group.

3.4 Lever 4: development of involvement

It is advisable to value information sharing initiatives as much as possible and to guarantee the integrity of individual contributions (in order to limit the fear of being "dispossessed of the fruits of one's work"). The explicit and/or symbolic recognition of agreed "investissements de forme" [Th86] is particularly important here.

3.5 Lever 5: network sustainability

The last lever is set in a longer term view of network sustainability and can be understood in various ways according to the objective and context in which the network develops. This can mean:

- increasing the quality of the information produced by the network;
- increasing the network's renown;
- adjusting the network's skills range according to strategic orientations;
- increasing the number of partners as required.

To support the network's innovation objectives, we propose to act here on the communication of the latter, on the skills present within the network and on the setting up of communication plans internal and external to the network.

Now that we have identified these action levers as so many items answering the major challenges of innovation networks, there remains an essential question: how do we know which point to act on? It will be necessary to find indicators for identifying the relative pertinence of these levers for any given network.

4 Indicators of the relative pertinence of the levers

Five indicators have been identified to define the relative pertinence of the levers: i) the degree of formalisation of the relationships, ii) the time and space for interaction, iii) the modes of communication within the network, iv) the necessity to create collectively or not information, and v) the presence of a cultural background, common to all the members. We are not going to give details here about the measurements related to each of these indicators, but we will show how they provide information on a network's needs in terms of tools for collaboration between its members.

4.1 Indicator 1: level of formalisation of the relationships in the network

This indicator takes into account:

- the existence of roles that are clearly defined and used on a daily basis to manage the network;
- whether decision-making methods are explicit and formally described in a document available to all the members or again;
- whether members prefer a formal or informal communication method for their discussions in the network.

The more accurately the roles are identified, the easier it becomes to coordinate actions undertaken by the network. If, on the contrary, the network is characterised by its members' informal relationships, then it is useful for the manager to focus on development of individual involvement and collective awareness in order to sustain the dynamics of experience and information sharing initiated between the members of the network.

4.2 Indicator 2: time and space

This is a matter of taking into account the time and location units characteristic of the network. For this, we can refer to standard situations, as described in particular by Johansen and Grudin [Jo88; Gr94]:

- members meet in the same place and at the same time to share information during plenary sessions or in workgroups;
- members get together at the same time but in different places, during teleconferences, webinars[2] or videoconferences;
- members make information commonly available in non-real time, by exchanging messages or transmitting documents.

[2] Seminars using the internet as a distribution method for the presentations given by the speakers, an option for editing is retained by using a text dialogue area in the margin of the presentation.

Geographic remoteness and discontinuity of relationships between network members are major items in the definition of needs in terms of providing support for information sharing and regulating collective action.

4.3 Indicator 3: exchanges within the network (type, rhythm and frequency)

It is also necessary to know the type and frequency of exchanges in order to refine the assessment of the importance of the factors of regulating collective action, collective awareness and development of involvement. Type of exchange means the forms that the interactions take between the various persons (managers, members, external persons). For example, these different interactions can enable information to be distributed (distribution type) or target achieving consensus (negotiation type). Similarly, we identify the rhythm and frequency of these exchanges in order to determine and/or assess the relevance of a support.

Thus, for example, when exchanges are planned and numerous, and members share little information during / between ? network encounters, it will be useful to strengthen regulation of the collective activity and development of of involvement (levers 2 and 4).

4.4 Indicator 4: production within the network

Production within the network means, in term of technological support, the drafting of a document by several persons who are not located in the same place. Consequently, the making available of documents produced either by a single member or collectively during a workgroup meeting does not come within the scope of this definition. Such a distinction is crucial when it comes to instrumenting a network's practices since computer support for truly cooperative production requires a large infrastructure and complex functionalities to be implemented. However, there is a wide range of variations between simply making documents available and collaborative production. For example, if a network is characterised by substantial collective production performed in a distributed way and characterised by weakly formalised processes, it will be necessary to greatly increase the control upon collective action, information sharing and the development of individual involvement.

4.5 Indicator 5: common culture

The cultural aspect is important in an innovation network as it serves to cement relationships that are by nature episodic between its members. When members share the same values, a common technical or social culture, it is easier for them to make contact to exchange information or share experiences. Otherwise, great care must be taken with misunderstandings and differing interpretations between members coming from different backgrounds. We consider here that the more heterogeneous the culture of the network, the more it is necessary to strengthen collective awareness and develop members' involvement.

5 Computerising the levers, a gradual approach.

As stated above, software tools for exchanges are naturally intended to serve network needs in terms of infrastructure and have little impact on the social issues affecting the network. However, there is a whole raft of research focussed on how certain functionalities encourage a community spirit within a heterogeneous group assembled for collective action [BS89; En92; Sa95; EW94; Mi01; Lo03]. We will find this research under the topic awareness in collective software, meaning: gaining awareness of the group's activity by means of computer software. The point that emerges from this research and which could help us here is the way in which people gain awareness of the environment through the use of computer software [DB92]. This is referred to as the "awareness loop" [ESS00] which comprises the following steps:

- Perception (passive) of pertinent elements of the environment;
- Understanding of these elements by means of active analysis of the situation;
- Prediction of the state of these elements in the near future;
- Implementation of coordination actions as required.

