Sharing Knowledge in the Organisation: a Retrospective Analysis and an Empirical Study

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Abstract: Knowledge has long ago been recognised as an important asset for sustaining competitive advantage. Recently, the use of information technologies for knowledge-sharing within an organisation is identified as an important tool for managing organisational knowledge in order to improve business performance. This paper starts with a retrospective analysis of the basic theories that during the course of the 20th century, gave birth to the Knowledge-based Theory of the Firm. Then it focuses on Knowledge Sharing within the organisation, and the Knowledge Sharing Networks that facilitate this complicated task. Through an empirical study, it evaluates the role and the level of contribution of Information Technology functions and infrastructure among knowledge-sharing groups, for their relationship and the organisation's performance. Finally, building upon both the theoretical analysis and the empirical results, the paper concludes with guidelines that help management to overcome existing barriers and at the same time, make Knowledge Sharing Networks the backbone of their knowledge-sharing infrastructure.

Keywords: organisational knowledge, knowledge sharing networks, information technology, organisational performance
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1. Introduction

It was Plato and Aristotle who first studied the nature of knowledge. Centuries later, in the 1950s, cognitive philosophers –like Polanyi and Wittgenstein, for whom knowledge was explicit, capable of being coded and stored, and easy to transfer– carried on with scientific research in the area of social and psychological sciences, and it is not long ago that business emphasis was given on the topic. In a series of recently published management books (Quinn 1992, Drucker 1993, Nonaka and Takeuchi 1995, Prusak 1997, Davenport and Prusak 2000 among them) the implications of knowledge-based work and knowledge-based competitive advantages are outlined and the role of knowledge sharing within the organisation is highlighted. What is interesting about these books is the fact that they all integrate theory with practice, in the so-called 'knowledge-based view of the firm', and therefore surpass the division between academic research and management practice (Grant, 1997).

On the other hand, amongst academics, the 'knowledge-based view of the firm' has received influences from various research lines. Based upon Polanyi's 'epistemology', the 'resource-based theory' (von Krogh and Roos, Wernerfelt) is acknowledged as the most dominant among them. Other research lines, like 'organisational capabilities and competences' (Prahaland and Hamel), 'innovation and new product development' (Teece, Wheelwright and Clark) and 'organisational learning' (Argyris) have also contributed significantly. As pioneers in the emerging 'knowledge-based view of the firm', one can easily distinguish the work of Robert Grant, Ikujiro Nonaka, Karl-Erik Sveiby and Georg von Krogh listed in alphabetical order and without stating, at this point, their numerous articles. The aim of this paper is to draw attention to the impact of Information Technologies infrastructure in knowledge sharing within the organisation and, at the same time, bring to light the support of certain IT functions to inter-organisational cooperation. Based mainly in the work of the above mentioned authors and researchers, this paper investigates both into the theoretical framework of knowledge sharing within an organisation and the implication it has for managers. The rest of the paper is organised as follows. In the next section we present the general framework of what is lately referred to as the Knowledge-based Theory of the Firm. In section three we focus on most specific issues of Sharing Knowledge and the Information Systems supporting knowledge-based work. In section four we present the results of the empirical study, upon which our investigation is built. Finally, in section five, we provide guidelines that may encourage industrial firms to make information technology the backbone of their knowledge-sharing infrastructure.

2. A retrospective analysis

Three theories that gave birth to the Knowledge-based Theory of the Firm and, thus, influence to a great extent the sharing of knowledge within an organisation, are briefly presented here below.

2.1 The transaction cost economics

It is mainly in the management and organisational areas where knowledge research has been focused in businesses. Scientists have long ago investigated knowledge related issues mainly due to their desire to understand why serious cost-

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performance differences are noticed among organisations. It was first Robert H. Coase who with his 1937 article "The Nature of the Firm" revoked the conventional microeconomic view of the theory of the firm (as viewed in orthodox textbook chapters under titles 'Production and Cost', 'Competitive Supply', 'Monopolies', and so forth) with his perspective of 'transaction cost economics' that succeeded in linking organisation with cost. Coase's views were neglected for almost thirty years, and they were only ultimately accepted and finally honoured with the 1991 Nobel Prise in Economic Sciences. In the new economy that emerged at the end of the 20th century, even the product-based theory has been altered. The manufacturing and transportation of physical goods from suppliers, via a factory to a buyer gave us the concept of the Value Chain (Porter, 1985). If we see the organisation as creating value from transfers and conversions of knowledge together with its customers the Value Chain collapses so the concept should better be seen as a Value Network (Allee, 2000); an interaction between people in different roles and relationships who create both intangible value (knowledge, ideas, feedback, etc) and tangible revenue.

2.2 The resource-based theory

Coinciding with Coase's Nobel Award, in the last decade of the 20th century the resource-based theory of the firm (Prahalad and Hamel 1990; von Krogh and Roos 1995; Wernerfelt 1984, 1995) received attention as an alternative to Coase's transaction cost economics and the traditional product-based or competitive advantage view (primarily of Porter 1980, 1985). Under the latter perspective, research on sources of sustained competitive advantage for organisations has focused on describing a firm's strengths and weaknesses, isolating its opportunities and threats, and analysing how these are matched to define strategies. Under the resource-based view of the firm, research emphasis has been given to the importance of alternative organisational resources, including intellectual capital, as a source of sustainable competitive advantage. Wernerfelt in his 1984 article titled "A Resource-based View of the Firm" recognises resources and products as the two sides of the same coin, and notices that: "Most products require the services of several resources and most resources can be used in several products" and he proposes that "… by specifying a resource profile for a firm, it is possible to find the optimal product-market activities''. In this pioneering article, Wernerfelt develops simple economic tools for analysing the "…relationship between profitability and resources, as well as ways to manage the firm's resource position over time" (p. 171).

