Sensemaking processes of organizational identity and technological capabilities: an empirical study in new technology-based firms

PROCESOS DE *SENSEMAKING* DE IDENTIDAD ORGANIZATIVA Y CAPACIDADES TECNOLÓGICAS: Un Estudio Empírico en Empresas de Base Tecnológica.

RESUMEN: Este artículo analiza los procesos de *sensemaking* de la identidad organizativa y las capacidades tecnológicas que son facilitadores de innovación en Nuevas Empresas de Base Tecnológica (NEBTs). La propuesta que establece este estudio señala que en este tipo de empresas el conocimiento transferido a través de estos procesos responde simultáneamente a dos preguntas fundamentales: su identidad organizativa y sus capacidades tecnológicas. Desde un punto de vista teórico nuestro estudio vincula estos dos marcos conceptuales (identidad organizativa y capacidades tecnológicas), que apenas han sido tratados en conjunto en investigaciones precedentes sobre el tema. Desde un punto de vista práctico, los hallazgos identifican que en este tipo de empresas ambos procesos tienen lugar simultáneamente, lo que podría ayudar a mejorar su gestión. Por tanto, los miembros y los directivos de estas empresas deberían tener en cuenta estos procesos como referencia para lograr competitividad y, por ende, éxito.

PALABRAS CLAVE: Procesos de *sensemaking*, significados compartidos, identidad organizativa, capacidades tecnológicas, nuevas empresas de base tecnológica.

PROCESSUS DE *SENSE-MAKING* D'IDENTITÉ ORGANISATIONNELLE ET CAPACITÉS TECHNOLOGIQUES : UNE ÉTUDE EMPIRIQUE DANS DES ENTREPRISES À BASE TECHNOLOGIQUE.

RÉSUMÉ: Cet article examine les processus de *sense-making* de l'identité organisationnelle et les capacités technologiques qui sont des facteurs facilitant l'innovation dans les entreprises innovantes à base technologique [EIBT]. L'étude part de l'idée que dans ce type d'entreprises la connaissance transférée à travers ces processus répond simultanément à deux questions fondamentales : leur identité organisationnelle et leurs capacités technologiques. D'un point de vue théorique, l'étude met en relation ces deux cadres conceptuels (identité organisationnelle et capacités technologiques) qui dans les travaux antérieurs sur la question ont été peu traités ensemble. D'un point de vue pratique, les observations montrent que dans ce type d'entreprises les deux processus s'effectuent simultanément, une conclusion qui pourrait contribuer à améliorer leur gestion. Pour les dirigeants et membres de ces entreprises il convient donc de prendre en compte ces processus comme référence pour améliorer leur compétitivité, et donc leur réussite.

MOTS-CLÉS : processus de *sense-making*, signifiés partagés, identité organisationnelles, capacités technologiques, entreprises innovantes à base technologique.

PROCESSO SENSE-MAKING DA INDENTIDADE ORGANIZACIONAL E DA CAPABILIDADE TECNOLÓGICA: UM ESTUDO EMPÍRICO DAS EMPRESAS DE BASE TECNOLÓGICAS

RESUMO: Este artigo analisa o processo sense-making da identidade organizacional e da capabilidade tecnológica, que são facilitadores da inovação das empresas de base tecnológicas (EBTs). O objetivo da pesquisa mostra que nesse tipo de organização o conhecimento, transferido por tais processos simultâneos, trabalham dois aspectos-chave: Sua identidade organizacional e capabilidades tecnológicas. De um ponto de vista teórico, o presente estudo conecta duas estruturas conceituais (identidade organizacional e capabilidades tecnológicas), raramente mencionadas juntas na pesquisa. De um ponto de vista mais prático, as descobertas identificam esses processos e sugerem que, nesse tipo de organização, ambos sejam simultâneos, o que poderia ajudar stakeholders, investidores, a ampliar seus negócios. Dessa forma, membros e diretores de tais organizações deveriam levar em conta estes processos, como uma força-tarefa, para alcançar competitividade e, com isso, o sucesso.

PALAVRAS-CHAVE: Processo sense-making, significados compartilhados, identidade organizacional, capabilidades tecnológicas, novas empresas de base tecnológica.

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ABSTRACT: This article analyzes the *sensemaking* processes of organizational identity and technological capabilities that are facilitators of innovation at New-Technology-Based Firms (NTBFs). The research proposal points out that in this kind of organization, the knowledge transferred by these processes simultaneously addresses two core aspects: their organizational identity and technological capabilities. From a theoretical point of view, our study links two conceptual frameworks (organizational identity and technological capabilities), rarely mentioned together in the preceding research. From a practical point of view, the findings identify these processes and suggest that in this kind of organization both take place simultaneously, which could help stakeholders improve their management. Hence, members and managers of these organizations should take these processes into account as a framework to achieve competitiveness and therefore success.

KEY WORDS: *Sensemaking* processes, share meanings, organizational identity, technological capabilities, new-technology-based firms

Introduction

Recent contributions to the Organization Theory in the area of organizational identity show that it is important for the members of an organization to know who they are as an organization and that this consensual knowledge has a strong bearing on the company's activities, behavior and decision-making while clarifying its mission. These contributions also study organizational identity construction processes and their relationship to organizational knowledge (Bürgi and Oliver 2005, Nag *et al.* 2007; Bueno, Longo and Salmador, 2010, 2011). Additionally, contributions to the Knowledge-based Theory of the Firm analyze innovation processes that create and facilitate technological capabilities (Acosta, 2009; Barney, 1986, 1991; Dierickx and Cool, 1989; Wernerfelt, 1984). Regarding innovative organizations for which innovation is decisive, we propose that the knowledge transferred through these processes simultaneously addresses two core aspects: their organizational identity and their technological capabilities. The objective of this research is to identify these processes of creation and

development of organizational identity and technological capabilities. To do so we make an empirical study in the NTBFs of the Madrid Scientific Park (PCM) and the Leganés Science Park (LEGATEC), located in the Community of Madrid, Spain. These organizations were relevant to our study because they define themselves as "innovative organizations" (Bueno, Longo and Salmador, 2010).

Taking into account the objective of this research, its theoretical foundations and the lack of previous theoretical and empirical studies linking organizational identity and technological capabilities, the application of the research methodology has been designed in two stages. The first qualitative stage has provided data about the reality with the aim of inspiring and supporting the general model and research hypotheses. The second quantitative stage has allowed us to relate these data and draw conclusions from the hypotheses (Gioia, 1998; Longo, 2010; Sarabia, 1999).

