Collaboration, Communication, and Control: The Effects of ICT-Enabled Innovation Projects on Informal Organizational Structures

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Abstract

This paper examines knowledge sharing in ICT-enabled innovation projects in bureaucratic settings. The fact that individuals from different organizational units work on a common task creates a network that coexists with the functional subdivision of tasks and traditionally rigid hierarchical reporting structures within an organization. Based on empirical data from four project workgroups in Switzerland and the United States, I propose a theoretical model for knowledge sharing in ICT-enabled innovation projects. The model ties together processes and content of knowledge sharing through two task dimensions, each of them subdivided into two phases: (1) Conception and implementation of the project, and (2) Exploration and exploitation of knowledge. I show that the implementation of ICT-enabled innovation projects requires a balanced mix of exploration and exploitation of knowledge, where exploration through sparse networks is more important in the conceptual phase, and exploitation in tightly-bound groups becomes more fruitful in the implementation phase.

1. Introduction

The possibilities the Internet affords have grown to be ever more important for bureaucratic organizations in recent years. With tasks continuously growing in complexity and with more decentralized structures, Internet-related technologies have become a necessity for bureaucracies to function profitably. The fact that individuals with differing skill sets and from different organizational units work on a common task creates a network that coexists with the functional subdivision of tasks and traditionally rigid hierarchical reporting structures within an organization. Common tasks by their nature require knowledge sharing in order to be fulfilled successfully. With multiple functions and multidisciplinary knowledge coming together, it is necessary to combine and reconnect the required knowledge.

Often, the introduction of these new technologies takes place in the form of a specific project. These project workgroups may assume any form between the two extremes of a tightly-knit team with clear boundaries, whose members were recruited specifically for the project, to a loosely-bound group of individuals spread across various organizational units. In this paper, I refer to ICT-enabled innovation projects to denote projects aiming at delivering services online in a customer-oriented fashion. These initiatives comprise a wide range of IT-enabled applications which require a new way of thinking about traditional work processes in order to achieve efficiency gains by taking advantage of the possibilities that new technologies offer. The success of an ICT-enabled innovation project depends upon a mix of external and internal factors. In terms of factors external to an organization, stakeholder endorsement and customer satisfaction are especially important, whereas significant internal factors are the ability to manage innovation, and intra-organizational knowledge sharing. This study focuses on the last, examining how knowledge is shared in ICT-enabled innovation projects: how do managers decide what to include and what to exclude in a project? How do they attribute priorities to various activities? What sources inform these decisions? How is their communication network structured?

2. Theoretical foundations

The rising importance of knowledge has been used to characterize post-industrialist societies [1-3]. Knowledge, it is argued, is a principal economic resource. Unlike traditional factors of production (such as land or equipment) to which knowledge is often compared, knowledge resides within individuals, making it an intangible asset, and therefore difficult to acquire and share. In post-industrialist societies in general and in contemporary organizations in particular, knowledge acquisition and sharing is one of the most important social processes.

Scholarly interest in the causal relationship between technology and knowledge processes predates the invention of computers. The prominence of the topic, however, has grown enormously with the event of computer technology, since information technology differs substantially from traditional technologies: in addition to affecting the production of goods and services, IT has the potential to affect the functioning of coordination and communication within an organization and between organizations. This impact, however, can be positive or negative - technology can be supportive of

more efficient coordination and communication processes, but it can also stand in the way of efficiency and effectiveness when existing technologies, such as legacy information systems, determine the choice of new technologies, thus creating a path dependence [4].

From a theoretical perspective, the following elements of knowledge sharing are particularly important in this context: (1) Modes of knowledge sharing – knowledge can be imitated, copied, or transferred through communication, each mode yielding different results according to the actors involved (individuals, groups, the organization, and other organizations). (2) Influencing factors of knowledge sharing – experience, trust, motivation, and the difficulty of knowledge transfer significantly influence whether and how effectively knowledge is shared. (3) Coordination mechanisms of knowledge – knowledge sharing is different in hierarchies, routines, networks, and groups [5].