Oddly enough, Werner felt's article has also been neglected until 1994, when it won the annual prise for the 'best paper' published in the Strategic Management Journal five or more years prior. On receiving the prise at the 1994 Strategic Management Society meeting, the author used the following metaphor: "[in 1984] I put a stone on the ground and left it. When I looked back, others had put stones on top of it and next to it, building part of a wall." (Wernerfelt 1995, p. 172). Prahalad and Hamel (1990), who picked up on what Wernerfelt called the 'stepping stone' strategy, start their article with an ascertainment and a prediction: "During the 1980s, top executives were judged on their ability to restructure, declutter, and delayer their corporations. In the 1990s, they will be judged on their ability to identify, cultivate and exploit the core competencies that make growth possible…" (p. 79). They define core competences as the "… collective learning in the organisation, especially how to coordinate diverse production skills and integrate multiple streams of technologies" (p. 82). Their contribution has been widely recognised and Wernerfelt (1995) acknowledges, "… these authors were single-handedly responsible for diffusion of the resource-based view into practice" (p. 171).

von Krogh and Roos (1995, pp. 56-57) in the introduction to their article on knowledge, competence and strategy, are further "... building on the resource-based perspective, [in order to develop] a better understanding of how competences build firms' competitive advantage. The point of departure is knowledge, implying that the relevant unit of analysis in competence-based prospective is the individual. This is different from the unit of analysis used both within the competitive strategy perspective (the industry) and the resource-based perspective (the firm)." According to the authors "… knowledge is not seen as a resource in a traditional meaning [i.e. financial, physical, organisational, technological, intangible, and human resources]… and differs from these types of resources in many ways;". We deem this perspective as the common link between the resource- and the knowledge-based theories and we have considered their remarks in our conclusions section.

2.3 The knowledge-based theory

At the turn of the 20th century Grant, in a series of articles, and Sveiby (2001) presented in a very clear way the fundamentals of a knowledge-based theory of the firm. Let us quote Grant summarising his recent work (Grant 1995 with Baden-Fuller, and 1996a, 1996b): "Based on certain premises regarding the nature of knowledge and its role within the firm, the [knowledge-based] theory explains the rationale for the firm, the delineation of its boundaries, the nature of organisational capabilities, the distribution of decision-making authority and the determinants of strategic alliances" (Grant, 1997, p. 451). Grant has also gone one step further, by exploring the implications of the new theory for practicing managers; an important issue that we shall further built upon in our conclusion section. According to Sveiby (2001) while competitive-based and product-based strategy formulation generally makes markets and customers the starting point for the study, the resource-based approach tends to place more emphasis on the organisation's capabilities or core competences. Thus the knowledge-based strategy formulation should start with the primary intangible resource: the competence of people. Sveiby (2001, p. 346) believes that people can use their competence to create value in two directions: by transferring and converting knowledge externally or internally to the organisation they belong to.

- When the managers of an industrial company direct the efforts of their employees internally, they create tangible goods and intangible structures such as better processes and new designs for products.
- When they direct their attention outwards, in addition to delivery of goods and money they also create intangible structures, such as customer relationships, brand awareness, reputation and new experiences for the customers.

In both these above transactions shared knowledge, within an organisation, becomes a critical factor for the organisational performance and this is exactly the way sharing knowledge is conceptualised for the purposes of our investigation. We shall refer to this issue in more detail, in the section following.

3. Sharing knowledge

At its first stages, knowledge management focused on sharing knowledge related to industrial world applications. The two dominant and mostly cited examples of the 1990s refer to new product design and development, and industrial innovation. The first one, by Nonaka (1991), relates to the development of new product lines (like Matshusita's bread making machine, the Honda City car, and Canon's revolutionary mini-copier) and persuades researchers, product designers, manufacturing and sales personnel to work together across departmental boundaries. With these examples Nonaka has made Matshusita's software developer Ikuko Tanaka with her 'twist dough' identical to his SECI model, Honda's project team leader Hiroo Watanabe with his 'Tall Boy' concept and Canon's task-force leader Hiroshi Tanaka with his beer can analogy, identical to terms like 'metaphor', 'analogy' or 'model'. The analogy to the knowledge-sharing situation that our research is focused on is very strong.

The second example refers to the sharing of what Seely Brown (1991) and the researchers of the Xerox Palo Alto Research Centre (PARC) call 'local innovation' in the design of usable technology by sharing the knowledge end-users have of the products under consideration. PARC research is focused on new work practices, in parallel to new products, and recognises the customer as the research department's ultimate innovation partner. In both these classic examples, the emphasis is on the way large organisations (namely Matsushita, Honda, Canon and Xerox) used brainstorming methods and software systems for co-designing and cross levelling the knowledge within the organisation. Recently, knowledge sharing emphasises more on indirect interactions between members of different groups in an organisation, or members of a community, that are not always working at the same geographic location. Davenport and Probst (2002), in their Siemens Best Practices case book, refer to a number of organisations devoted on their staff sharing 'best practices' using document repositories (such as reports of past successful or failed projects, employee, product and service profiles, known as Yellow Pages) and IT-based tools for inputting and extracting knowledge from the repositories. The range of such knowledge sharing systems includes from simple document management systems that help in the storage, annotation and retrieval of documents (Gibbert et al 2000, Kalpers et al 2002), to Group Support Systems and Expert Systems that help in problem solving and decision making (McNurlin and Sprague 2004).