The main contributions of our study are both theoretical and practical. Theoretically we link two conceptual frameworks (processes of creation and development of organizational identity and technological capabilities) rarely mentioned together in previous literature, which has enabled us to guide and support the objective of this research. Theoretically, we also use a qualitative-quantitative research methodology for formulation and verification of the general model and hypotheses. There is also a practical contribution because: a) this study presents a model that helps stakeholders of innovative firms to understand the *sensemaking* processes of these firms and their influence as factors for innovation and competitiveness; b) we make management proposals to help members and managers use these processes as a framework to achieve their firms' success.

We proceed as follows: first, we review the theoretical foundations that guide this study. Secondly, the research objective and methodology are presented. The next section describes the research context followed by exploratory multiple case studies. Next, we show the general model of analysis, where the hypotheses are presented and which guides the quantitative phase of the research. The quantitative phase section is then followed by managerial implications, limitations and future research directions, and contributions to the literature. Finally, we make some concluding comments.

Theoretical foundations

The theoretical foundations of this study are based on the organizational studies and approaches that have facilitated analysis of the communication processes that create

and develop organizational identity and technological capabilities. In the Theory of the Organization, the first formal definition of organizational identity comes from Albert and Whetten (1985). They pointed out that the identity of an organization responds the question of "who are we as an organization?" and also captures the essential, enduring and distinctive characteristics of that organization. Following this first definition, several studies have analyzed the concept using different theoretical frameworks and research approaches (Gioia, 1998; Bueno, Longo and Salmador, 2010, 2011; Cornelissen, 2006; Longo, 2010; Porter, 2001). In this regard, in order to carry out this study we have used the interpretive paradigm and the "shared meaning" research approach as a reference to generate the empirical study (Bueno, Longo, and Salmador, 2011; Bueno, Salmador and Longo, 2008; Longo, 2010).

The interpretive paradigm, and the "shared meaning" research approach, define organizational identity as a set of meanings, shared by members of the organization, about what is essential, enduring and distinctive. These shared meanings are created and developed through continuous processes of claims and counterclaims. The processes are developed through social interaction, which helps communication between organization members while enabling them to share and discuss points of view and experiences associated with facts and situations derived from their condition as members of the organization. Thus, members take part in *sensemaking* processes and by doing so transfer knowledge (Brown and Duguid, 1991; Nonaka, 1994; Nonaka and Takeuchi, 1995; Polanyi, 1969) and negotiate the organizational identity (Bürgi and Oliver, 2005; Gioia, 1998; Nag *et al*. 2007; Bueno, Longo and Salmador 2010, 2011). In innovative organizations with an innovation core, we are suggesting that the knowledge transferred in the *sensemaking* processes simultaneously addresses two core questions about these firms at the organizational level: a) "Who are we as an organization?", which has to do with their organizational identity; and b) "How do we innovate?", which involves their technological capabilities.

According to Acosta (2009, 2010), technological capability is defined as follows: all of the generic powers of a knowledge-intensive firm to mobilize individual techno-science resources that successfully foster improvement or creation of new products and innovative production processes. The objective is the implementation of competitive strategies that create value under certain environmental conditions.

In this sense, the approaches that have addressed the study of knowledge-intensive capabilities agree on their high strategic potential that stem from their significant

influence on a firm's performance. However, in the literature there is a great diversity of different positions and complementary theoretical and methodological perspectives that make possible to conceptualize and empirically investigate this concept (Teece, 1990; Roumelt *et al*. 1991). As with organizational identity, the different perspectives make difficult to study this subject.

Terminology was the major difficulty in defining the concept of technological capability. Based on the underlying theoretical foundations of the resources and knowledge-based theory of the firm, the best option is that resources are firm specific assets while capabilities are the highly complex activities developed through routines and processes that the organization is able to carry out using its resources (Amit and Schoemaker, 1993, Grant, 1991). The dynamic capabilities approach places great importance on innovative and technological capabilities (Teece *et al*. 1997; Eisenhardt and Martin, 2000). Such capabilities are viewed as the most effective tool for countering threats and exploiting opportunities in the environment (Bueno and Morcillo, 1997, Helfat and Raubitschek, 2000, Zahra and Nielsen, 2002).

It is important to reiterate that Amit and Schoemaker (1993), Grant (1991) and Teece *et al*. (1997) assert that capabilities are highly complex activities developed through

processes. It is also important to remember that it has been said that organizational identity is created and developed through *sensemaking* processes (Bürgi and Oliver, 2005; Gioia, 1998; Nag *et al.* 2007; Bueno, Longo and Salmador, 2010, 2011). These two theoretical foundations (capabilities processes and identity processes) fill the gap in the current literature and link organizational identity with technological capabilities. We propose that in innovative or knowledge-intensive firms, both processes simultaneously answer the two essential questions that we have already stated above: "Who are we?" and "How do we innovate?" In this research we focus on the analysis of these processes.

Research objective and methodology

The research objective, inspired by the above theoretical foundations, is to describe the *sensemaking* processes that simultaneously create and develop organizational identity and technological capabilities.

The methodology designed and used in carrying out the empirical study to achieve the research objective was both qualitative and quantitative. There are few theoretical and empirical precedents regarding the processes that simultaneously create and develop identity and technological

capabilities at knowledge-intensive firms. Based on previous studies, it has been impossible to define and select scales for measuring these processes. To solve these problems, the first and qualitative phase of the analysis was a source of information about reality through an exploratory multiple case study. The qualitative data inspired the model and supported the research hypotheses and the variables for measuring the processes during the quantitative phase. This second phase enabled us to relate these data and draw conclusions from the assumptions (Acosta, 2010; Longo, 2010; Sarabia, 1999).

Research context

The empirical work of this study was conducted at New-Technology-Based Firms (NTBFs) at the Madrid Scientific Park (PCM) and the Leganés Science Park (LEGATEC), in the Community of Madrid, Spain. According to Little (1977), Butchart (1987) and Shearman & Burrel (1988), these firms are new-technology-based because they have been recently established by a group of entrepreneurs, who exploit an invention or technological innovation and employ a large proportion of qualified employees. We have focused on these organizations because they have been recently established and define themselves as "innovative organizations" (Bueno, Longo and Salmador, 2010). Therefore, they form a major sample for studying the influence of their *sensemaking* processes on their organizations' identities and as factors for innovation.

Adopting the European Commission definition of recommendation C (2003) 1422, these organizations are micro or small firms: a small firm is defined as "an enterprise which employs fewer than 50 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 10 million"; and a micro firm is defined as "an enterprise which employs less than 10 people and whose annual turnover and/or annual balance sheet total does not exceed EUR 2 million".