This paper's aim is to advance theory on the interdependencies between the introduction of ICTs and formal and informal organizational structures by closely examining two coordination mechanisms that coexist in ICT-enabled innovation projects: hierarchies and social networks. The remainder of this section is dedicated to the theoretical underpinnings of these coordination mechanisms.

Scholars of many disciplines have studied formal and informal organizational structures as coordination mechanisms for knowledge processes. The role of hierarchies as opposed to markets, and increasingly the notion of networks, have been discussed as allocation mechanisms for knowledge [6, 7]. The main distinguishing factors of those different allocation forms are the locus of authority and control, and consequently the different ability to either transfer or develop tacit or explicit knowledge efficiently. Organization design theory suggests that the information capacity of coordination mechanisms should match information requirements of the task at hand [8]. In a hierarchy approach of allocation, knowledge is readily available in the organization, as the organization has complete control over the knowledge process. Bureaucracies rely on rationalized knowledge that is collected mostly in databases, reports, or handbooks [9]. In line with Weber's [10] depiction of the ideal-type bureaucracy, individuals are arranged in a bureaucracy to carry out specialized tasks, based on explicit rules and procedures [11]. In this formal organization mechanism, knowledge is likely to be structured with explicit rules of action. A recent network theory-based explanation for the theory of the firm argues that organizations have advantages over markets because they can mobilize social capital embedded in human relations in order to create intellectual capital [12].

Prior research has shown that, while hierarchies are generally efficient for carrying out specialized tasks based on explicit rules and procedures [9-11, 13, 14], informal networks more efficiently diffuse, utilize and integrate knowledge [6, 7, 15-17]. Kogut & Zander [18] propose several coordination mechanisms for knowledge transfer operating on different organizational levels. They argue that transfer of knowledge from an individual to a group level occurs through the development of unique language or code which allows group members to learn who knows what and to coordinate their activities. On the organizational level the transfer of knowledge within the same function (horizontally) is realized by boundary spanners. At the same time, a vertical transfer of knowledge among different organizational functions relies on the use of higher-order organizing principles through formal and informal structures. Coordinating different units to share their knowledge is critical to enhance an organization's capabilities [16]. Similarly, Tsai [19] suggests that knowledge sharing within a multiunit organization requires both formal and informal structures as coordination mechanisms. For the purpose of this study, I examine hierarchy as a formal coordination mechanism of knowledge; and social networks as an informal coordination mechanism. These coordination mechanisms of knowledge are discussed in greater detail below.

2.1. Hierarchy

Formal hierarchical structures are one way to coordinate knowledge processes in complex organizations comprised of multiple specialized units [19]. In hierarchies, communication occurs in the context of an employment relationship, and relationships are important, although the patterns of interaction are most strongly determined by an individual's position within the formal hierarchical structure [6]. The analysis of hierarchical structure as a coordination mechanism of communication has played an important role in organizational research. Exemplary elements of formal organizational structure are formalization, specialization, and centralization [20]. Another traditionally mentioned feature of hierarchical structure is centralization based on an authority structure. From a coordination perspective, if the requisite information-processing and decision-making talents are not widely distributed, a centralized structure can be beneficial to decision-making processes [14]. On the other hand, centralization could prevent a unit manager from exercising sufficient discretion in dealing with the demands of his or her task environment. This might be the cause for inefficiencies, as the knowledge transfer from the individual unit to the head of the agency is inclined to error and therefore slows decision-making [21]. In addition, centralization can reduce the initiatives that a unit might take in inter-unit exchange, thus not being interested in sharing knowledge with other units unless required to do so by a higher authority [19].

