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Contextual Issues in the Diffusion of Innovation: The Interaction of Social Networks and Organizational Knowledge

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Abstract

This paper discusses the linkages between Social Network Theory (Granovetter 1973) and Organizational Knowledge Theory (Polanyi 1966, Nonaka 1994; Nonaka, Toyama and Byosiere 2001) as it relates to diffusion of organizational innovation within large organizations. The focus is on examining these theoretical interrelationships in three case studies delving into major change projects in three large telecommunications firms. Findings indicate that weak ties are vital when the focus is on explicit knowledge while strong ties are vital when the focus is on tacit knowledge. Further, a model is posed to expand this theoretical interrelationship to include a third dimension: knowledge source.

Keywords

Innovation – Knowledge – Network – qualitative – case studies

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1. INTRODUCTION

Knowledge is power. This phrase is often heard in organizations today, and it is the main reason for not sharing knowledge. Thus, a crucial question for not sharing this knowledge would seem to be: "Is the knowledge equation a zero-sum game or can the sharing of knowledge result in mutual benefits for both individuals and organizations?"

The process of intra-organizational diffusion of innovation has been investigated from various research perspectives : Technology and Innovation Management (TIM), R&D, Strategy, Marketing, Organizational Behavior and Sociology. Each one of these approaches explains the process of innovation diffusion in reference to how it is embedded in discipline-specific frameworks. Several authors have recently drawn attention to the importance of studying diffusion phenomena in the fields of organizational learning (Koenig, 1994), organizational knowledge (Nonaka and Takeuchi, 1995), strategy (Mintzberg, Ahlstrand and Lampel, 1999), and innovation (Rogers, 1995; Van de Ven and Poole, 1995; Leonard-Barton, 1988).

The purpose of this paper is to bridge two major theoretical approaches pertaining to the diffusion of innovation and to demonstrate cross-fertilization of these theories to mutual benefit in applied organizational settings. The two theoretical approaches considered in this paper investigating the diffusion of organizational innovation are the social network theory (Granovetter, 1973) and the organizational knowledge creation theory (Nonaka and Takeuchi, 1995).

The importance of the diffusion of organizational innovation will be investigated by focusing on the interrelationship of these two theoretical approaches in analyzing major change projects within three large telecommunication companies, the first a large telephone operating system (TelOper), the second a manufacturer of telephone systems (TelManu), and the third a large telecommunications innovation company (TelTech).

2. THEORETICAL FRAMEWORK

2.1 Organizational Knowledge Creation Theory

The theoretical foundation in this area lies in the various organizational knowledge theories that identify and recognize two major types of knowledge: explicit and tacit (Polanyi, 1966). Explicit knowledge refers to knowledge that can be translated into

formal, systematic language. It is knowledge that can be written, documented and widely distributed. Tacit knowledge is considered to be that which you know, but have difficulty explaining. It is often called "hidden knowledge," because it is difficult to explicate, such as explaining to someone how to ride a bicycle. Tacit knowledge has a personalized quality that makes it hard to formalize, therefore, it is deeply rooted in action and commitment in a very specific context. Several theories of organizational knowledge build on the interaction between tacit and explicit knowledge that occurs at the individual, the group, the organization and the inter-organization level.

Four knowledge conversion modes are identified which describe how tacit knowledge is converted, or transferred, into explicit knowledge and vice versa, as well as how each of these two types of knowledge generate more of the same kind of knowledge. These four conversion modes are: socialization (tacit-to-tacit knowledge conversion), externalization (tacit-to-explicit knowledge conversion), internalization (explicit-to-tacit knowledge conversion) and combination (explicit-to-explicit knowledge conversion) (Nonaka, 1994; Nonaka, Toyama and Byosiere, 2001). The argument is made that innovation is largely based upon the continuous dynamic exchange between tacit and explicit knowledge (Nonaka and Takeuchi, 1995).

2.2 Social Network Theory

Social network theory posits that individuals have both small but strong social networks of friends and family with very strong ties as well as larger, more dispersed networks of acquaintances with much weaker ties. Granovetter (1973, 1983), in his study of how people find jobs, initially theorized the different types of ties. On the basis of the cohesion model (friendship), this theory identifies groups of individuals who are interconnected by strong, often bilateral, ties, and analyzes each group as a collective actor called a clique.

As such, social networks comprise a structure of individuals or organizations (nodes) which are linked together through various social relationships varying in strength and familiarity. The size and shape of a social network has implications regarding the trust and access to information for members of that network. Small, tight networks with many

strong ties and redundancies tend to have a high degree of trust and excellent access to information within the network. This enables individuals within the network to act very quickly, calling on individuals with whom they have strong ties. In addition, strong ties are very important in order to transfer complex information or tacit knowledge (Hansen 1999). However, to the extent that individuals are in a relatively closed network characterized primarily by many strong ties and few weak ties, what Simmel (1950) refers to as gemeindschaft, there may exist an absence of outside influence more common with weak ties that inhibits knowledge from the outside disseminating into the network leading to a "distinct weakness in strong ties" (Simmel 1950, p.242). On the other hand, more open networks tend to have many more weak ties, and as such, are more likely to be receptive to new ideas as well as to be linked to a wider variety of other networks (Burt, 1992, 2000; Granovetter 1983; Hill and Dunbar 2003). It is precisely this openness that allows for much more bridging to other networks, and hence, the dissemination of new information to come into the network from other groups (Granovetter 1983). Thus, in Granovetter's (1983) terms, if one is currently unemployed, they would first seek out their strong ties, as immediate action is needed to find employment, and they would seek those they trust and can count on. However, if unemployment is not eminent, or if an individual has some time to find a better job, they may tend to seek out weak ties in order to access a wider variety of contacts and information.