Exploratory multiple case study

In order to get information about reality to support the model and the hypotheses, we used a case study methodology, suitable for answering "how" and "why" questions (Yin, 1984). This methodology gives voice in the interpretation of events to the organization members, who experience and allow researchers to structure these interpretations that are suitable for the interpretive paradigm. We therefore made our interpretation and structured the interpretations of the informants in light of both contextual and previous theories to develop a final emergent model (Nag, Corley and Gioia, 2007; Strauss and Corbin, 1990; Van Maanem, 1988).

In accordance with Yin (1984) and Eisenhardt (1989), we promoted construct validity by using the multiple sources of evidence described in the "Data Sources" section and by establishing a chain of evidence as we concluded the interviews. Reliability was enhanced by: (a) Using a case-study protocol in which all firms and informants were subjected to the same entry and exit procedures and interview questions (see "Data Sources" section); and (b) by creating similarly organized case databases for each firm we visited. External validity was guaranteed by the multiple-case research design itself, because all cases were New-Technology-Based-Firms (NTBFs) at the Madrid Science Park. Finally, we addressed internal validity using the pattern-matching data-analysis method (see "Data Analysis Procedure" section).

Sample and analytical approach

We conducted an exploratory multiple case study with five NTBFs. However, this sample was not random; it reflected a representative selection of NTBFs at the Madrid Science Park. These new knowledge-intensive firms were of great interest to our empirical study because they collaborated in our research as they thought it was a good way to set the best strategies and patterns of work in order to achieve success; they employed a large proportion of qualified employees, so that when we analyzed their ways of working and the relationships between their employees, it was easy to make them understand the emerging concept of organizational identity and technological capabilities. This made our work as researchers easier and more fruitful. Finally, these firms belong to different industries, which allowed us to treat this element as a constant variable and focus our attention on the patterns of behavior they share as NTBFs.

The comparison of case studies within the same context (NTBFs at the Madrid Science Park) enabled "analytic generalization" through replication of the results, either literally (when similar responses emerged) or theoretically (when contrary results emerged for predictable reasons) (Yin, 1984). Thus, we ensured that the evidence in one well-described setting was not wholly idiosyncratic (Miles and Huberman, 1984). Although space constraints prevent us from providing "in-depth descriptions" of each case (McClintock, Brannon and Maynard, 1979), Table 1 briefly describes the firms at the time of the analysis. This table also presents the technical record of the case studies, showing the period and average length of the interviews; fictional names of the firms (to maintain confidentiality); their activity sector; legal entity; number of employees;

date of establishment; the informants and their jobs and qualifications.

The Table shows that, following the European Commission definition, the companies in the case studies were micro and small firms with 4 to 19 employees. They were founded between 2000 and 2007 as Limited Companies and belong to activity sectors based on the exploitation of an invention or technological innovation: Information, Technology & Communications; Biosciences and Chemistry; and Environment & Renewable Energies. Finally, they employ qualified people with a PhD, Masters or Bachelors Degree.

Data sources

Interviews

The primary source of data collection was the semi-structured interviews with eleven informants from the five NTBFs that took part in the case study. Table 1 shows the average length of the interviews, the period of time and the qualifications of the informants. The in-depth interviews were conversational and open-ended (Yin, 1984). To avoid potential bias, at each firm we conducted in-depth interviews with the General Manager and/or founder shareholder or promoter and one or two employees. A case-study protocol was developed in pursuit of reliability and a pilot study was carried out to refine our data-collection plan in terms of both the content of the data and the data analysis procedures. All interviews were recorded and transcribed immediately afterward, including all data, regardless of its apparent importance in the interview (Eisenhardt, 1989). We then checked facts and ended the transcription notes with our lingering impressions, to supplement the transcribed interviews and try to sharpen them by asking ourselves such questions as "What did I learn? How does this interview compare to previous interviews?" We completed the interview notes and impressions within a day of the interview and discussed them to understand the emergent findings and modify the interview protocol (Yin, 1984).

We began the interviews by asking the respondents to assume the role of spokesperson for the organization in order to focus on organizational level issues. We then clarified the concept of organizational identity and technological capabilities and explained that the aim of the interview was to determine how these elements were created and developed in the organizations through *sensemaking* processes. Next, we asked the informants to describe their tasks in the firm and we posed open questions about the activity of the firm, its history, structure, strengths, core characteristics, mission, customers and activity sector. In the last stage of the interview, we focused on areas such as ways and tools for sharing knowledge, rest breaks during the work day, the firm's mission and objectives, the feeling of being a community, the employees' features and ways of communications between them.

TABLE 1. Case Studies Technical File

NTBF	ACTIVITY SECTOR	LEGAL ENTITY	EMPLOYEES	ESTABLISHMENT	INTERVIEWS	
					Months and year: JUNE-AUGUST, 2008	
					Average length: 60 MINUTES	
					INFORMANTS AND JOBS	QUALIFIATIONS
NTBF A	Information, Technology & Communications	Limited Company	19	2005	President and Founder Shareholder	Bachelor Degree
					Sales & Marketing Department	Bachelor Degree
NTBF B	Biosciences and chemistry	Limited Company	8	2005	General Manager	Master Marketing & Management
					Sales & Marketing Department	Bachelor Degree
					Business Development Area	MBA
NTBF C	Environment & Renewable Energies	Limited Company	5	2004	Founder Shareholder and collaborator in the Development Area	Bachelor Degree
					Research & Development Manager	PhD
NTBF D	Information, Technology & Communications	Limited Company	7	2007	Promoter and in charge of the Organization and Consulting Services Area	PhD
					Promoter and in charge of the Technological Implementation Area	Bachelor Degree
NTBF E	Environment & Renewable Energies	Limited Company	4	2000	Founder Shareholder and Technical Manager	Bachelor Degree
					Taxonomic Identifications and Reports Area	Bachelor Degree

Source: Own elaboration

Observations and Secondary Sources

To complete the information and confirm the interviews emerging findings, we used observations and secondary sources. During our visits to the different sites, we kept a daily record of our impressions. We also recorded informal observations we made during interviews and activities such as lunches and coffee breaks. In addition, whenever possible, we attended meetings as passive note-takers. These observations provided real-time data and we discussed them immediately after each visit to confirm the informants' interpretations and modify future interviews.

We also used secondary sources to collect background information about the cases. Such sources included annual reports, internal documents provided by the interviewees, agendas for meetings, minutes of past meetings, internal newsletters and intranets, industry reports, websites, and various articles in magazines and newspapers about the situation and evolution of the industry in general and of the different cases in particular. The aim was to obtain additional information about the organizations' communication and development dynamics.