2.2. Social networks

Even in the most bureaucratic settings, informal social relations are an important source of task advice [22-24], and can affect the content and quality of decision-making [25, 26]. The study of organizational social networks has attracted the attention of scholars from different fields for many years [for a review, see 27]. The structure of social networks builds around the positions and roles of the involved actors, and the ties that exist between them. An important distinction in social network theory is made between strong and weak ties, i.e. the frequency or intensity, also termed 'quantity' of ties. Whereas strong ties tend to bind cliques of individuals and primarily convey within-group knowledge, weak ties bridge cliques and are therefore source of new knowledge [28]. However, knowledge sharing in networks requires strong ties [29, 30]. In a study on the performance of organizational teams, Ancona & Caldwell [31] draw together internal and external ties of teams, finding that teams engage in vertical communications aimed at molding the views of top management, and in horizontal communication aimed at coordinating work and obtaining feedback. They show that the type of external communication teams engage in, not just the amount, determines performance.

Of particular interest to this study is the recent concept of knowledge networks [32-34], indicating that the content of ties between actors consists of some form of knowledge. The location of knowledge within a network of actors varies along a continuum, spanning from knowledge residing with one actor to knowledge distributed among many actors [35]. At the individual level, actors have their own ideas about the distribution of knowledge among actors in the network; i.e. their own cognitive knowledge networks [32]. Furthermore, knowledge networks are characterized by fluidity of actors and their ties: based on the tasks to be accomplished, their interests, resources, and commitments, actors join or leave a knowledge network. In addition, the ties within a knowledge network are prone to change with evolving tasks, the distribution of knowledge, or changes in the actors' cognitive knowledge networks [32].

3. Methodology

This study combined a qualitative exploratory case study design [36] and a grounded theory approach [37], with the aim of theory building through the comparative analysis of case studies [38].

3.1. Data collection

The data for this study were collected in the period May 2001 – June 2002 during field research at the sites of four project workgroups, and after a follow-up email survey sent to these sites in the beginning of 2003. In the field, I conducted open-ended, semi-structured one-on-one interviews with the key persons involved in each project, using an informal list of questions as interview guidelines. I was also allowed to observe several meetings and explore office buildings, and I took field notes on observations, spending between four and seven full working days at each site. Furthermore, I analyzed documents which I received from the interviewees or through official sources. All interviews were recorded on tape and transcribed, totaling over 700 pages of single-spaced interview transcripts. In addition, throughout the study I kept a research journal, taking notes whenever I came across literature, a presentation, or documentation which I deemed relevant to my research process. Toward the conclusion of the study, I also conducted a follow-up network survey to gain a better understanding of the knowledge networks in ICT-enabled innovation projects in terms of relevant actors and task interdependence structures. I asked all interviewees to whom they give information and from whom they receive information relating to their project, letting them choose from a list of names which had arisen during the interviews, in addition to all the interviewees from each project. Furthermore, they had the possibility to add names that I had not listed. I entered the resulting matrices of communication links into UCINET (Borgatti et al. 2002) and visualized them with NetDraw (Borgatti 2002). The response rate was 93%.

3.2. Sampling strategy

The sample for this study consists of four cases. I selected the sample through theory-driven, progressive sampling; i.e. I chose the cases sequentially based on theoretical rather than statistical considerations [39]. The cases needed to be comparable, which is why I applied a literal replication strategy [36] for the sites, selecting them based on the same relevant characteristics over time. The sampling parameters were (1) state-level government agencies in economically advanced settings with comparable jurisdictions, and (2) a clearly identifiable ICT-enabled innovation project. However, I also used a theoretical replication strategy [36] by (1) selecting cases in two different countries, Switzerland and the United States of America, assuming an influence of the cultural context on knowledge sharing processes; and (2) by selecting cases in different stages of their project, in order to gain a better understanding of the processes. For the informants, I employed a reputational selection strategy, i.e. the instances were chosen on the recommendation of

an "expert" or "key informant" [40]. An overview of the cases is given in table 1.

3.3. Data analysis

The data interpretation process was carried out simultaneously with the data collection and a review of relevant literatures. This iterative process, of which the causal model presented in above was an intermediate result, is a distinct feature of the grounded theory approach [37], and it continued until the completion of the project.