According to Granovetter (1973, 1983), the strength of ties between people plays a dominant role in the diffusion of new knowledge. He presents the weak ties as bridging links to connect a small clique of intimate friends with other, distant cliques. Whereas cliques run the risk of working behind closed doors and are often not very effective when it comes to obtaining new information, links between more distant individuals (the weak ties) are more apt to obtain new information. Unique in Granovetter's theory is the fact that "weak" ties, although, characterized by little intimacy, little emotional intensity and small commitment of time are not seen as being negative, stating the importance of weak ties and strong ties, because the role and attitude of individual people who are part of social network characterized by weak ties is different from the role and attitude of the same individual person in a strong ties network (White and Houseman, 2002). Even if weak ties are not a frequent path for the information flow, the information they convey is

crucial for individuals and for the system (Rogers, 1995). On the one hand, the weak ties play an essential role in conveying new information (between-group information) while on the other the strong ties play a fundamental role in the transmission of interpersonal influences within the cliques (within group information).

2.3 Social relationships and knowledge in diffusion of organization innovations

The nature of the social relationships that exist among the actors in the process of innovation is considered to have a strong impact on the effectiveness and the efficiency of the diffusion. Research on social networks suggests major differences in the diffusion of innovation between strong and weak social networks. Granovetter (1973, 1983) distinguishes between strong and weak ties in social networks suggesting that strong ties result in more efficient diffusion of innovation.

Given the nature of social network theory and diffusion of information (knowledge) within an organization, several questions come to mind. Do these network relationships differ from organization to organization? Do network relationships share knowledge processes or vice versa? How does the relationship between network relationships and knowledge type affect the effectiveness of the diffusion of innovation process and consequently the competitive advantage of the firm, as would be suggested by Grant (1996)? Or is competitive advantage simply a facet of the uniqueness of certain interpersonal social networks and knowledge in a particular organization, as suggested by Barney (1986)? These questions can be answered only by examining the relationship between the strength of the social interpersonal network and the nature of the knowledge exchanged in the diffusion of organizational innovation.

Organizational innovation has been defined as the adoption of a behavior or an idea which is new to the firm or organization (Daft and Becker 1978; Damanpour 1991; Hage 1999; Wood 1998; Zammato and O'Connor 1992). Various studies have examined innovation from a number of perspectives, with the most common being innovations of new products, new technologies, new services, or new administrative processes. Many of these studies have focused upon measurement of innovation rates rather than case studies examining the innovation process in-depth, leading to more consistent yet perhaps more

superficial knowledge about the innovation process (Hage 1999), especially in terms of multiple cases studies that can lead to better theoretical development (Jones 2005). Alänge, Jacobsson and Jarnehammar (1998) note that it is useful to distinguish between technical innovations, more closely associated with product development and new technologies and characterized by hardware-embodied innovation; and organizational innovations, which tend to be characterized by person-embodied knowledge or human factors. In this context, organizational innovations would tend to be more tacit, context dependent, take more time and have less "market value" in a traditional sense (Alänge, et al. 1998; Teece 1980).

Two reviews of the literature have examined organizational innovation in-depth. Damanpour (1991) looked at 23 studies and found that both organic structure and pro-change strategies were key determinants in organizational innovation. Zammuto and O'Connor specifically focused upon flexible manufacturing adoption, and they also found the above two determinants impacting innovation acceptance. They additionally found that job complexity, particularly increased complexity at low levels of the organization, positively impacted both flexibility and innovation adoption. In support of these results, Vas and Ingham (2003) also found that organizational innovation was highly dependent upon the context, process and content of the change.

Until now, the major focus in the research on knowledge has been primarily theoretical in nature. In addition, limited attention has been paid to the practical application of these theoretical propositions and the knowledge transfer of the case studies has been cut short because of specific organizational context variables that were not easy transferable. One area that Hage (1999) notes that is most unexplored is the impact of a radical innovation in large scale technical systems, such as railroad, electrical or telephone systems. He further notes that there is a dearth of information on how radical innovation impacts institutional and societal change at the meso and macro levels. Since most studies examine innovation adoption rates, few look at the broader issue of how the overall innovation impacts the organization as a whole or how organizational policies in general foster innovation.

This study seeks to address both those issues, looking at three, indepth case studies in the telephone systems industry and using those studies to draw organization and industry conclusions. Specifically, we are focusing on how theoretical development and empirical research of knowledge in organizations can lead to real-life strategic initiatives and implementations in organizations. The research reported here is a case study which is both empirical and experiential in nature and serves as a testimonial to how three large European organizations coped with the duality of ever-increasing external environmental business changes with equally increased internal organizational flexibility. The common denominator in this balancing act was based on the identification of specific strengths of interpersonal networks and the nature of the knowledge residing in individuals, groups and departments throughout the organization in a historical, actual and prospective context.

3. RESEARCH METHOD

The purpose of this research is to explore the process of knowledge transfer during the diffusion of organizational innovation process. The nature of the research question (exploratory) and the objective (understanding a process) are investigated using in-depth qualitative methodology to generate theoretical propositions. We used a case study approach, particularly suitable for answering "how" and "why" questions (Yin, 1984). It also enabled us to use "controlled opportunism" to respond flexibly to new discoveries made while collecting new data (Eisenhardt, 1989).

By making this choice, we addressed the major challenge of ensuring that data collection and analysis met tests of construct validity, reliability, and internal and external validity by carefully considering Yin's (1984) tactics. We promoted *construct validity* by using multiple sources of evidence, as shown in “Data collection” in this section. *Reliability* was enhanced by : (1) Using a case-study protocol in which all firms and all informants were subjects to the same entry and exit procedures and (2) by creating similarly organized case data bases for each firm we studied. *External validity* was assured by the multiple-case research design itself, whereby all cases were firms from the same industry, as developed in “Research design” in this section. Finally, we addressed *internal validity* by using the pattern-matching data-analysis method .