Classical knowledge sharing models suggest that the knowledge transfer and/or sharing process involves the conversion of tacit knowledge into explicit and vice versa. At the same time, there are processes that help share tacit and explicit knowledge without conversion; although for Nonaka and Takeuchi (1995) the conversion of knowledge from tacit to explicit and finally tacit is the basis of knowledge creation. The knowledge conversion process involves close interaction between, and complete understanding amongst key employees, the so-called knowledge group of an organisation. This team includes employees and staff (from manufacturing, quality, RandD, marketing, supplies and sales) and in most cases the end-users of the products or services created by the organisation.

3.1 Knowledge sharing networks

For knowledge to be shared effectively between, within and across organisations and persons, those who possess knowledge should make it available in an accessible place and manner and with a focus on its application. Those who seek knowledge should first be aware of the knowledge locus and, second, be capable of interpreting the knowledge within their own context, prior to applying it. In recent literature, a number of scientists have successfully addressed the topic of inter-organisational networks. Based mainly in the work of von Krogh and Roos (1996), Zack (1999) and Dyer and Nobeoka (2000) we consider Knowledge Sharing Networks (KSN) as those types of networks among individuals, communities, organisations (or even between groups of organisations), which have as main common characteristic the sharing of both tacit and explicit knowledge. Dyer and Nobeoka (2000) consider that a KSN serves as a locus for facilitating knowledge sharing and effective knowledge work, since it makes knowledge permanent, accessible and portable to those who need it, both inside and outside organisations. Zack (1999) proposes a framework that he calls Knowledge Management Architecture, in order to manage mainly explicit knowledge, based on two KSN elements:

- Repositories of explicit knowledge, and
- Refineries for accumulating, refining, managing and distributing explicit knowledge.

He also recognises the new organisation roles needed in order to execute and manage the refining process, and the importance of IT in supporting the repositories and processes. We shall briefly explain these two KSN elements, building mainly upon Zack (1999) and Ruggles (1998).

3.1.1 Knowledge repository

Knowledge repositories capture explicit, codified information wrapped in varying levels of context. They are used to store and make accessible 'what the organisation knows'. They include data warehouses, which are useful in knowledge management when the mining and interpretation of their content allows employees to become better informed. More sophisticated repository approaches attempt to enfold more context around information as it is captured. According to Zack (1999) the basic structural element of a repository is the Knowledge Unit, a formally defined atomic package of knowledge content (labelled, indexed, stored, retrieved and manipulated). The repository structure also includes schemes for linking and cross-referencing the different knowledge units. A Knowledge Platform may consist of several repositories, each one with a structure appropriate to a particular type of knowledge or content. The most common types of knowledge repositories are those accumulating:

- Structured internal knowledge (or knowledge embodied in documents) like memos, reports, product oriented material, etc
- Informal internal knowledge, a less structured form of accumulated knowledge, like discussion databases, containing know-how, and usually referred as 'best practices' or 'lessons learned'
- External knowledge, like competitive intelligence knowledge encompassing analyst reports, trade journal articles and external market research on competitors.

Repositories may be linked to form a 'virtual' repository. For example, product literature, best-sales practices and competitor intelligence might be stored separately, but viewed as though contained in one repository.

3.1.2 Knowledge refinery

The refinery represents the process for creating and distributing the knowledge contained in a repository. This process includes five stages:

- Acquisition (a firm either creates or acquires knowledge)
- Refinement (value-adding process, i.e. cleansing, labelling, indexing, sorting, abstracting, standardising, integrating, and recategorising)
- Storage and Retrieval (bridges upstream repository creation and downstream knowledge distribution)
- Distribution (mechanisms used to make repository content accessible)
- Presentation (the context in which knowledge is used influences its value).

Acquisition, refinement and storage create and update the knowledge platform, whereas retrieval, distribution, and presentation derive various views of that knowledge. For KSN –and knowledge projects in general– to succeed, organisations must create a set of roles and skills to do the work of capturing, distributing and using knowledge. The majority of researchers (Earl and Scott 1999, Zack 1999, Davenport and Prusak 2000, among others) coincide with the need of a Chief Knowledge Officer (CKO), responsible for the overall organisation's knowledge management. As Davenport and Prusac (2000) mention, many firms in the United States and a few in Europe have already appointed CKOs, although in some of them the title may vary. It may be Chief Learning Officer (CLO), Director of Intellectual

Capital, or Director of Knowledge Transfer, just to mention a few. Zack (1999) gives a more detailed scheme of the organisational roles required, including knowledge creators, finders, collectors, and more, like organisational 'reporters', analysts, classifiers, and integrators. Finally, a librarian, or 'Knowledge curator' must manage the repository. We shall emphasise here the role of Information Technology. The IT infrastructure provides a 'pipeline' for the flow of explicit knowledge through the five stages of the refinery process. Using IT (i.e. the World Wide Web and Groupware) an organisation can build a multimedia repository with knowledge units indexed and linked by categories. In this way, the organisation's explicit knowledge will be displayed as flexible subsets via dynamically customisable views. Effective use of IT allows knowledge sharing via electronically mediated channels. Explicit, factual knowledge may be disseminated by means of an electronic repository. When the exchanged knowledge is less explicit, e-mail or discussion databases are more appropriate and when knowledge is primarily tacit, most interactive modes, such as videoconferencing or face-to-face conversation are the best answers.