Table 1. Case overview

Project	Revenue* (employees)	Project objectives	Project initiation	Description of project group
1	$3.83 billion (32,800)	• Life events portal • Integration of IT infrastructure • Incorporation of existing projects	State government appointed the state secretary to explore the situation of ICT adoption in the state and draft a project proposal	Project manager, many loosely connected project members *Affiliation*: State chancellery
2	$10.17 billion (141,300)	• Life events portal • Intranet • Optimization of internal processes • Implementation of partial projects	State government hired consultant to assess the potential of ICT project as part of the ongoing government reform	Project manager, core team of four *Affiliation*: State chancellery
3	$32.01 billion (327,000)	• Intentions-based portal • Common IT infrastructure • Implementation of partial projects	Governor appointed a public-private task force to develop a strategic plan and implementation roadmap	Project manager, core team of five *Affiliation*: State IT department
4	$36.62 billion (305,500)	• Coordination of applications, infrastructure, and policy	Legislature appointed a board to explore and coordinate ICT initiatives, resulting in a roadmap and a strategic plan	Various project managers, members of project group loosely connected *Affiliation*: State IT department

*2001

The general work process of grounded theory revolves around the elements of data collection, analysis, and theory formulation. My analysis involved three data coding processes, which partially overlapped: open, axial, and selective coding. During *open coding*, where data is broken open to identify relevant categories, I examined the interview transcripts line by line [41], resulting in an initial list of 160 codes. During the process of discovering categories, I assigned and specified properties for each category. The purpose of *axial coding* is to reassemble data that were fractured during open coding. The categories that emerged during axial coding were (1) decision-making processes in ICT-enabled innovation projects, (2) modes of knowledge sharing, (3) influencing factors of knowledge sharing, and (4) coordination mechanisms of knowledge. Finally, *selective coding* is the process of integrating and refining the derived theory derived [42]. Categories retrieved during open and axial coding are systematically integrated to form a larger scheme, which constitutes the form of theory. I developed four core categories along two task dimensions: (1) conception and implementation of ICT-enabled innovation projects, and (2) exploration and exploitation of knowledge.

4. Findings

Three coordination mechanisms for knowledge sharing were found to exist concurrently in the four cases; hierarchy, social networks, and group dynamics. As would be intuitive to assume, hierarchical reporting structures, and especially power and authority, had a strong influence on knowledge sharing in the observed projects. However, the effects of social network relationships emerged as being extremely powerful, oftentimes overruling the given hierarchical structures. As could be expected, group dynamics had a lesser effect on cross-agency knowledge sharing, but they significantly shaped the advancement of the projects' processes. In this paper, only hierarchy and social networks are examined.

4.1. Hierarchy

As discussed above, whereas the traditional understanding of hierarchies is that decisions are made top-down and reporting is made bottom-up, ICT-enabled innovation projects require collaborative structures of decision-making, both within and across agencies. This tension between existing and required communication structures was a predominant topic for all projects in this study. For example, the web master of project 3 explained the difficulties of communicating bottom-up with respect to suggestions for improvement:

"A lot of it is because we're working with people who have a job, they have a boss, their boss ultimately is the commissioner of their agency, whose concerns are their goals and objectives, mandates from the legislature or from the governor's office, and for the webmaster down here at the bottom of the pile to say, 'Hey, we should do this', just either never makes it to the top, or is just not a priority at the top."

On the other hand, individuals across cases stated the importance of referring to rules as a tool for reinforcing the adherence of agencies to the project, therefore availing themselves of the hierarchical power structure:

"There are agencies that said, 'Look, gee, we've invested in our own marketing, we don't want to confuse it with yours.' In those cases we had to be a little more strong in our communication and our sales pitch and say, 'look, we've already decided at the highest level of government, this is an enterprise-wide initiative, you need to put aside your desire to market your own agency and join the team.'"

In even stronger terms, a member of project 2 claimed that turning rules into regulations was "the only possibility to achieve something in government", which is why they elaborated a link policy that subsequently was submitted to parliament for ratification, thus obliging all agencies to adopt the policy. This claim was only partially confirmed by a member of project 3, who stated that agencies can be "convinced" to participate in cross-agency collaborations, for example by leveraging budget pressure:

"So when there's no money and you say, 'You can't afford to do that, unless you use the shared service that we're putting in, and if you follow our rules', well then they follow the rules so they can get the money, but not because - because the basic nature of things is still they get an edict from the governor or from the legislature, and that establishes the priority for that agency, and those edicts have nothing to do with cooperating with other agencies."