As we already sketched out at the start of this section, perception of the environment entails information sharing. The second step takes place using representations and views enabling pertinent information to be extracted and all the finer points of a situation to be understood. When these representations are computerised, the corresponding functionalities are based on several analogue types such as radar [GGR95], fisheye type views [GGC96] or even spatial metaphors as for media spaces [Bl93]. These different views will make it easier to understand contextual elements, increase forecasting capabilities, and thereby reduce the reaction time of network members involved in a collective action. The primary function of collective software is to compensate for the difficulties created by the geographic and time distribution of the network's partners. To this we can add a consequential but critical need in the setting up of any technology and which relates to the question of its appropriation by the users. Studies and feedback on this type of tool have shown that it requires a very high adoption rate to ensure the effectiveness of any collective software, even in organisations that are generally supportive of new technologies. Therefore, we handle the innovation network tools topic with care. We return first to the levers that we identified previously by making links with currently available functionalities then, by pointing to the difficulties involved in setting up this type of tool, we will identify a number of possible steps for setting up collective software in a network.

5.1 Functionalities to be linked to the levers

The first question to be taken into consideration is the following: do network members need computerised support to jointly produce information (distributed in time and space) or is it "simply" a matter of making available various documents, produced separately from the tool that we are attempting to define here? In the latter case, it will be possible to make use of functionalities and an infrastructure that are far less complicated and user friendly. The "collective awareness", "development of involvement" and "sustainability" levers are not supported directly by dedicated software functionalities but rather by an advanced use of existing functionalities set in a logic of shared awareness of the group's activity, such as defined above.

However, to strengthen "information sharing" in a network, there is a range of functionalities for supporting direct dialogue and ensuring the persistence of information shared by a group of users. These functionalities are generally well known and do not in themselves constitute innovation. Thus, to support dialogue, we have functionalities based on direct text exchange, audio conferencing or videoconferencing. Similarly, email and documentary service functions can be used to ensure information persistence.

As regards regulating collective action, there are the functionalities of shared schedules, assistance with meeting planning and process management.

Altogether, collective software, as a set of functionalities [Da01], offers the capability of transmitting, structuring (conversations or sets of information) and situating contextual items that provide information on the activity of other members. These functionalities can allow the members to coordinate their activities as they proceed and produce what Schmidt calls "cooperative work mediated by the field of work" [Sc94].

The table below gives some functionalities by specifying their outcome and synchronous or asynchronous character.

		Capability provided by the tool		
		Transmit	**Structure**	**Situate**
Time	**Real time**	Audio or videoconference Shared white board Brainstorming support	Control of speaking turns Synthesise, compare	List of members on line Trackers
	Non-real time	Email File server	Document indexer Version management	History Graphical representation of documentary relationships

Figure 1: Some examples of functionalities

To conclude this point, remember that if one wishes to take full advantage of the potential offered by collective software in a network, these functionalities should be made as simple, user-friendly and non-intrusive as possible so that they can be used easily by all the network's members.

6 Conclusions: a set of factors not to be ignored

The conditions enabling collective software to be implemented are both technological and social. On the one hand, a solution will have to be found that is compatible with all the computing hardware used by the network's members: operating systems for tools installed locally and type of browser, version and settings for tools based on internet technologies. On the other hand, it should be ensured that future users will not only benefit from real added value in using the collective software, but also that they have the skills and/or use habits required to use the tool.

A commonplace example may be used in illustration: the fact that the collective software offers an RSS[3] channel can be decisive for people who habitually use this standard to access information websites from their email service while other members may have to change their software or install others just to access this service. As can be seen in this example, the choice of functionalities and the structuring of collective software will largely be guided by the personal investment that future users are willing to agree to in order to take on the tool made available to them. These conditions are identified and evaluated by analysing the capability of network members to appropriate the tool made available to them. This analysis is based on questionnaires and analogies with known networks.

To respond constructively to these conditions, it is necessary to consider the various levels of use of the tools answering the technical needs of the network and the levers identified as pertinent. Level 1 corresponding to functionalities that are commonly used or very simple for members to appropriate and the following levels representing desirable evolutions and possible improvements, depending on whether the level of support offered by the tool is increased. Obviously, such an analysis constitutes a time-based view and must be repeated periodically during the life of the network so that it remains in touch with its concerns and the inevitable technological changes.

The table below gives a simplified view of the three ‘use levels’ of file-sharing functionalities for a network wishing to set up dynamic collaborative document production.

[3] RSS stands for "Rich Site Summary" or "Really Simple Syndication" and means a format enabling a summary description of website content. This format allows compatible tools (email software, websites, dedicated tools) to check a website's updating and so alert a user, or show on a website news coming from a partner site.

	User's responsibility	Provided by the tool	Risks
Level 1	Version management Notification of other users Management of document consistency	Downloads Locking of documents for revisions List of shared documents Management of access rights	Inconsistency between document versions Random notifications
Level 2	Management of document consistency	Automated version management Automated notification Routing of documents for validation	Too frequent notifications Requires a definition of responsibilities
Level 3	Regulation of the group activities collaboration	Management of version consistency and merging aid Shared work spaces Option of fine-tuning notification settings	Complexity Need for specific training

Figure 2: Example of computer support levels for document sharing

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