Data Analysis Procedure

To carry out the data analysis, we followed the general analytic strategy called "Relying on Theoretical Propositions" (Yin, 1984). The procedure was as follow: First, in the theoretical foundations we have introduced propositions regarding organizational identity and technological capabilities as well as *sensemaking* processes; second, these theoretical propositions have been the guide for analyzing

and interpreting the empirical evidence from the cases. We have also used the comparative analysis method because it is a relevant procedure for exploratory case studies whose goal is to develop ideas in order to generate hypotheses and further study based on data in narrative form (Glaser and Strauss, 1967; Yin, 1984). Consequently, the final explanation of the multiple-case research is the result of: 1) the initially-established theoretical propositions about the *sensemaking* processes that simultaneously create and develop organizational identity and technological capabilities; 2) an iterative process to compare these propositions and the multiple case study findings; 3) a continuous revision of the propositions.

Finally, we have used tables to organize, structure, make comparisons and present associations between the empirical evidence, the data and theoretical propositions (Miles and Huberman, 1984).

Model of processes of organizational identity and technological capabilities

As stated in the Theoretical Foundations, section we propose that in NTBFs, which define themselves as "innovative organizations" (Bueno, Longo and Salmador, 2010), the knowledge that is transferred in the *sensemaking* processes between members of these firms simultaneously address two core questions at the organizational level: their organizational identity and their technological capabilities as is shown in Figure 1.

As has been stated, the objective of our research is to describe the *sensemaking* processes that simultaneously

FIGURE 1. *Sensemaking* processes that create and develop simultaneously the organizational identity and Technological capabilities
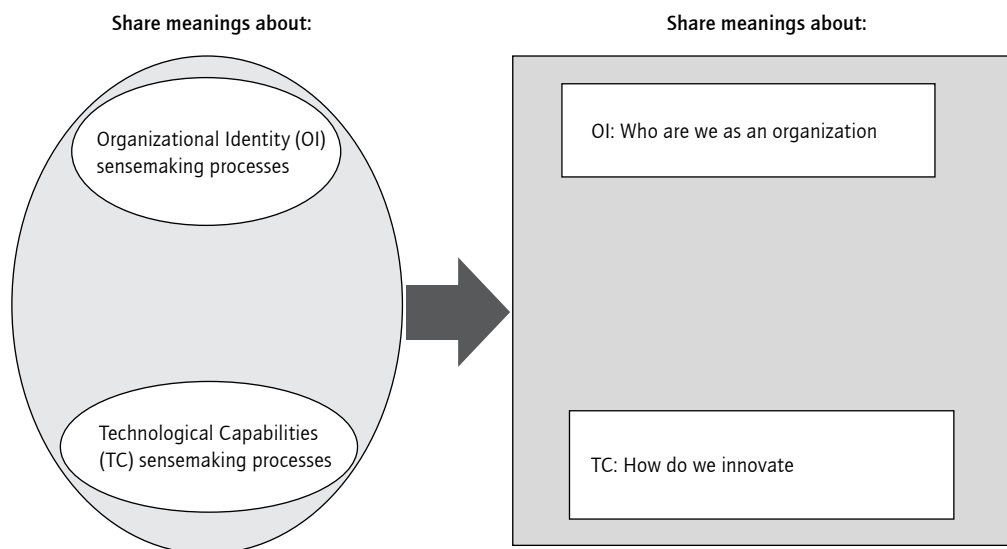
create and develop organizational identity and technological capabilities. These processes are illustrated in the left column of Figure 1. The findings from the exploratory multiple cases study have been the source of information about reality that has inspired the model for these *sensemaking* processes in NTBFs. Therefore, this qualitative phase of the analysis and a review of the literature about the concepts of organizational identity and technological capabilities have supported the research hypotheses and the variables for measuring these processes in the quantitative phase.

Tables 2, 3 and 4 present the structured narrative empirical data and organize the analysis and interpretations. They show the meanings shared by the members of the five NTBFs with regard to the *sensemaking* processes used by them to create and develop their organizational identity (Bürgi and Oliver, 2005; Gioia, 1998; Nag *et al.* 2007; Bueno, Longo and Salmador, 2010, 2011) and technological capabilities (Grant, 1991; Amit and Schoemaker, 1993, Nonaka and Takeuchi, 1995; Leonard-Barton, 1995; Teece *et al.* 1997; Acosta, 2009, 2010). The cells of the tables contain the comments by one informant from each firm only if the other informants from that same company had the same opinion or if the comment reflects a collective opinion corroborated by secondary sources. We decided to present these comments using tables as a way to summarize a large amount of data, facilitate cross-analysis and organize the narrative data. As the three tables show, after interpreting all the data, we are presenting the

shared meaning about organizational identity and technological capabilities *sensemaking* processes as grouped under three definitions: collaboration and knowledge processes; mission and strategy processes; and commitment, trust and information and communications technology (ICT) processes.

The shared meanings in Table 2 show that the members of the five NTBFs positively value the processes of collaboration and knowledge. Through these processes, they create an environment of collaboration that allows them to share experiences, problems, ideas and knowledge to develop who they are as an organization and how they innovate. As shown in the comments in the first column, collaboration processes are about the management style that is used and which encourages active behaviors of support and collaboration among employees; the promotion of the wellbeing and careers of the employees; the value placed on new ideas at work; and the overall perception of the organization that achieves behavior by its members consistent with the company's objectives. This is shown by the following comments from the table: NTBF A: *"Social responsibility starts when the work environment is good and the people who spend many hours at the office feel comfortable working together and see that they advance in their careers"*; NTBF B: *"If someone has a question and another member of the firm can help, we ask directly and there is no jealousy about what someone knows"*; NTBF C: *"We develop what we call 'community life', that is, we promote participation by all employees at the firm"*; NTBF D:

TABLE 2. Share meanings about collaboration & knowledge processes

	Colaboration & Knowledge Processes	
	Colaboration Processes	**Knowledge Processes**
NEBT A	**President and Founder Shareholder:** "For us, social responsibility starts when the work environment is good and the people, who spend many hours in the office, feel comfortable working together in their workplace and see they develop their carriers and there are no problems".	**Sales & Marketing Department:** "There is something we call "coffee time" that consists of everybody having breakfast at the same time everyday. We have a kitchen that allows us to do this and sometimes we speak about our jobs and tasks, other times about the sales or about the weather, or about…, then this is more familiar"
NEBT B	**General Manager:** "In a very informal way, if someone has a question and other member of the firm can help, we ask directly and there is not jealousy about what someone knows".	**Sales & Marketing Department**: "We interact constantly. From a small comment we can make a meeting, from an e-mail I receive we can put the chairs together and discuss what to answer. With the laboratory I interact constantly […] We speak, speak, speak, speak, speak very much. We discuss, discuss very much".
NEBT C	**R&D Manager:** "We develop what we call 'community life', that is, we promote the participation of all the employees in the firm".	**R&D Manager:** "In lunch and coffee breaks we never talk about our job because of the protection data policy […] We talk about our tasks in our workplace but in resting places we talk about other things".
NEBT D	**Promoter and in charge of the Technological Implementation Area:** "The most important moment is the coffee time because it's the lunch time when you take a break and we're all sitting on the sofas and you create that emotional state that you feel part of this company as entrepreneurship".	**Promoter and in charge of the Organization and Consulting Services Area:** "We share coffe maybe too much but I think this is part of the work. Thinking people is not working when they are having a coffe is wrong. It is during those breaks when people get deeply in touch and make report".
NEBT E	**Founder Shareholder and Technical Manager:** "We work a lot in the countryside and there you need an important organization of fellowship because between two or three people one has to do one thing, other another thing".	**Founder Shareholder and Technical Manager:** "We share our knowledge everyday because things arise and we say 'Look, I know how to do it!', it is like this".

Source: Own elaboration

"The most important moment is the coffee break because it's at lunch time when you take a break and we're all sitting on the sofas and you create that emotional state where you feel part of this company as an entrepreneur"; NTBF E: *"We work a lot in the countryside and there you need an important organization of fellowship because, between two or three people, one has to do one thing, another something else"*.

The comments in the second column of Table 2 describe processes of knowledge. These processes are about the promotion of a working environment of openness and consideration, where employees can express their feelings and problems; also about the fact that members of the organization share individual experiences and knowledge: NTBF A: *"We have a kitchen that allows us to do this and sometimes we talk about our jobs and tasks"*; NTBF B: *"We talk, talk, talk, talk, talk a lot. We discuss, discuss a lot"*; NTBF C: "We *talk about our tasks in our workplace"*; NTBF D: *"To think that people are not working when they are having coffee is wrong. It is during those breaks when people get deeply in touch and report to each other"*, NTBF E: *"We share our knowledge everyday because things arise and we say 'Look, I know how to do it!'"*.

Considering the above analysis and interpretations, we define the first hypothesis. This hypothesis is about the *sensemaking* processes of collaboration and knowledge that simultaneously create and develop organizational identity and technological capabilities:

H1: *There are shared meanings about organizational identity and technological capabilities referred to as collaboration and knowledge sensemaking processes.*

The share meanings illustrated in Table 3 show that members of the five NTBFs value positively the processes of mission and strategy used to formulate and implement the strategy, to define the mission, goals and politics of the organization and to achieve share knowledge about the issues of their performance. As it happened with the *sensemaking* processes of collaboration and knowledge, through the processes of mission and strategy the members of the organizations create the conditions to agree on their organizational identity and technological capabilities. First column describes the processes that group share meanings about the mission of the organizations. These processes are about the promotion of the definition of a shared mission that sets the company's strategic direction and the communication of the objectives and policies to the members of the organization. These are the comments that illustrate them: NTBF A: *"Our way of working is a model by responsibilities, by objectives. Everybody knows his or her mission and goals"*; NTBF B: *"The work is done by objectives and responsibilities, with start and end date, goals, etc."*; NTBF C: *"Our goal is not to do a mass production. What we want to do is generate knowledge"*; NTBF D: *"Our basic mission is to offer quality for organizations to evolve"*; NTBF E: *"Our mission is to increase our specialization, achieve continuous information and have a union between the firm and the universities and research centers"*.

The second column of Table 3 depicts three kind of processes: processes of strategy that are about the development of periodic processes of strategic thinking to shape the mission objectives and specific policies; process about the promotion of a strategic coherence and coordination with the integration of different objectives and plans of action; and the achievement of the members of a share

TABLE 3. Share meanings about Mission & Strategy processes

	Mission & Strategy Processes	
	Mission Processes	**Strategy Processes**
NEBT A	**Founder Shareholder and collaborator in the Development Area:** Our way of working is a model by responsibilities, by objectives. Everybody knows his or her mission and goals.	**Sales & Marketing Department:** We members of Sales & Marketing department meet every Monday to comment how the accounts go. We also meet with the General Manager and The Technical Department.
NEBT B	**General Manager:** The work is done by objectives and responsibilities, with start and end date, goals, etc. We also made the business planning control.	**Sales & Marketing Department:** We have a push strategy because in our business area the client does not perceive easily our services and products.
NEBT C	**R&D Manager:** Our goal is not to do a mass production. What we want to do is generate knowledge, that is we want to generate new ways of doing things, create new services.	**R&D Manager:** Periodically, we have coordination meetings. Weekly, there is a coordination meeting to plan the goals and set the results we must get at the end of the week.
NEBT D	**Promoter and in charge of the Organization and Consulting Services Area:** Our basic mission is to offer quality for organizations to evolve.	**Promoter and in charge of the Organization and Consulting Services Area:** Our strategy is a niche strategy. We have defined and identified some niches where we think we have some competitive advantages.
NEBT E	**Taxonomic Identifications and Reports Area:** Our mission is to increase our specialization, achieve continuous information and have an union between the firm and the universities and research centers.	**Founder Shareholder and Technical Manager:** The three meetings we consider as fundamental and basic are: the budget allocation; the estimation of the incomes and annual turnover; and the forecast and organization of the task in order to know how many people we will need.

Source: Own elaboration

knowledge about the issues of their performance. These are the members' comments about these processes: NTBF A: *"We members of Sales & Marketing department meet every Monday to comment how the accounts go. We also meet with the General Manager and The Technical Department"*; NTBF B: *"We have to push strategy because in our business area the client does not perceive easily our services and products"*; NTBF C: *"Periodically, we have coordination meetings"*; NTBF D: *"Our strategy is a niche strategy. We have defined and identified some niches where we think we have some competitive advantages"*, NTBF E: *"The three meetings we consider as fundamental and basic are: the budget allocation; the estimation of the incomes and annual turnover; and the forecast and organization of the task in order to know how many people we will need"*.