Overall, the most effective mechanism for convincing agencies to participate and therefore to make a project successful was executive sponsorship, or "direction and commitment from the very top levels of government", as one senior member of project 3 stated:

"The problem that we find is that government is still organized the way government is organized, it's very hierarchical, so that if you don't get buy-in at the top level, where the agency heads are talking to each other and say, 'yes, our teams are going to work together and are going to share this application', it's not going to happen. It's just not going to happen. [But] when you have the governor or you have the [secretary of a department] at a cabinet meeting talk about, 'this secretary and this secretary need to work together to create this application', that's as important as the worker bee level is, because that gives the legitimacy to those worker bee people to work with each other."

In project 4, the project manager stated that "…executive sponsorship brings priorities and it brings resources". The governor holds agency directors accountable in a performance contract, creating a commitment on the part of the agencies to put a certain number of services online.

A major challenge for all projects proved to be the overcoming of existing 'stovepipes', or the inability to communicate across functional divisions and organizational boundaries. With the objective in mind to present a one-stop government to the citizens, the project members found themselves in a position where they attempted to bridge the gaps that exist between current online transactions, which mainly followed the traditional agency-by-agency approach. An individual from strategic planning in project 3 explained this challenge by saying:

"I think that one of the challenges with [ICT-enabled innovation] from the very beginning […] is that there are no mechanisms, there are no organizational structures that foster cross-agency collaboration and integration. Budgets are agency-specific, line-item specific, and statutes and regulations are agency-specific. There are statutes and regulations that actually prohibit data sharing across agencies, probably for a lot of good reasons but sometimes for not-very-good reasons, just because of territoriality. […] So that's the constant struggle, just how to get that horizontal view when everything is pointing to a very vertical view."

The communications officer in project 2 put personal effort into bridging the boundaries between agencies by creating "internal information structures", convincing the government that each department appoint an information delegate, and arranging regular meetings with them. However, individuals in all four projects stated that the integration of agencies across government runs against the interest of many agencies, who "actively try to keep their own system running and fend everything that might challenge their hierarchy and their right to exist", as expressed by one member of project 2. This "entrenched interest in keeping the bureaucracy the way it is" was one of the reasons in project 3 to centrally coordinate the project:

"[…] Because the agencies were part of the problem - they were all providing their own narrow little piece of information, and it wasn't being tied together. […] In order to achieve the goal of an intentions-based website, one face of government, it's not going to be done in a decentralized fashion. Basically, [the portal] is one big centralization effort, even though we like to talk about decentralized content management."

The approach of "centralized decentralization" of ICT-enabled innovation projects, denoting that initiatives are generated in a decentralized fashion (i.e. in the agencies), but coordinated centrally, is (or was) generally followed by all four projects. In the case of project 4, the most advanced project, the central coordination was relaxed somewhat, delegating the responsibility for the applications to the agencies themselves. Each agency is now responsible for the development and deployment of online services, having the legislative authority to deliver those services and collect the necessary data.

4.2. Social networks

As anticipated earlier, social network relationships emerged as being extremely powerful, oftentimes overruling the given hierarchical structures. In all four projects, individuals relied on informal networks within and across agencies on a daily basis. As an individual explained to me in project 3, retrieving information through informal channels is considered normal practice in government:

"The first thing you do when you're looking for something is get on the phone and start calling around. […] It's just a matter of, once you got the right person, to

get them to give you this information you're looking for. From that perspective, having built personal rapport really goes a long way, if they know you they're more likely to help you, […] if you have personal relationships established, you're more likely to get results…."