We selected three case studies in the European telecommunications industry where we conducted three in-depth qualitative studies. The first study was conducted in the Installation and Maintenance department of a large telephone operating systems company which we shall call TelOper. The second study was conducted with a large telephone manufacturing systems firm which we shall call TelManu. Data were collected in two firms through interviews with 63 fields technicians in TelOper and 80 executives in TelManu. The third study was conducted within the R&D subsidiary of a large telecommunications holding company which we shall call TelTech. The purpose of interviewing was to gather anecdotes, personal experiences and opinions about the introduction of an organizational innovation in their workplace. As Glaser and Strauss suggest (1967), each case was fully analyzed and informants in each case study were chosen according to information needs. These three cases were selected for a number of reasons. First, the organizational innovations occurred in major telecommunications companies, thus examining innovations within one industry. Second, the time frame to implement the organizational innovation was similar, thus making comparability easier. Finally, the context of application of the organizational innovation occurred within middle management in all cases.

Data collection

In addition to observations and various documents which were procured, we conducted face-to-face interviews as essential sources of data. Multiple sources of evidence were used: semistructured interviews, observations, internal documents, and public sources of information. Our methodological approach took the grounded theory as a starting point (Glaser & Strauss, 1967; Strauss & Corbin, 1990), as well as the techniques of qualitative data analysis (Miles & Huberman, 1991). According to grounded theory tradition, a case study method approach was followed in order to explain the complex human dynamic process of knowledge sharing and diffusion of organizational innovation. The operational sites were visited on several occasions in order to observe the exchanges that took place between organizational actors.

Context of the three case studies : TelManu, TelOper and TelTech

Case 1: TelManu

The results reported are based on a four year strategic effort in a large multinational corporation which builds next generation networks and delivers integrated end-to-end voice and data communications solutions to carriers. The company employs over 100,000 people, has annual revenues of $25 billion, and operates in more than 130 countries.

The company invests more than $3 billion per year in research and development and adds more than 800 innovations to its patent portfolio each year. Worldwide, the research and development organization employs about 23,500 people. This corporate research center employs 9,000 engineers, scientists and support staff. The center is specialized in advanced research into network architecture, network access and software. More specifically, this research center plays a key role in developing the Internet product strategy, multimedia mobile communications, and optical access networks. Given these product and service specifications, one might be of the opinion that this organization is a new high tech company that grew exponentially the last two decades. That is simply not the case. Although growth has been enormous during the last 20 years at the same physical location, this corporate research center saw its first activity in 1882 and went through 120 years of transformation from manufacturing hardware through the development of software today.

Computers, and other hardware peripherals, were all introduced as unique products that allowed the manufacturers to bring the products to the market with substantial profit margins. Software developers oftentimes were just one step behind hardware designers, resulting in an initial profit division for the IT area of 80% for the hardware manufacturers and 20% for the software developers. The commodization of computers and hardware in the past decade changed this proportion to 20/80. Software developers were rendering services to many clients. Hardware manufacturers only realized much later that more money was to be made with IT service rendering than marking up profit on tangible goods. These macro-industry changes had a direct impact on the roles of many hardware engineers. From operations and manufacturing functions, many had to become sales and service oriented, not the stereotypical personality description of the engineer. At first, many engineers struggled, resulting in much wasted talent. Many were sent out to sell and render service to small, medium and large corporate customers.

The attrition rates among talented and knowledgeable engineers took on dramatic proportions. Yet in many instances engineers were clinging on because of specific perks directly resulting from changes in their roles from manufacturing to marketing.

In order to cope with this trend, many organizational change efforts were launched in this telecommunications company in order to shorten the response time to clients, diffuse knowledge more efficiently through the organization and reduce the loss of young talented engineers. In this study, we focus in detail on the after-sales engineering department of the company which employed about 80 engineers who rendered problem-solving solutions to corporate customers, both SME as well as large corporations.

The after-sales service department consisted of engineers who had developed or worked with the manufacturing PABX telephone systems of 4 to 4000 phone lines. When a client purchases a product, a PABX system is installed, typically hooking up the system to the clients PC. After installation there is a learning curve for the client as they learn how to use and adapt the system to their business. As a result, there tend to be 2 kinds of problems. The first is a design problem or a software problem. In this case, a client, such as a hotel, may want bills printed a certain way that is consistent with past records. If so, the engineers will have someone write a program to do this, and occasionally there may be a bug in the program or a misspelling that may take an iteration or two in order to work correctly. The second type of problem is a systems problem. This is a hardware problem with the actual system itself. Such a problem could be the result of a burned chip or a faulty connection in a circuit board.

In the case of the after-sales service department at TelManu, when a problem was first noted, the receptionist was “trained” to complete a service sheet by asking each client specific questions, such as “can you turn on your computer” or “is your printer plugged in.” The receptionist would only tick off the yes or no answers to specific questions on the service sheet, and did not write down any examples of the client problem or what was happening. In the evening, someone would look at all of the service sheets and assign either a design engineer or a service engineer to go to the client site to fix the problem. Response time, on average was about 2 weeks. In addition, there was a 50-50 chance that

a software engineer would be sent for a systems problem or that a systems engineer would be sent for a software problem, since the service sheet was not effective in determining the nature of the problem. As a result, when the service person would go out and the client would tell his story, two things happened with equal regularity. One, it would be a design problem, but the systems engineer couldn't fix a software problem so a design engineer had to be rebooked with an additional delay or two, or it was a systems problem and it could be fixed. The same thing would happen with design engineers and systems problems.