After interpreting the shared meanings about the *sensemaking* processes of mission and strategy, which simultaneously create and develop the organizational identity and technological capabilities, we define the second hypothesis:

H2: *There are shared meanings about organizational identity and technological capabilities that refer to mission and strategy sensemaking processes.*

Table 4 focuses on processes associated with commitment, trust and ICTs that informants for the five case studies value positively. Through these processes, they create an atmosphere of commitment to their organization and trust in their colleagues. They also develop the necessary ICTs to focus this commitment and trust while obtaining an overall perception of the organization. As shown by the comments in the first column, commitment and trust *sensemaking* processes are about fostering commitment and trust among members of the organization. The following comments in the table illustrate this: NTBF A: *"Our business model is based on an environment of trust and employees' creativity"*; NTBF B: *"Our social commitment is internal and external. It is internal because we commit to our company's objective and it is external because we work on public health"*; NTBF C: *"What we look for in people working at the company is trust"*; NTBF D: *"It is during breaks when people get deeply in touch and report to each other and also talk about their private affairs too"*; NTBF E: *"There may be risky situations to face together, like when making a long car ride or going into a river, etc. It is when you think 'if I have an accident or I am in danger, you will have to help me or whatever', so you have to trust a lot"*.

The second column of Table 4 describes processes related to ICTs. As previously stated, these processes are necessary to focus commitment and trust to obtain an overall perception of the organization and to achieve behavior by the members that is consistent with the company's objective. These processes are about collaborative technologies (e.g. groupware, videoconferencing, virtual forums and

TABLE 4. Share meanings about Commitment, Trust & ICT processes

	Commitment, Trust & ICT Processes	
	Commitment & Trust	**ICT**
NEBT A	**President and Founder Shareholder:** Our business model is based on an environment of trust and employees' creativity.	**President and Founder Shareholder:** We make actions base on mailings using databases of potencial customers, workshops and we assist to trade fairs. Also, we develop management software so intellectual capital management is a core element.
NEBT B	**General Manager:** Our social commitment is internal and external. It is internal because we commit with the project of our company and it is external because we work on public health.	**General Manager:** About the members' knowledge, when someone tells us how to do a process this is stocked in electronic files that any other member can consult.
NEBT C	**Founder Shareholder and collaborator in the Development Area:** What we look for in people working in the company is trust, that is, for us is essential to know that they work well, with enthusiasm and can be trusted.	**Research & Development Manager:** All members are connected through the computer. We use e-mails although I prefer to talk face to face because is not the same is it?
NEBT D	**Promoter and in charge of the Organization and Consulting Services Area:** It is during breaks when people get deeply in touchm, make report and they tell private affairs too.	**Promoter and in charge of the Technological Implementation Area:** There are different groups in the firm: the group of technology consulting, the group marketing, etc. The communication among them is fundamental. In fact, we have a videoconference room, with a tv and a camera. Also, our website is very important because there we share our knowledge creating the firm knowledge memory.
NEBT E	**Founder Shareholder and Technical Manager:** "In some cases your life almost depends on your fellow traveler because there may be risky situations to face together like when making a long car ride or going into a river, etc. It is when you think 'if I have an accident or I am in danger you will have to help me or whatever', so you have to trust a lot".	**Founder Shareholder and Technical Manager:** We have access to the 'Universidad Autónoma de Madrid' bibliographic database. We are also making a bibliographic record with a program that is on the web and members of the firm can consult, enter and modify records.

Source: Own elaboration.

workflow); management technology tools (e.g. ORACLE, CRM, MP5, ERP) or decision support (e.g. data mining, data modeling and other software programs that aid in decision making); and document management systems (e.g. databases and repositories): NTBF A: *"We develop management software so that intellectual capital management is a core element"*; NTBF B: *"When someone tells us how to do a process, this is saved in electronic files that any other member can consult"*; NTBF C: *"All members are connected through the computer. We use e-mails"*; NTBF D: *"We have a videoconference room, with a TV and a camera. Our website is also very important because there we share our knowledge"*, NTBF E: *"We have access to the 'Universidad Autónoma de Madrid' bibliographic database. We are also making a bibliographic record with a program that is on the web and which members of the firm can consult, enter and modify records"*.

Considering the above analysis and interpretations, we have defined the third hypothesis. This is about *sensemaking* processes associated with commitment, trust and ICTs that simultaneously create and develop organizational identity and technological capabilities:

H3: *There are shared meanings about organizational identity and technological capabilities that refer to commitment, trust and ICTs sensemaking processes.*

To summarize, the general model of analysis, which structures and groups the shared meanings about organizational identity and technological capabilities *sensemaking* processes under three taxonomies or dimensions

(collaboration and knowledge processes; mission and strategy processes; and commitment, trust and ICT), is shown in Figure 2:

Quantitative phase

Sample

To test the study's hypotheses, we used data collected in 2009 through an e-mail survey, which allowed us to construct the 2004-2009 NTBFs database (NEBTs 2004-2009®). This survey targeted NTBFs from the Madrid Science Park (PCM) and Leganés Science Park (LEGATEC), both located in Madrid (Spain). The questionnaire was sent to the NTBFs at these science parks in June 2009. These firms were micro (less than 10 persons) or small enterprises (fewer than 50 persons) that were founded by entrepreneurs, based on the exploitation of an invention or technological innovation and employed a large proportion of qualified employees (Butchart, 1987; Little, 1977; Shearman and Burrel, 1988). The names and e-mail addresses of the 117 NTBFs firms were identified in the directories of both science parks. Two mailings and several telephone calls targeted these firms' promoter-founders and/or CEOs, which generated 68 completed responses (58.12%). The respondents identified their primary industry category from the following: Information, Technology and Communications; Biosciences and Chemistry; Environment and Renewable Energies; Nanotechnology, New Materials and Engineering; and others. The main methodological issues of the survey are summarized in Table 5:

FIGURE 2. **Organizational Identity and Technological Capabilities s***ensemaking* **processes**
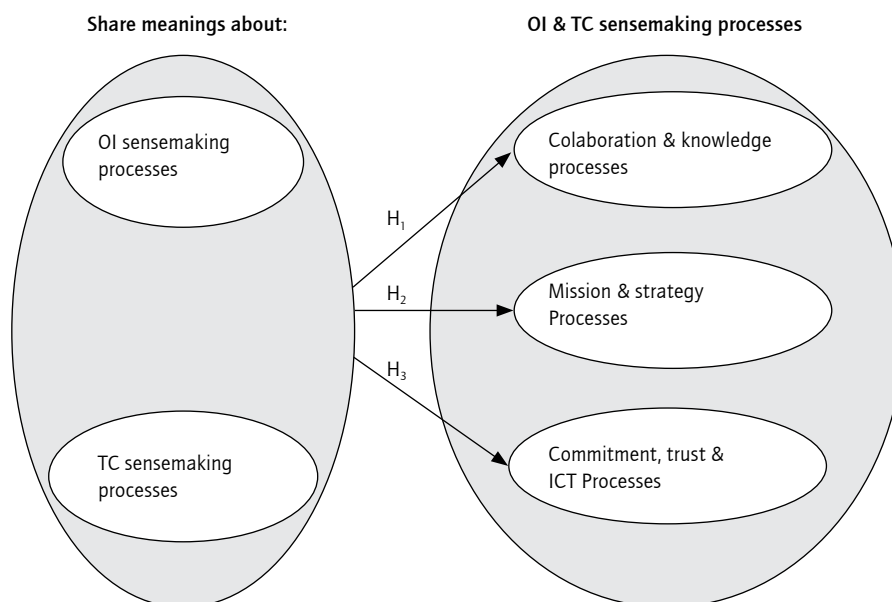
TABLE 5. Survey technical file