From a process view, ICT-enabled innovation projects can be divided into two major phases; conception and implementation of a project. These phases are reflected in the social networks of the projects. Before attempting to justify this claim, it is useful to recall that the four projects find themselves in different stages of implementation; project 1 currently being in a conceptual phase, projects 2 and 3 having recently entered the implementation phase, and project 4, having implemented a large part of the applications envisioned in the strategic plan. Many social networks came into existence during the conceptual phase of the projects, where people from different agencies and interest groups came together to jointly consider the organization-wide introduction of Internet-related technologies. For example, a channel manager from project 3 stated:

"From that whole process of those access channel workgroups, I got to know more people, and became more familiar with their content, information on their sites and things like that. So now that the workgroup period is completed, […] I talk to and follow up with people, and kind of check in with them, take requests, follow up on requests."

The project director of project 2, who was hired from the private sector to manage the project, stated that he socialized with representatives from the agencies through the (centrally coordinated) conception of their partial projects. The deputy director of project 2 explained how the launch of the Intranet was conceived as a way of casting a net of contacts across agencies, encouraging people to share their needs and give their input. As recounted above, she also explicitly promoted the creation of networks by introducing a monthly networking event for managers of partial projects. Similar stories can be told about the other projects, with the common denominator that most of the individuals involved were surprised by how conceptual meetings brought together so many like-minded people for the first time. Fundamentally then, there were weak ties as well as large, sparse networks in the conceptual phase. In the implementation phase, the knowledge networks of the observed projects gained in density, indicating stronger ties. Team members have established most of their contacts and use them for "getting the work done". Contrarily to the conceptual phase, this development can be recognized in project 2 and project 3, but becomes clearly visible in project 4, the most advanced project.

5. A model of knowledge sharing in ICT-enabled innovation projects

In the previous section, I have analyzed the coordination mechanisms of knowledge in four ICT-enabled innovation projects. I have shown how these projects differ in their stage of advancement, in the functional subdivisions of their actors, and in their organizational form; and how these factors affect the way knowledge is shared in the projects. In this section, I reassemble the salient features of the work processes that emerged during the analysis and distill them into core categories . Two main dimensions in terms of tasks emerged in achieving the project objectives, each of them subdivided into two phases: (1) Conception and implementation, and (2) Exploration and exploitation. I present the developed theory by means of four propositions, and conclude the section with a discussion of the theory.

5.1. Task dimension I: Conception and implementation

Throughout this paper, I have asserted that ICT-enabled innovation projects may be subdivided into two major phases; conception and implementation. At first glance, this finding appears to be trivial, as the very nature of any project requires that the project be conceived first, and implemented subsequently. What makes this pronouncement relevant is the fact that these two phases necessitate certain characteristics of tasks.

Borrowing the concept of decomposability from Herbert Simon [43], I propose that the conception and implementation phases move along a continuum of task decomposability. The concept of decomposability represents the extent to which large tasks can be decomposed into smaller, specialized tasks. With regard to the two phases of ICT-enabled innovation projects, the degree of decomposability is low during the conception phase, requiring the collaboration of different agencies and stakeholders; and it is high in the implementation phase, once the necessary tasks have been defined.

Proposition 1. The conception and implementation phases of ICT-enabled innovation projects move along a continuum of task decomposability, where the decomposability is low during conception and high during implementation.

5.2. Task dimension II: Exploration and exploitation

The second dimension emerged in the course of my analysis of knowledge sharing activities. It describes the variation in the content of knowledge sharing activities, moving from discovery to retrieval of knowledge. In other

words, the first phase is dedicated to the exploration of knowledge, while the second phase involves the exploitation of knowledge. This dichotomy was originally coined by Schumpeter as exploration of new possibilities and exploitation of old certainties [44], and presented to the organizational learning community by James March in a famous *Organization Science* article [45]. According to March, "Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution," [45].

Returning to the second task dimension, the two phases demand certain types of organization: while there is greater reliance on networks during the exploration phase, a hierarchical structure is more efficient in the exploitation phase. From a governance perspective, this is equivalent to asserting that collaboration among actors in a network prevails during the exploration phase, and the coordination and control of actors is more important during the exploitation phase.