4. The empirical study

The empirical results used in this paper stem from an investigation that aimed to evaluate the contribution of shared knowledge and information technology to manufacturing performance. For the purpose of this research, an evaluation model was developed and survey data collected from 51 medium to large size industrial companies with a total of 112 manufacturing groups, representing 5 industrial sectors (alimentation, automotive, chemical and pharmaceutical, electro-mechanical, and textile) were analysed to test the model. The key elements of the methodology deployed for that investigation are summarised here below. Two symmetrical relationship questionnaires, worded in a reverse form, were addressed to Production and Quality or RandD managers -and their assistants- and aimed at portraying the opinion and the attitude of the two collaborating groups towards each other, in reference to sharing knowledge. In addition, the role and level of contribution of Information Technology, both as a tool and/or enabler in supporting sharing knowledge among the collaborating groups, was investigated. A last, ad hoc question evaluated the use of commonly used IT infrastructure for inter-firm knowledge sharing. The third, a performance questionnaire, attempting to measure manufacturing group performance, was addressed to senior managers or their assistants. They were asked to compare the manufacturing group under question to other comparable manufacturing groups they had managed. In addition, the level of contribution of Information Technology to manufacturing group performance was investigated and again, a last ad hoc question evaluated the use of specific IT functions on four knowledge sharing issues, closely related to the group performance. Design of the indicators was carried out using two types of measures, for every variable: a general one, where each informant was asked to assess the overall level of interaction for a specific characteristic of a particular relationship; and a multiplicative or interaction measure, where each informant was asked, for example, to assess the role of manufacturing and either RandD or quality group for each characteristic separately. Using the conceptualisation of fit as interaction, proposed by Venkatraman (1989), the measurements were operationalised as 'manufacturing role X RandD or quality role', i.e. by multiplying the two responses. There are a number of advantages to such a measurement scheme, as indicated by Churchill (1979) and Campbell and Fiske (1959). First, the two types of measures (general and multiplicative) can be thought of as different methods; second, it provides a stronger test for the validity of the measurement scheme, and third, it balances possible threats to validity inherent in either type alone.

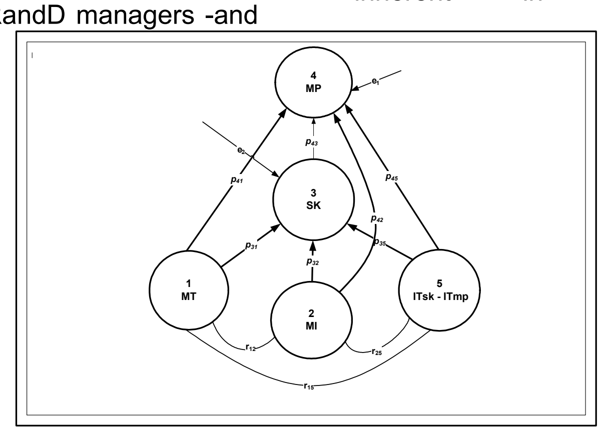

Figure 1. The Proposed Causal Model

Key-informant methodology was used for the selection of our research responders, and path analysis was applied for the testing of the investigation hypotheses that were found to be fully or partially supported, by the degree of significance of the relevant paths, as indicated in Figure 1. IT constructs that were measured with the relationship questionnaires, Type A and B, are marked ITsk. Those measured by the performance questionnaire, Type C, are marked ITmp. In the following two sub-sections we are presenting the specific results of our study that make obvious the impact of IT-supported sharing of knowledge within the organisation.

4.1 Information technology and sharing knowledge

By means of the relationship questionnaires (Type A, for Manufacturing and Type B, for Quality or RandD) we measured the role and level of contribution of IT in supporting shared knowledge and the use of the Information Technology (IT) infrastructure within the cooperating groups. Here are the questions relevant to our investigation:

Please characterise the general working relationship that currently exists between the [Manufacturing] group and the [Quality or RandD] group (Questionnaire Type A), or [Quality or RandD] group and the [Manufacturing] group (Questionnaire Type B).

Use the following scale to measure constructs:

1 2 3 4
5 6 7
Extremely Weak Moderately About
Moderately Strong Extremely
Weak Weak Average Strong
Strong

In every question below, titles in brackets were customised to reflect the exact names of the participating organisations and functional groups, as they are used in every firm. The results of our investigation are presented in parenthesis here below; detailed statistical analysis is given in the Appendix, under 3.1.