Country-Region	Spain-Madrid
Universe	The 117 NTBFs of the scientific park of Madrid (PCM) and of the scientific park Leganés Tecnológico (LEGATEC)
Activity sector	Information, Technology & Communications; Biosciences and chemistry; Environment & renewable Energies; Nanotechnology, new materials and engineering; and Others
Sampling unit	Firm
Collection method	Questionnaire sent by e-mail to the 117 NTBFs of the universe
Answer rate	58,97%
Sample	68
Sample error	7,60%
Confidence interval	95%
Information source	Promoter-Founder and/or CEO
Date of collection	May 01, 2009 - June 30, 2009

Source: Own elaboration

Measures and Analysis

The measures in the study were a five-item Likert-type scale developed specifically for this study because of the lack of prior research linking organizational identity and technological capabilities. These measures are shown in the Appendix. The items were based on the literature reviewed in the "Theoretical Foundations" section and on the analysis and interpretations made in the "Model of Processes of Organizational Identity and Technological Capabilities" section.

In order to validate the use of the data collected for the factorial analysis of this study and to avoid potential bias, we estimated internal reliability through Cronbach's Alpha, the result of which was 0.909. We did not make a pre-test using a random group of sample firms for the following reasons: the population was small (117 firms), some of the firms had taken part in the previous multiple-case study and Cronbach (1951) points out that Cronbach's Alpha can be applied in multiple item scales without conducting a pre-test. We then conducted Bartlett's test (1950) (χ^2 =703.963; DF =105 y p =0.000), which rejects the null hypothesis of no significant correlation between the observed variables, so that it was appropriate to apply the factor analysis to find the underlying variables or factors (Dillon and Goldstein, 1984).

Results

The data collected in the survey were factor analyzed using the principal components and varimax rotation procedure as methods for factor extraction that ensure the uni-dimensionality, reliability, convergent validity and discriminating validity of the underlying variables. The objective was to obtain the underlying variables for the study in order to confirm the three dimensions of *sensemaking* processes of organizational identity and technological capabilities identified as facilitators of innovation through multiple-case analysis and in the hypotheses.

We performed the analysis in SPSS using the correlation matrix and retaining all factors whose Eigen values exceeded 1. After varimax rotations and five iterations there were three retained factors. The total amount of variance that accounted for the three extracted factors was 72.751%. The analysis of the rotated factor loadings enabled us to interpret each factor.

Factor "collaboration and knowledge" (Cronbach's alpha = 0.877), consistent with hypothesis 1, represents the shared meanings about *sensemaking* process of collaboration and knowledge used in the NTBFs to create and develop their organizational identity and technological capabilities. It is determined based on six observed variables associated with these kinds of processes: (1) promotion of a working environment of openness and consideration where employees can express their feelings and problems; (2) a management style that encourages active behaviors of support and collaboration among employees; (3) promotion of employees' wellbeing and careers; (4) the fact that members share individual experiences and knowledge; (5) the contribution of new ideas at work; (6) the overall perception of the organization that achieves members' behavior consistent with the company's objective.

As predicted in hypothesis 2, the factor labeled "mission and strategy" (Cronbach's alpha = 0.906) is determined by observed variables that represent the shared meanings about mission and strategy *sensemaking* process used in the NTBFs to create and develop their organizational identity and technological capabilities: (1) promotion of the definition of a shared mission that sets the firm's strategic direction; (2) development of periodic strategic thinking processes to shape mission objectives and specific policies; (3) promotion of strategic coherence and coordination with the integration of different objectives and plans of action; (4) dissemination of the objectives and policies among members of the firm; (5) achievement of shared knowledge among the members about issues of their performance.

Finally, in support of hypothesis 3, on the "Commitment, Trust and ICT" factor (Cronbach's alpha = 0.855), load highly observed variables associated with the shared meanings about these kinds of *sensemaking* processes used in the NTBFs to create and develop their organizational identity and technological capabilities: (1) collaborative

technologies (e.g. groupware, videoconferencing, virtual forums and workflow); (2) management technology tools (e.g. ORACLE, CRM, MP5, ERP) or decision support (e.g. data mining, data modeling and other software programs that aid the decision making); (3) document management systems (e.g. databases and repositories); (4) promotion of commitment and trust among organization members.

Discussion

On Organizational Theory, the studies regarding organizational identity point to the importance of this consensual knowledge in the organization about what is essential, enduring and distinctive, because it influences the organization's mission, activities, performance and decisions. Moreover, technological capabilities are seen as a strategic element for the organization, given their influence on the organization's performance and its potentiality to exploit opportunities in the environment.

The organization's identity and technological capabilities are created and developed through processes of claims and counterclaims between organization members. These communication and *sensemaking* processes allow innovation organization members to simultaneously share core meanings about 'what they are as an organization' and 'how they innovate'. Applying an interpretive paradigm to carry out the empirical study of this research, the results have identified three dimensions of *sensemaking* processes of organizational identity and technological capabilities as facilitators of innovation at NTBFs. These are dimensions that, through common *sensemaking* processes, foster improvement and promote change through continuous assessment, as shown in the general model of analysis (Figure 2).

In support of hypothesis 1, NTBF members share meanings about organizational identity and technological capabilities referred to *sensemaking* processes of collaboration and knowledge. Through these processes, the NTBFs create a working environment that allows employees to share experiences, problems, ideas, feelings and individual knowledge to develop who they are as an organization and how they innovate. The shared meanings involved in these processes involve collaboration between members and promotion of their welfare and careers through a management style that supports them and achieves an overall perception of the organization and employees' behavior that is consistent with the firm's objective.