There were so many complaints about the length of service time that management determined something needed to be done. Currently, service representatives were completely decentralized; they would come to the office in the morning, get their order, and leave for the first client, then the second client and so on. Each after-sales service engineer had a company car to call on clients, but they still had their own cliques, having lunch together occasionally. In order to reduce the lead time to visit a client, management wanted to bring all of the after-sales service engineers together to spend time in the office a certain number of days in the weeks. As a result, it was proposed that an engineer might be out making calls two days a week and in the office three days a week. The service engineers were quite vocal and adamant that this option would not work. The company soon realized that many of the engineers thought they would lose their company car, and as a result, they were more than extremely hesitant to change the way things worked currently. It was not until the company guaranteed that no one would lose their company car that the reps themselves devised a solution to solve the problem. What they did was to have the company create two large rooms, each with a round table in the center of the room and outfitted with numerous speaker phones. One of the rooms was designed for clients with 40 to 400 lines and contained a number of PCs where software for these small clients could be replicated. The other room was designed for clients with over 400 lines. With the smaller systems, the engineers could recreate the software issues right in the room, and all of the engineers listened into the problem. If it was a specific system, they would try to replicate the exact problem to determine whether the problem was a software or systems problem. In addition, all of the engineers were available, so there was a great deal of brainstorming and information sharing. As a result, in most cases (>90%), engineers were able to solve the problem from the office. Most

were simple problems that did not require a sales call. The client was pleased with a quick fix, and the engineers were sharing their thoughts and ideas and learning from each other. They also were able to spend more time with more resources (people) to solve more complex problems (over 400 lines). Since it is impossible to replicate a problem with such a large system, engineers would listen to the client to try to determine whether or not it was a design or systems problem. However, since there were so many engineers freed up from making calls on the road, they were able to send both a systems and a design engineer to the client. The total change in response time went from over 2 weeks to 1 day. So in this case, engineers began with weak ties, and came together in the central office so that they could develop strong ties and exchange tacit knowledge.

The importance of the diffusion of innovation in this organization was very well recognized, primarily on in the product development section of the R&D department. The same process of diffusion of innovation proved to be a major challenge for the company on the marketing and customer service side of the equation. This indicates that the context in which the diffusion of innovation process is occurring may be a determining factor in the effectiveness of this process.

Case 2: TelOper

For more than 60 years, TelOper, Inc. operated in a stable monopolistic environment which protected it from any fundamental changes in its internal organization. In the middle of the 1990s, the explosion of technological innovations, the opening of markets to competition and the arrival of a new CEO marked the beginning of a drastic transformation. A vast program of structural and cultural change was implemented, coupled with a plan for early retirement and retraining which affected more than half of the staff. The change program has helped to transform a strongly introspective technology-oriented organization to a customer-oriented organization. To accompany this thorough transformation, a special center was created with the responsibility to coordinate various organizational change programs over several years. A centralized organizational change team suggested re-examining the "end to end" “Installation and Maintenance” process, by centralizing several core functions. The Work Force Management (WFM) project constitutes the continuation of a large organizational change project affecting TelOper’s “Installation and Maintenance” (I&M) department.

The research reported in this paper focuses on one specific change project named WFM (Work Force Management). We compared several documents, observations, and interviews of organizational actors representing various hierarchical levels. More specifically, given the top down decision-making process in TelOper Inc., we focused at first on analyzing internal and external documents as well as interviewing several top management teams (25 semi-structured interviews lasting an average of two hours). These top teams appeared to be key-informants in the entire change project.

Nine teams, totaling 63 technicians, were followed throughout the project in order to follow the change propagation process generated by the WFM project. The nine teams represent a homogeneous sample in term of age (average 45 years), professional experience (average of 20 years), and educational background. Prior to the WFM project, these 63 engineers were organized into nine groups, each group having diverse experiences and a breadth of knowledge among the individuals within each group. Each group worked extensively with their team members and developed very strong ties within the group, but there was little communication outside of the group with other engineers. After a number of months, the structure was decentralized, and regional groups were formed based on the geographic location where the technician lived. As a result, new groups were formed based on proximity to the technician's home, and territories were established with technicians serving clients within their territory.

Formerly, all technicians were in one office. Meeting up in the morning to get assignments and chat, each technician would go out and serve clients as needed and directed by the head office. The focus was on technical competency rather than customer relationship or customer problems. As a result, these technicians would go out and fix problems, but they would meet each other in the office, staying primarily in their little cliques (9 groups) which had very strong ties. These individuals within the groups relied upon each other to solve problems if they were stuck. If they went out into the field and had a problem, they would call up one of their "clique members" with whom they had a strong tie, and they would be able to solve the problem together.

The WFM project began in January 1999 and we followed it up in real time, by being a participating observer in the organization two days a week. We opted for a qualitative

approach because the change project required direct, in-depth contact with the actors involved and focused on current developments in a real-time context. In addition to merely describing the change process, we also wanted to understand the relationship between the phenomena studied and the context as well as to examine the exchange project in more theoretical terms.

The operation of "I&M" department was characterized by major decentralization. Previously, the firm operated with more than 70 local offices directed by a section leader. The section leader was in charge of local area management, responsible for the administrative and technical follow-up of each technician, setting up appointments with customers, dispatching work orders to technicians, and managing suppliers. The plan of the WFM project called for the new I&M department to become more centralized and resulted in 3 Integrated Assignment Centers (IAC) and 6 Integrated Dispatching Centers (IDC). The task of the IAC constituted documenting all technical situations, while the dispatching centers (IDC) would generate and sort work orders and dispatch them to the field via PC laptop connections.

This change caused increased tension for the actors involved on all organizational levels. The plan was to replace fax transmission to the local office section leaders by allocating a personal PC laptop to each field technician. The employees would be directly connected to a central server by mobile phone connection. The purpose of the system was to optimize work dispatching. The central server selected the most competent technicians who were nearest to the intervention site and sent them to carry out the job required. The system permitted an almost real-time follow-up of each field technician. In addition, since decentralization and movement to a PC based system did not require technicians come to the office, the result was that technicians were placed into geographic regions depending upon where they lived, thus breaking the cliques. During this change process, if a person would have a problem, rather than going to his colleagues in the same regional group, with whom he did not have strong ties, he would call one of his former group members. Based on the cell phone records of the company, there was a clear indication that technicians were relying upon the strong ties with their former colleagues to help them solve problems, either because they did not want to appear ignorant to their new

team member or because they may not have known which individual had the expertise they needed.