A.10 In general, the role and the level of contribution of Information Technology (IT) as a tool and/or enabler, in supporting shared knowledge between [Manufacturing] groups and [Quality or RandD] group is: **(Mean 5,25893;** SD 0,8776; Range 4)

B.10 In general, the role and the level of contribution of Information Technology (IT) as a tool and/or enabler, in supporting shared knowledge between [Quality or RandD] groups and [Manufacturing] group is: (**Mean 5,19820**; SD 1,10223; Range 5)

A.11 In general, the use of the Information Technology (IT) infrastructure in the [Manufacturing] group is: (**Mean 5,21429**; SD 0,90473; Range 5)

B.11 In general, the use of the Information Technology (IT) infrastructure in the [Quality or RandD] group is: (**Mean 5,54128**; SD 0,95774; Range 4)

The fact that all means indicate Moderately Strong to Strong opinion supports our investigation hypothesis. That means that IT has a positive impact on the knowledge-sharing process and IT infrastructures are amply used within the collaborating groups. Finally, the use of certain IT infrastructure by the company, as a whole, is evaluated by the responses to the following multiple question:

A.12/B.12. Specifically, the use of the following IT infrastructure is:
Intranet: Extranet:
Groupware: Workflow:
Internet : e-mail :
Data warehouse:
Other ……………:
……..……………:
………….……..:

The most noteworthy findings regarding the use of IT infrastructure by managers, or their deputies, of the three collaborating groups (Manufacturing, Quality and RandD) also strongly support our investigation hypothesis, as they indicate that:

- E-mail is used by 86,6 percent of the participating companies.
- 71 percent of the participating companies use Intranets.
- Internet is used by 42,85 percent of the participating companies.
- 30 percent of the participating companies use Data Warehouse software.
- Extranets are used by 23,65 percent of the participating companies.
- 20,95 percent of the participating companies use Groupware software.
- Workflow software is used by 11,6 percent of the participating companies.
- Finally, SAP, investigated under Other, is used by only 2,25 percent of the participating companies.

Percentages here refer to the sum of ‘strong’ answers (Likert ratings 5, 6 and 7) between key-informants of questionnaires A and B. For simplicity purposes we have grouped ratings of the 7-points Likert scale into three categories:

Extremely Strong, Strong or Moderately Strong= Strong; About Average= Average, and Extremely Weak, Weak or Moderately Weak= Weak. It is noticeable that, in certain areas, there is room for improvement and we shall come back to that in our conclusions.

4.2 Information technology and manufacturing performance

By means of the performance questionnaire (Type C) we measured the role and level of contribution of IT in supporting the performance of the manufacturing group. Here are the questions, relevant to our investigation: The following questions ask you to compare the [Manufacturing] group to other such Manufacturing groups. In relation to other comparable groups you have observed, how does the [Manufacturing] group rate on the following:

Use the following scale to measure constructs:

1 2 3 4
5 6 7
Non- Very Weak About Strong
Very Extremely
Existent Weak Average
Strong Strong

In approximately 95 per cent of the manufacturing units under investigation, the two stakeholders that completed the performance questionnaire were related one to Production and the second to Quality or RandD (in most cases Production or Quality Directors). For reasons related to our initial study, we treated the answers separately (A for Manufacturing and B for Quality or RandD stakeholders), although this does not affect results here. The interesting results of our investigation are presented in parenthesis here below; detailed statistical analysis is given in the Appendix, under 3.2.

C.A7 In general, the level of the Information Technology (IT) Contribution to the [Manufacturing] group performance is: (Mean 5,17857; SD 0,91252; Range 5)

C.B7 In general, the level of the Information Technology (IT) Contribution to the [Manufacturing] group performance is: (Mean 5,38393; SD 0,72591; Range 4)

CA/B8 In general, the use of the Information Technology (IT) infrastructure, among the three groups is: (Mean 5,22321; SD 0,94640; Range 4)

It is noticeable that no significant difference is observed between responders of questionnaires A and B, regarding question C.7. Here again, the fact that all means indicate Moderately Strong to Strong opinion supports our investigation hypothesis. That means that IT has a significant contribution to manufacturing performance and that IT infrastructures are amply used within the collaborating groups. Finally, the use of certain IT functions by the company, as a whole, is evaluated by the responses to the following multiple question:

CA/B9 Specifically, the use of the following IT function is:

- Coordinating business tasks:
  (collecting, facilitating, sharing, etc. information)
- Supporting decision-making:
  (reaching the right information at the right time)
- Facilitating member' team to work together:
  (no matter where they are)
- Facilitating access of information in Data Bases:
  (no mater where they are)
- Other ……………………..:
- Other ……………………..:

Research findings, regarding the use of certain IT functions, do support our investigation hypothesis as they indicate that:

- Facilitating access of information in Data Bases has been reported as an IT function used by 84,4 percent of the participating companies.
- 82,6 percent of the participating companies use IT to coordinate business tasks.
- Facilitating team members to work together has been reported as an IT function used by 76,4 percent of the participating companies.
- 69,2 percent of the participating companies use IT to support decisions making.

Percentages here refer to the sum of 'strong' answers (Likert ratings 5, 6 and 7) given by key-informants of questionnaire C. For simplicity purposes we have grouped ratings of the 7-points Likert scale into three categories: Extremely Strong, Very Strong or Strong= Strong; About Average= Average, and Non-Existent, Very Weak or Weak= Weak.

More details on the initial study (sample, research design and instruments) and the complete analysis of the results (for all constructs, the regression equations, and the confirmatory tests) are given in the relevant sections and Appendixes of a Doctoral Thesis available in the database of the UPC (Universidad Politécnica de Catalunya, in Barcelona) at http://www.tdx.cesca.es/TDX-1019105-081507.