As predicted in hypothesis 2, the results show that NTBF members share meanings about organizational identity and technological capabilities, in this case referring to mission and strategy *sensemaking* processes. These processes are used to formulate and implement the firm's strategy, to define its mission, goals and policies and to achieve shared knowledge about issues of their performance. Specifically, the shared meanings involved in these processes have to do with the definition of a shared mission that sets the firm's strategic direction, the development of periodic strategic thinking processes, the promotion of strategic coherence and coordination between objectives, strategy and plans of action, dissemination of the objectives and policies to firm members and the achievement of shared knowledge among the members about the issues of their performance.

Finally, the results also support hypothesis 3 because they show that NTBF members share meanings about organizational identity and technological capabilities involving commitment, trust and ICT *sensemaking* processes. Through these processes the members of these kinds of firms create an atmosphere of commitment to the organization and trust in their colleagues. The creation of this atmosphere is associated with the ICTs of these firms because they promote communication among members. The shared meanings involved in these processes are about collaborative technologies, management technology and decision support tools, document management systems and the promotion of commitment and trust among members of the organization.

Managerial implications

One of the main findings of this study is that the three *sensemaking* processes identified have a significant impact in shaping the NTBFs' mission because through them members simultaneously answer two core questions: who they are as an organization and how they innovate. The shared meanings involved in the identified processes are associated with strategy, communication processes, commitment, trust, and ICTs. NTBF members and managers should understand and use them to give coherence to their organizations and to share and create knowledge. The aim is to focus the strategy on the resources and capabilities that will lead the firm to success.

The findings highlight the importance of the collaboration and knowledge *sensemaking* process to create an environment or context of interaction and communication where firm members share experiences, ideas and knowledge and where new knowledge is created (Fayard, 2003; Nonaka and Konno, 1998; Nonaka and Takeuchi, 1995, 2011; Von Krogh *et al.* 2000). These processes include the promotion of a working environment or atmosphere of openness and wellbeing where members feel free to share experiences,

ideas and knowledge and simultaneously obtain an overall perception of their organization. It is important to point out that this atmosphere needs a management style that encourages routines of collaboration and continuous dialogue between employees.

Another key implication from the empirical study is the relevance of the mission and strategy *sensemaking* processes in order to develop the strategic management process to define the NTBFs' mission and major goals (Hill and Jones, 2006). The empirical study suggests that mission and strategy *sensemaking* processes mainly refer to the definition and communication of a shared mission and goals, and to mutual knowledge of members' performance in order to achieve coherence and integration of the organization's activities and achieve success.

The last implication from the study has to do with the commitment, trust and ICT *sensemaking* processes that help the decision-making processes. The results show that NTBFs link development of members' commitment to the firm and trust between them with the use of collaborative, management and technology decision support tools and the use of document management systems.

Limitations and Future Research Directions

The above results and observations should be interpreted with caution. Factorial analysis is a technique that requires a large sample. Some studies hold that 50 cases are too few while a sample size of 500 is very good in order to avoid difficulties (Comrey and Lee, 1992; Tabachnick and Fidell, 2001). Our empirical research uses 68 cases, so that this rule is not fulfilled. However, the multiple case studies made before carrying out the quantitative phase have been useful to avoid the limitation of cases for factorial analysis. The results in both alternative approaches match up. Furthermore, the sample came from only one region in Spain so that the results are very localized, which limits their generalization. Another limitation is the e-mail survey. Although this is a legitimate type of survey it may not have obtained participation by the promoter-founder and/or CEO, who was the target person for each questionnaire.

These limitations and results open several research directions for the future. As noted above, our empirical study involves a small sample for the factorial analysis and is very localized. Therefore, future research should increase the sample size of innovative organizations and extend it to other regions to replicate the results. A further extension of this research should identify the technological capabilities and the organizational identity created and developed

by the *sensemaking* processes described in this study and their relationship with the organizations' results. Finally, a promising research direction would be a replication of the study in other kinds of organizations with other contexts and cultural settings that may use other processes to create and develop their identity and capabilities. This would help to develop this field of study because, as was noted, there is little theoretical and empirical precedents that simultaneously study both processes.

Contributions to the Literature

Despite the limitations mentioned above, this study makes several contributions to the field of study. As noted in the introduction, a key theoretical contribution is the integration of two frameworks in organizational studies that have rarely been mentioned before: organizational identity and technological capabilities. We have supported the research objective using the theoretical propositions derived from that linkage. The second theoretical contribution involves empirical research methodology. We have used a qualitative-quantitative methodology to formulate and verify the general model of analysis we have proposed as well as to avoid the limitations of the sample characteristics. Finally, the practical study's main contribution refers to the managerial implications of the model of processes of organizational identity and technological capabilities. The three identified dimensions of *sensemaking* processes have a great impact on the core characteristics of the organization and its capability to innovate and, consequently, on the organization's adaptation to the context. Therefore, innovative organizations' members and managers should bear these processes in mind as a framework when making decisions aimed at achieving the firm's competitiveness and therefore its success.

Conclusion

Organizations whose core is innovation develop *sensemaking* processes that simultaneously answer two core questions: Who we are as an organization and how we innovate. These processes transfer knowledge between members that shape NTBFs' identity and core technological capabilities that will make the firm a success. This consensual knowledge refers to strategy, mission, decision-making, management style, communication processes, commitment, trust and ICTs. Therefore, these processes influence the innovative firms' success so that managers should bear them in mind as a framework in the course of their decision-making processes.

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Appendix

The study's measures and the reliabilities are described in the text. This Appendix shows the measures used to capture the research's variables. The scale was on a 1 to 5 Likert-type format (1=Not at all; 2=Slightly true; 3=About halfway; 4=Mostly True, 5=True). Items were as follows:

Sensemaking processes of organizational identity and technological capabilitieS

In the organization it is valued...

- The promotion of a working environment of openness and consideration where employees can express their feelings and problems.

- A management style which encourages active conducts of support and collaboration among employees.

- The promotion of human welfare and the carriers of the employees.

- The fact that members share individual experiences and knowledge.

- The contribution of new ideas at work.

- The promotion of the definition of a shared mission that sets the firm's strategic direction.

- The development of periodic processes of strategic thinking to shape the mission objectives and specific policies.

- The promotion of strategic coherence and coordination with the integration of different objectives and plans of action.

- The communication of the objectives and policies to the members of the firm.

- Collaborative technologies (e.g. groupware, videoconferencing, virtual forums and workflow).

- Management technology tools (e.g. ORACLE, CRM, MP5, and ERP) or decision support (e.g. data mining, data modeling and other software programs that aid the decision making).

- Document management systems (e.g. databases and repositories).

- The promotion of commitment and trust among members of the organization.

- The global perception of the organization that achieves a consistent members' behavior with the company's project.

- The achievement of the members of shared knowledge about the issues of their performance.