Now that these technicians were spread far and wide, if the technician wanted assistance or guidance, there were only a few people from which to choose in a region, with no guarantee that their skill set was what was needed for the job since regional assignment was based upon location rather than skill set. The findings of this project show the importance of social networks, not only for mere communication purposes but moreover as informal assistance resources. In order to investigate the nature of these interpersonal social networks we inquired to what extent technicians received assistance from colleagues in utilizing the new computer system. In addition, we also inquired to what extent the technicians provided assistance to other technicians. In each case, when the answer was affirmative, we inquired how many times and which specific individual was involved. Although the introduction of the WFM project accelerated and ensured the transfer of formal information, such as working orders, time sheets, technical information, the change also seems to have damaged the informal transfer of knowledge. Change de-materialized social meeting spaces and favored the creation of virtual sections. The local offices (real spaces), which symbolized the section's life, became empty. The laptop PC allowed one to start the working day at home and to end it at home. Calling on the office in the morning and meeting at mid-day in the canteen became inadvisable. These informal meetings were considered to be unprofitable and a waste of time, as indicated by the following quote.

" Communication with colleagues is finished. The offices are empty now."

We observed a general feeling of isolation among many field technicians. Change has abolished physical proximity between individuals and transformed social relations within groups. The inter-group relationships have also been affected. This particular change seems to foster mechanisms of competitiveness between the peers. The new system makes it possible, for example, to produce national statistics on field work and this in turn clearly puts sections in competition. Previously, the rivalry between sections was scarcely visible, in the absence of standardized, comparable data. The change generated by WFM has enabled better global organizational integration but also the destabilization

of local integration, source of knowledge transfer, and of powerful interpersonal channels of communication.

The PC laptop is, for field technicians, the tangible symbol of a major technical change that fundamentally transforms both intra- and inter-group social relations. Most of the pooled persons, whatever their section, regret the loss of human contact resulting from the implementation of the new system. People feel they have lost the human side of their job because they don't see their colleagues any more, or they are working alone. This dehumanization of their working conditions affects motivation and leads to a loss of the information which used to be exchanged during daily informal meetings, as the following quotes show.

> *"You don't see anybody any more and I feel that's a negative aspect. Before, when you met people, you discussed yesterday's problems. You had lunch at the same table, you spoke about specific problems in this or that field or about the teething problems of a new product. We used to share tips about many different things. Now we don't exchange any more. It's each man for himself." [P13] .*

> *"With the PC laptop and the car at home, you don't pass by the office and you don't see anybody any more. That a pity because you wouldn't believe how much information we exchanged in a quarter of an hour in the morning. In our job, you can sometimes look for hours for the cause of a breakdown. Before, when you fixed a breakdown, you shared the solution with others. That was how you acquired experience and hands-on knowledge of the job." [P15]*

Case 3: TelTech

TelTech is a world leader in the telecommunication sector, with presence in Europe, Africa and Latin America. As of 2006, TeleTech had 191.7 million customers. TelTech is one of the integrated operators with the largest percentage of its business outside its home market and a reference point in the Spanish and Portuguese speaking market. In Spain, the Group has over 80 years experience with over 16 million fixed lines and close to 4.5 million data and internet access customers and more than 20.6 million mobile customers.

The Meeting of Directors held in 2004 established as a main objective for the company to become the best and most integrated group of telecommunications activities in the world. In this same meeting, it was agreed that this would only be possible with a major transformation process, where innovation was deemed as one of the keys of the future competitiveness of the TelTech. The process of innovation in TelTech is based in the activities of the R&D center. This center works mainly for the business lines of TelTech, and its mission is to harness the competitiveness of the companies of the entire organization by means of technological innovation. Thus, the R&D center acts as motor of the technological innovation of the TelTech and as catalyst around which the most dynamic managerial activity in advanced telecommunications is developed.

Most of the activities of the R&D Center were presented in the denominated Innovation Plan. The plan indicated that it was fundamental that innovation activities should not be isolated within divisions of TelTech, nor reduced only to technological innovation. Innovation activities should include all the organizations in TelTech as well as commercial innovations and innovation of processes so that a culture of innovation could be promoted along with an improvement of commitment to innovation and competitiveness of the organization. As a result, it was imperative that the Innovation Plan overlap with the Strategic Plan, such that innovations would have corporate components as well as components linked to the business units. In order to implement this new strategy, TeleTech established a new Model of Technological Innovation in 2004, in which there was a search of greater integration of the different business lines. In this attempt, the company has created innovation teams across business units and under the initiative and coordination of the organization.

In this case study, our aim was to study how the R&D subsidiary organized the process of generating innovative projects; and in particular, how they promoted ideas throughout the organization, how they developed these innovations and how they materialized the ideas into specific projects. Our interest was focused on understanding the diffusion of these

innovations, mainly studying the relationship between the phenomena studied and the context.

Using a series of interviews with management, we found that TelTech organized the process of generation, development and materialization of ideas into specific projects by means of three sequential phases in time. First, a "mix of tools" was used to promote the basic generation of ideas. The ideas could come from any part of TelTech in what could be called a bottom-up design. Second, these ideas then underwent an initial phase of analysis that assessed different ideas in terms of their feasibility as business concepts that were related to the global strategy of TelTech and that were most likely to be successfully launched and implemented in reality. This process also required the development of a feedback loop from the tools in the first step in order to capture the dynamism of the most entrepreneurial areas of the sector. Finally, an evaluation process was developed to identify the best business concepts in order to initiate the final goal of execution and implementation by the business lines. This task of evaluation was complemented with the revision of the weakest concepts so that they could be improved for possible launch consideration in the future.

As all the ideas did not have the same process of development, the business concept generation process needed a set of tools which could be adapted to each tactical mission in particular. Thus, the information for the market came fundamentally from the investigation of the sources of data available: the information compiled by the sales force or client centers, data obtained via IT departments of customers or the state, and the use of the networks and the services. The technological information came from those who were more in contact with the leading-edge technologies, such as the industrial sector of telecommunications, universities and research centers, as well as from technical areas in the firm, such as the R&D Center. Thus, the information varied from more scientific-based, such as the ones from the agents in universities, to the more commercial information, such as that coming from hardware manufacturers.