5. Conclusions and guidelines for management

As the 20th century drew to a close, companies, guided by a new logic of value, tended to consider knowledge and its circulation among cooperating groups as a driving force in order to gain sustainable competitive advantage (Davenport and Probst 2002; Grant 1997). This paper has identified particular aspects in the knowledge sharing process that create problems for both the Knowledge Sharing Networks and the knowledge management system in use. These are some of the most common ones:

- Discrepancies among the various versions of information stored in different locations of the KSN.
- Extensive use of personal (or group) information stores and the absence of easy-to-use indexing systems.
- Over-dependence upon sharing explicit knowledge and information, as the tacit one is more difficult to flow.
- Loss of skills developed due to collaboration, as they are not transferable through the KSN.
- Over-dependence on the KSN, and thus minimisation of face-to-face contacts.

In business environments where these situations are not overcome, they may result in inefficiencies, which may, in their turn, produce a negative influence on the performance of the organisation. Academics and economists have argued that in an environment characterised by globalisation, increasingly strong competition and the growing complexity of new products, knowledge sharing within the organisation is a key contributor (Ciborra and Patriotta 1998; Gibbert et al. 2000; Drucker 2002). Under this new shift, and by putting into practice the main findings of our study, managers should make sure that employee:

- Include in their objectives the task to share knowledge and available information with colleagues in cooperating groups;
- Are entirely aware of the information technology resources available, and especially the KSNs, within the organisation.

In doing so their companies will take maximum advantage of the positive role that IT-based knowledge sharing may play on the performance of their group and the organisation. One particular result of our study (only 20,95 percent of the managers and creative workers among the participating companies use groupware software) is a strong indication that there is room for improvement in this field. This, combined with other positive findings about information and communication technologies supporting cooperation (the e-mail with 86,6%, the Intranets with 71% and the Internet with 42,85%, all appear to be amply used), indicates that the infrastructures do exist for further improvements.

Despite the high percentages regarding the use of IT functions reported in our study and indicated below, managers should not moderate their efforts to ensure that shared knowledge and information technology are best exploited for the four IT functions they are primarily designed to assist. This will be achieved by:

- Coordinating business tasks, reported by 82,6% of the participating companies and by facilitating teamwork, reported by 76,4%. Thus, most of the factors that unfavourably affect operating efficiency among the collaborating groups may be eliminated.
- Supporting decision-making processes, reported by 69,2% of the participating companies. In their effort to make better decisions, employees have the option to search for accurate information usually possessed by their colleagues in another group. Implementing decision systems will allow them to capitalise on opportunities and to defend the group against threats already recognised in one of the cooperating groups.
- Facilitating access to information in Data Bases, reported by 84,4% of the participating companies. In this way collaborating group members may improve their intellectual skills and may use the accumulated experience to increase manufacturing performance.

To conclude, getting value out of knowledge sharing requires more than technology. Knowledge is inherently hard to control as it is ever expanding and unpredictable. Only when executives view knowledge in this light will they manage it for most effective use. It is in the hands of management to increase organisational performance, by improving the channels for knowledge to be shared among the organisation and by selecting the information technologies that best fit its innovative efforts and competitive strategy.

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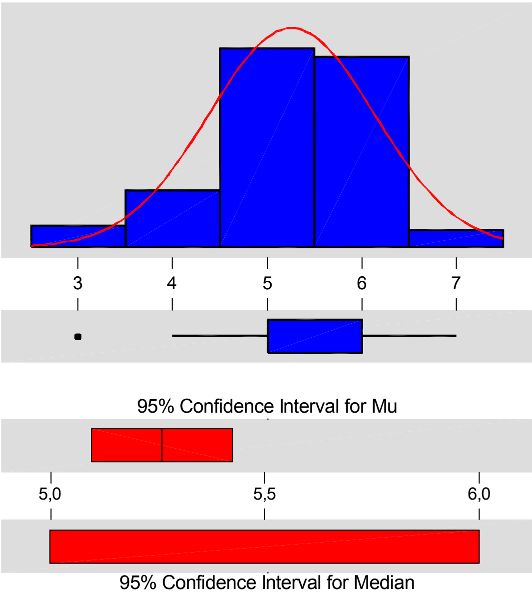
Appendix

Information technology and sharing knowledge

A.10. In general, the role and the level of contribution of Information Technology (IT) as a tool and/or enabler, to support shared knowledge between [Manufacturing] group and [Quality or RandD] group is:

Descriptive Statistics



Variable: A10

Anderson-Darling Normality Test

A-Squared:	7,142
P-Value:	0,000
Mean	5,25893
StDev	0,87760
Variance	0,770190
Skewness	-6,2E-01
Kurtosis	0,333033
N	112
Minimum	3,00000
1st Quartile	5,00000
Median	5,00000
3rd Quartile	6,00000
Maximum	7,00000