In an analogy to the first dimension, I propose that exploration and exploitation also move along a continuum, in this case given by the configuration of ties in the informal network. The network is sparse in the exploration phase and dense in the exploitation phase, corresponding to weak ties during exploration and strong ties during exploitation.

Proposition 2. The exploration and exploitation phases of knowledge move along a continuum of network configuration, where the network is sparse during exploration and dense during exploitation.

5.3. Assembling the parts: A model of knowledge sharing

It is intuitive to assume that the two task dimensions occur concurrently, and that they influence each other in some way. Before I draw a conclusion on this assertion, a few remarks need to be made regarding the characteristics of the proposed dimensions. The first task dimension, conception and implementation, builds on subsequent phases, therefore carrying a temporal connotation. Similarly, the phases of the second task dimension, exploration and exploitation, might succeed each other temporally, but their main characteristic is that they are content-related. As March [45] affirmed, a combination of exploration and exploitation must be present at all times. Therefore, it can be asserted that the two task dimensions are interrelated. The implementation of ICT-enabled innovation projects requires a balanced mix of exploration and exploitation, where exploration is more important in the conceptual phase, and exploitation becomes more fruitful in the implementation phase.

Proposition 3. In ICT-enabled innovation projects, task dimension I (conception and implementation) and task dimension II (exploration and exploitation) are interrelated, where exploration is primarily associated with the conceptual phase, and exploitation is mainly linked to the implementation phase.

Since the two task dimensions discussed above are interrelated, it makes sense to arrange them in a two-by-two matrix. Figure 1 depicts the matrix, summarizing the model developed in this section.

With regard to the types of organization, I have shown that ICT-enabled innovation projects rely on sparse networks during the conceptual phase of the project, and tend to employ teams or tightly-bounded groups when the project moves towards implementation.

Proposition 4. In a lifecycle view of an ICT-enabled innovation project, the project's advancement is driven by effective knowledge sharing, moving from exploration in a sparse network during the conceptual phase to exploitation in one or more dense groups in the implementation phase.

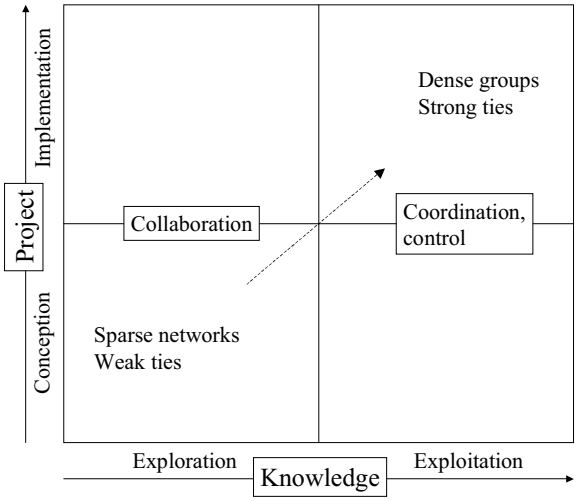

Figure 1. Task dimensions in ICT-enabled innovation projects

6. Discussion

The presented model shows that the implementation of ICT-enabled innovation projects requires a balanced mix of exploration and exploitation, where exploration is more important in the conceptual phase, and exploitation becomes more fruitful in the implementation phase. From a governance perspective, collaboration among actors in a network prevails during the exploration phase; and the coordination and control of actors is more important during the exploitation phase. With regard to the types of organization, I have shown that ICT-enabled innovation projects rely on sparse networks during the conceptual phase of the project, and tend to employ teams or tightly-bound groups when the project moves towards implementation.

Some caveats to this theory can be described by means of the matrix representation. Two of the quadrants, conception/exploitation to the upper right and implementation/exploration to the lower left are less immediate than the other two, as they appear as 'side products' of the general flow of the model. Furthermore, with the present results it is difficult to demonstrate that apart from the general flow there exists a feedback loop, leading from the exploitation of knowledge in one partial project to the exploration of new possibilities. This feedback loop would need to be studied in a longitudinal analysis.

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