In addition to the market and technological information forums were the study and standardization forums, in which the same agents participated in order to decide the progress of technology. Of a generally open nature, these forums allowed the groups to make decisions that unified the progress in the technological development.

Another forum was one which examined studies of competitive intelligence and analyzed the initiatives developed by other competitors in the same industry or by other companies in other industries that could have possible applications in the telecommunication area. In this case, a strong component of qualitative analysis was needed that was radically different from those previously mentioned above. The same happened with the application of prospective scenarios that provided information on the possible alternatives of evolution of technology and markets in the middle and long terms.

This multiplicity of idea generation activities and requisite tools, with existing weak ties among the agents undertaking these activities, required a strong overlap within TelTech in order to suitably manage and canalize the inevitable flow of ideas that arose in each area of activity. Therefore, the organization highlighted the importance of establishing and maintaining information channels that allowed the ideas to flow to those who were best able to put them into action. Possible contributors needed to emphasize the explicit nature of their knowledge in order to be able to communicate their initiatives in the information channels established by TelTech.

Thus, the innovation model was completed with the definition of a philosophy that unified the innovation strategy and served as a reference point at the time of generating ideas, creating business models and materializing specific projects. As a result, this case illustrates the effectiveness of the weak ties-explicit knowledge linkage. Weak ties existed as a result of the multiplicity of both generators of ideas and tools, widely dispersed and distributed using market analysis, technology analysis, study and standardization forums, competitive intelligence and prospective scenarios. Contributors were required to emphasize the explicit nature of this knowledge to more readily communicate their information to those who would be able to move from the idea stage to action. The effectiveness of this process was clearly reflected in the creation of a broad portfolio of innovative initiatives generated through numerous projects developed at the national and international levels necessary to maintain competitiveness and leadership in the telecommunications sector.

4. FIRST RESULTS

Table 1 summarizes the results of the three case studies. The first study is an in-depth qualitative analysis of how an after-sales engineering service organization of a

telecommunications manufacturer is transformed by rendering more optimal services to small, medium and large commercial customers. The changes in the configuration of the social network, moving from decentralized weak ties to centralized strong ties suggests that innovation diffusion depends on the type of knowledge. In the weak ties decentralized social network configuration, the diffusion of innovation was the most effective for explicit knowledge. After the change to the centralized strong ties configuration, the diffusion of innovation was most effective for tacit knowledge diffusion. The resulting effectiveness of the diffusion process was clearly indicated in the response time reduction from two weeks to one day.

The second study, conducted in a national telephone operator, a strong ties centralized technician's organization was dispersed to cover specific geographical areas over a period of time. This resulted in a reduction of direct social contact and exchange.
It was found that the diffusion of innovation in the existing strong ties centralized social network was largely based on the transfer of tacit knowledge. Once the technicians were dispersed, the strong ties social network slowly dissolved resulting in a weak ties social

Table 1: Summary of the three case studies

Concepts	Telanu	Teloper	TeleTech
Change Process	Centralized process	Decentralized process	Centralized process
Organizational Innovation	After sales organization	Automatized work orders dispatching	Integrated process of technological innovation
Nature of social networks	Weak ties in team	Strong ties in team	Weak ties in team
Knowledge transfer	Technical information	Field expertise skills	Market and technology information, study and standardization forums, competitive intelligence and prospective scenarios.
Nature of	Explicit knowledge	Tacit knowledge	Explicit knowledge

knowledge			
Sources of information	Competence (expert)	Benevolence (friendship)	Competence (expert)

network. Although a vast reduction of tacit knowledge diffusion in innovation took place, at the same time a gradual spread in diffusion of innovation of explicit knowledge manifested itself via access to the PC and additional documentation. In this case, the effectiveness of the diffusion process is less obvious. Here we see a "dehumanization" on a social level, with actors far less happy and continuing their strong tie relationships despite the new innovation. Only after time, when the explicit knowledge manuals had been developed did knowledge diffuse within the organization. This dichotomy is similar to that noted by Ostroff and Schmitt (1993) where they distinguished between an effective organization with a positive internal, person-oriented environment and an efficient organization with an external, controlled environment.

The third case, conducted in the research subsidiary of a telecommunications organization, shows that the weak ties that existed among various functions and areas were most effective in transferring explicit knowledge from these divergent areas to be translated into the processes of idea generation, business model development and project implementation. The effectiveness of the Innovation Plan which developed this process was indicated here primarily by manager self-reports of the ability to generate more new products to market in a shorter period of time with more data driven evidence to support both development and implementation.

Through these three case studies, we identified the linkage of strong and weak ties in social network theory with the theory of organizational knowledge creation in assessing the effectiveness of the process of innovation diffusion. Our analysis yields two exploratory propositions expressing the relationship between social networks and organizational knowledge transfer:

> Proposition 1: *With strong ties among the actors involved, the process of innovation diffusion will be more effective when tacit knowledge is utilized.*

In an organization in which the social relationship between actors responsible for the diffusion of innovation are characterized as close, deep, trustful, friendly and social, the diffusion process will benefit when the exchange is tacit knowledge based. This may relate to the fact that interaction and communication is primarily based upon verbal and non-verbal face to face communication rather than the exchange of written documents and contracts. The second proposition we make states:

> Proposition 2: *With weak ties among the actors involved, the process of innovation diffusion will be more effective when explicit knowledge is utilized.*

This means that the process of diffusion of innovation in an organizational setting in which the social relationship among the individuals responsible for the diffusion is distant, professional, on the surface that the process of diffusion of innovation will benefit when the exchange between the individuals is explicit knowledge based. The interaction and communication between the actors is based on exchanging tangible clearly written documents rather than colloquial social conversations.