95% Confidence Interval for Mu

5,09461 5,42325

95% Confidence Interval for Sigma

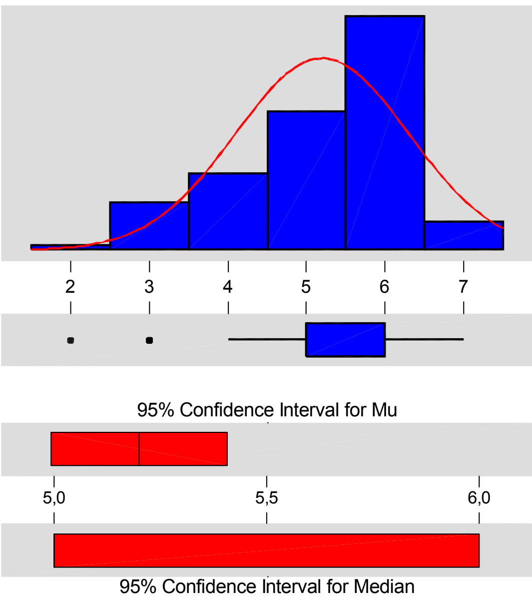
0,77579 1,01043

95% Confidence Interval for Median

5,00000 6,00000

B.10. In general, the role and the level of contribution of Information Technology (IT) as a tool and/or enabler, to support shared knowledge between [Quality or RandD] group and [Manufacturing] group is:

Descriptive Statistics



Variable: B10

Anderson-Darling Normality Test

A-Squared:	6,702
P-Value:	0,000
Mean	5,19820
StDev	1,10223
Variance	1,21491
Skewness	-7,4E-01
Kurtosis	-1,3E-01
N	111
Minimum	2,00000
1st Quartile	5,00000
Median	5,00000
3rd Quartile	6,00000
Maximum	7,00000

95% Confidence Interval for Mu

4,99087 5,40553

95% Confidence Interval for Sigma

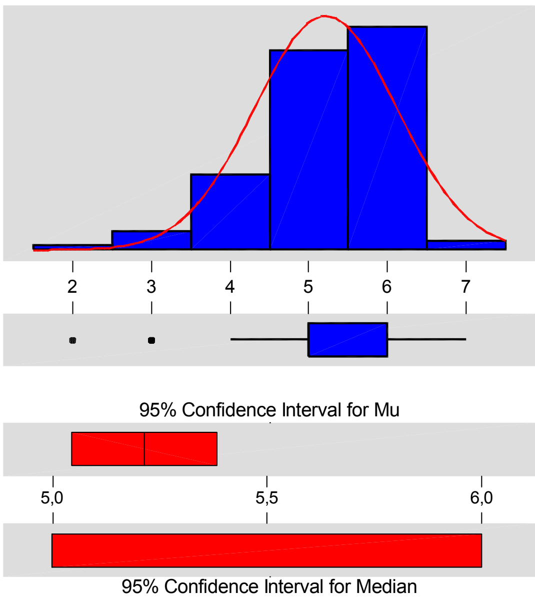
0,97384 1,26992

95% Confidence Interval for Median

5,00000 6,00000

A.11. In general, the use of the Information Technology (IT) infrastructure in the [Manufacturing] group is:

Descriptive Statistics



Variable: A11

Anderson-Darling Normality Test

A-Squared:	7,562
P-Value:	0,000
Mean	5,21429
StDev	0,90473
Variance	0,818533
Skewness	-8,9E-01
Kurtosis	0,834893
N	112
Minimum	2,00000
1st Quartile	5,00000
Median	5,00000
3rd Quartile	6,00000
Maximum	7,00000

95% Confidence Interval for Mu

5,04488 5,38369

95% Confidence Interval for Sigma

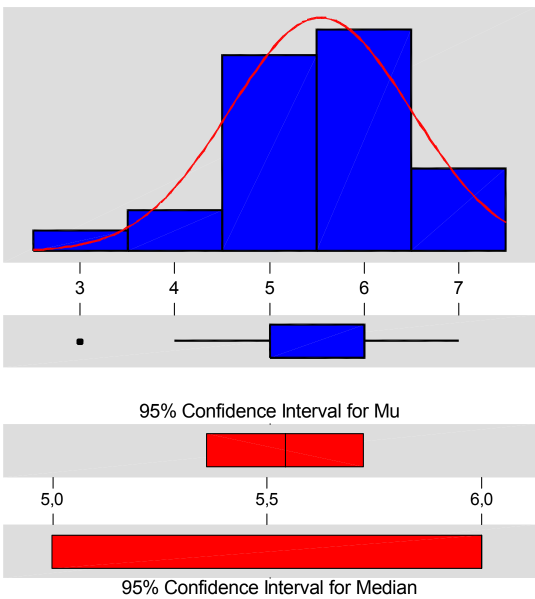
0,79976 1,04166

95% Confidence Interval for Median

5,00000 6,00000

B.11. In general, the use of the Information Technology (IT) infrastructure in the [Quality or RandD] group is:

Descriptive Statistics



Variable: B11

Anderson-Darling Normality Test

A-Squared:	5,400
P-Value:	0,000
Mean	5,54128
StDev	0,95774
Variance	0,917261
Skewness	-5,1E-01
Kurtosis	0,283797
N	109
Minimum	3,00000
1st Quartile	5,00000
Median	6,00000
3rd Quartile	6,00000
Maximum	7,00000