In investigating the relationship between the strength of the personal network and the nature of the knowledge it is important to point out that the context in which the diffusion of innovation takes place is a determining factor in the effectiveness of the diffusion process.

Discussion

The results of both studies led us to conclude that the effectiveness in the diffusion of organizational innovation is determined by the interaction of the nature of the social network and the knowledge type. This interaction indicates that it is not a zero sum game, but is more complex and requires a dynamic balancing act between the nature of the social network and the knowledge type. Hence, the purpose of this paper is to bridge two of the major approaches pertaining to the diffusion of organizational innovation and to demonstrate cross-fertilization of the theories to the mutual benefit in applied organizational setting. Figure 1 summarizes the propositions of our research.

Figure 1: Effectiveness in the Diffusion of Innovation (Strength Social Network and Nature of Knowledge)

	TACIT KNOWLEDGE	EXPLICIT KNOWLEDGE
STRONG TIES	*HIGHLY EFFECTIVE*	LOW EFFECTIVENESS
WEAK TIES	LOW EFFECTIVENESS	*HIGHLY EFFECTIVE*

The nature of the social relationships that exist among the actors in the process of organizational innovation is considered to have a strong impact on the effectiveness and the efficiency of the diffusion. Research on social networks suggests major differences in the diffusion of innovation between strong and weak social networks. Granovetter (1973, 1983) distinguishes strong and weak ties in social networks suggesting that strong ties result in more efficient diffusion of innovation. Empirical research further suggests that strong informal networks between the actors are some of the most effective channels for diffusion of innovation within an organization. Yet we see here that the type of organizational network chosen for knowledge diffusion is highly dependent upon the type of knowledge to be diffused.

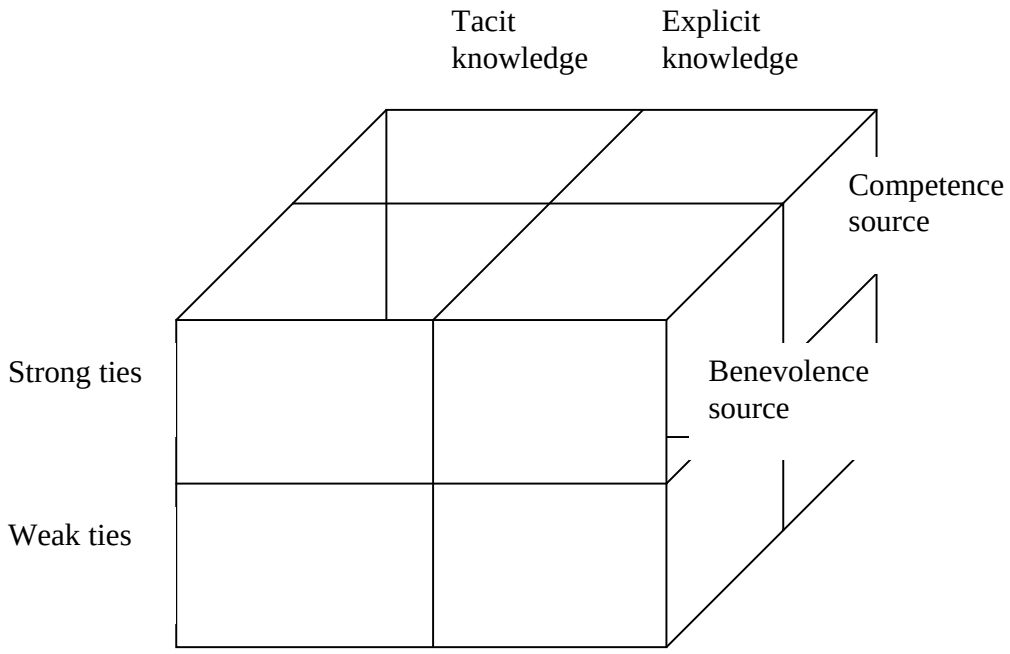
Further, we propose examining the extent to which the source of tacit knowledge impacts the nature of the diffusion, and the extent to which strong or weak ties are used (Levin, Cross and Abrams, 2002; Mayer, Davis and Schoolman, 1995). We would propose that when the source of information comes from someone whom you trust, that additional knowledge would be sought using relationships based upon strong ties. However, those individuals may not always have the exact information that you need. For example, if you need to have a cardiac bypass operation, your strong ties with friends, family and coworkers may not include a relationship with someone who is a cardiologist. However, you may seek names of contacts outside of your network (weak ties), from those inside your network, in order to get information from someone who is well-respected in the field. Thus, it seems likely that if information comes from an expert, or competence-

based source, that weak ties would be involved in seeking that additional knowledge if the expertise is not widely available among your strong tie relationships. As a result, we would propose the following model, and further, propose examining the effectiveness of diffusion of organizational knowledge in all of the cells within the model (see Figure 2). On the other hand, if you are looking for an introduction to a sporting event or party, a benevolence-based source (good friend or family) and the corresponding strong ties associated with that source may be a better option.

Conclusion and Directions for Future Research

The research presented in this paper sheds light on the importance of the relationship between the nature of the knowledge exchanged and the strength of the relationship among the actors in the process of diffusion of innovation. On the basis of the three in depth cases we showed that it is important to consider this relationship with respect to the effectiveness of the diffusion of organizational innovation. Although quite different, all cases led us to draw the following main conclusion, that in strategic decision making processes, the strength of the social relationship between individuals determines the specificity of the transfer of knowledge and information. Furthermore, whether the organizational change is either a decentralization of activities or a centralization effort,

Figure 2: Source-Network-Knowledge model



the strength of the social network and the nature of the knowledge is overriding. With regard to practical implications we oftentimes observe structural organizational change that does not reveal the expected results. The question is whether this can be explained by the fact that mere structural change not only largely neglects the nature of the information to be shared but also the strength of the personal social network involved. We view this differently from the classic culture-structure dichotomy, since we believe that the explanatory factors pertaining to personal social network are more deeply rooted than the overall organizational culture. Although we assume that the causal relationship is initiated by the strength of the social network rather than the content of the information or knowledge, one of the limitations of this approach is the fact that this relationship is not exclusive.

The majority of empirical research conducted on the issues of organizational knowledge is based upon US and Japanese organizations. Very few efforts have taken place in a Pan-European context. As such we feel that our research is complementary, enriching and adds to the theoretical and empirical contributions published earlier about US and Japanese organizations. In addition, we contribute to the difficult translation of knowledge into practical implications for strategic intentions of an organization. In the future, research in this area should address measurement issues in the effectiveness and

efficiency of the diffusion of organizational innovation, specifically looking at differences in diffusion between process and product innovation. Further, additional studies are warranted in the examination of contextual and cross-cultural determinants of the diffusion process. Finally, a future question to be answered is how diffusion in organizational innovation impacts the various components of competitive advantage.

References

Alänge, S., Jacobsson S. and Jarnehammar, A (1998). Some aspects of an analytical framework for studying the diffusion of organizational innovations. *Technology Analysis & Strategic Management*, 10 (1), 3-21.

Barney, J. (1986). Organizational culture: Can it be a source of sustained competitive advantage? *Academy of Management Review*, 11 (3), 656-665.

Burt, R.S. (1992). *Structural holes*. Cambridge, MA: Harvard University Press.

Burt, R.S. (2000). The network structure of social capital. *Research in Organizational Behavior*, 22, 345-423.

Daft, R. and Becker, S. (1978). *Innovation in organizations: innovation adoption in school organizations.* New York: Elsevier.

Damanpour, F. (1991). Organizational innovation: a meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, 34, 555-590.

Eisenhardt, K. (1989): "Building theories from case study research", *Academy of Management Review*, vol. 14, 4, 532-550.

Glaser, B.G. & Strauss A.L., (1967). *The Discovery of Grounded Theory : Strategies for Qualitative Research*, New York : Aldine de Guyter.

Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, 78, 1360-1380.

Granovetter, M. (1983). The strength of weak ties: A network theory revisited, *Sociological Theory*, 1, 201-233.

Grant, R. M. (1996). “Toward a knowledge-based theory of the firm.” *Strategic Management Journal*, 17 (Winter Special): 109-122.

Hage, J. (1999). Organization innovation and organizational change. *Annual Review of Sociology*, 25, 597-622.

Hansen, M.T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly*, 44, 82-111.

Hill, RA and Dunbar, R.I. (2003). Network Size in Humans, *Human Nature*, 14 (1) 53-72.

Jones, O. (2005). Manufacturing regeneration through corporate entrepreneurship: middle managers and organizational innovation. *International Journal of Operations & Production Management*, 25 (5), 491-511.

Koenig, G, (1994). L’apprentissage organisationnel : repérage des lieux. *Revue Française de Gestion*, Janvier-Février : 76-85.

Leonard-Barton, D. (1988). Implementation and Characteristics of Organizational Innovation : Limits and Opportunities for Managerial Strategies, *Communication Research*, 15 (5) : 603-631.

Levin, D.Z., Cross, R and Abrams, L.C. (2002). The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer, *Proceedings of the Academy of Management*, Denver, Colorado.

Mayer, R.C., Davis, J.H. and Schoorman, F.D. (1995). In integration model of organizational trust, *Academy of Management Review*, 20, 709-734.

Miles, A.M. and Huberman, A.M, (1984). *Analysing Qualitative Data : A Source Book for New Methods, Beverly Hills*, CA, Sage.

Mintzberg, H., Ahlstrand, B and Lampel, J. (1999). *Safari en pays stratégie*, France: Village Mondial.

Nonaka, I. (1994). "A dynamic theory of organizational knowledge creation." *Organization Science* 5(1): 14-37.

Nonaka, I. and Takeuchi, H. (1995). The Knowledge-Creating Company. New York: Oxford University Press.

Nonaka, I., Toyama, R. and Byosiere, P. (2001). A Theory of Organizational Knowledge Creation: Understanding the Dynamic Process of Creating Knowledge. In M. Dierkes, Antal-Berthoin, A., Child, J. and Nonaka, I. (Eds.): *Handbook of Organizational Learning and Knowledge Creation*. Oxford University Press. pp. 491-517.

Ostroff, C. and Schmitt, N. (1993). Configurations of organizational effectiveness and efficiency. *Academy of Management Journal*, 36 (6), 1345-1361.

Polyani,M(1966).*The Tacit Dimension*, London: Routledge & KeganPau

Rogers, E.M., (1962, 1971, 1983, 1995). *Diffusion of Innovations*. New York, The Free Press.

Strauss, A. L., Corbin, J. (1990). *Basics of Qualitative Research : Grounded Theory Procedures and Technics*, Newbury Park, CA, Sage.

Teece, D. (1980). The diffusion of an administrative innovation. *Management Science*, 26 (5), 464-470.

van de Ven, A.H. and Poole, M.S., (1995). Explaining Development and Change in Organizations, *Academy of Management Review*, vol 20, N°3 : 510-540.

Vas, A. and Ingham, M. (2003). Organisational change: Open your eyes, use a wide angle lens. *European Business Forum*, 16 (Winter), 60-64.

White, DR and Houseman, M (2002). The navigability of strong ties: Small worlds, tie strength and network topology. *Complexity*, 8 (1) September/October, 72-81.

Wood, E. (1998). Determinants of innovation in SME's. In Michie, J and Smith, J (eds.) *Gl;obalization, growth and governance: Creating an innovative economy*. Oxford: Oxford University Press, 119-150.

Yin, R. K., (1984): *Case study research: design and methods*, Sage Publications, Newbury Park, CA.

Zammuto, R and O'Connor, E. (1992). Gaining advanced manufacturing technologies benefits: The role of organizational design and culture. *Academy of Management Review*, 17, 701-728.

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