95% Confidence Interval for Mu

5,35945 5,72312

95% Confidence Interval for Sigma

0,84527 1,10499

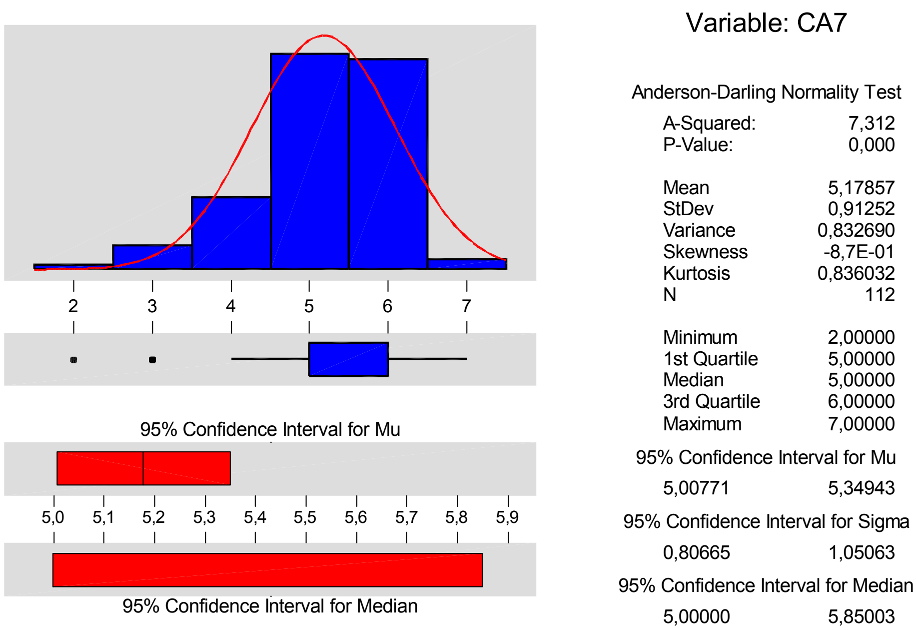
95% Confidence Interval for Median

5,00000 6,00000

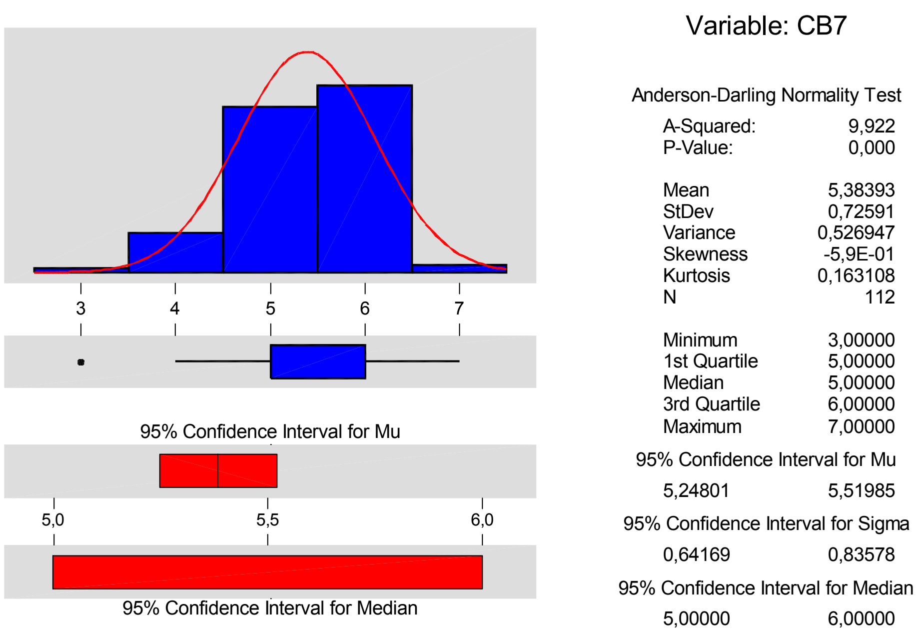
Information technology and manufacturing performance

CA/B.7.In general, the level of the Information Technology (IT) contribution to the [Manufacturing] group performance is:

Descriptive Statistics

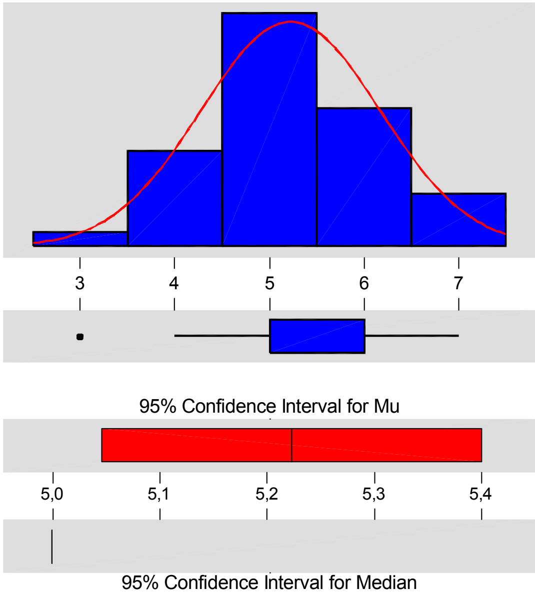


Descriptive Statistics



CA/B.8. In general, the use of the Information Technology (IT) infrastructure, between the three groups is:

Descriptive Statistics



Variable: CA8

Anderson-Darling Normality Test

A-Squared:	5,336
P-Value:	0,000
Mean	5,22321
StDev	0,94640
Variance	0,895672
Skewness	5,60E-02
Kurtosis	-2,6E-01
N	112
Minimum	3,00000
1st Quartile	5,00000
Median	5,00000
3rd Quartile	6,00000
Maximum	7,00000

95% Confidence Interval for Mu

5,04601 5,40042

95% Confidence Interval for Sigma

0,83660 1,08964

95% Confidence Interval for Median

5,00000 5,00000