KNOWLEDGE MANAGEMENT AND SOCIO-TECHNICAL SYSTEMS: A CASE STUDY

Jose Manuel Cardenas Medina (USP)
ppcardenas777@gmail.com
Mauro de Mesquita Spinola (USP)
mauro.spinola@usp.br

Within the knowledge management arena, two forms of knowledge have been considered, in the aim of implanting systems and align them with the available resources: explicit knowledge and tacit knowledge. In this sense, resources based on infoormation technology have demonstrated a good alignment and have been a great help for storing explicit knowledge and, in many cases for recovery it. But, it is created a bigger problem in implementing a knowledge structure; it lies in the difficulty of establishing the parameters for the tacit knowledge and the users' requirements in order to create a culture of efficient knowledge transfer. However, the codification of explicit knowledge allows its transfer/transformation in information that can be easily manipulated using tools information technology tools. This paper presents an example of a socio-technical approach for resolve a problem involving specific behavior and emergent opportunities and about how was performed the fact of transfer knowledge from a little group of practitioners for a bigger group of people who need to attain the understanding of the job to be performed. The case study was presented like an action research cycle because it was seemed that the process followed in order to underpin the problem was similar to the course of actions took for the firm. Finally, it was concluded that the socio-technical approach is an option in course of diminish the effects of a traumatic process of try to share knowledge from a social community of practice to some people in order to train new individuals.

Palavras-chaves: Tacit knowledge,

1. Introduction

In the perception of the Taylorism, people are an appendage of the machine (ZARIFIAN, 2001). And, in that sense people should have a specification for the work as it comes to machines, so people should perform their tasks in a standardized time. But subsequently, the socio-technical proposal (Tavistock) did aim to improve the working conditions of people and generate a tendency to generate innovation in all areas of the organization and use it with the intellectual capital generated within the organization.

Thus, knowledge becomes a key issue for organizations as it helps develop the routine processes and creates a differential in respect of competition.

In the evolution of work, Information Technology (IT) would appear as a new wave, generating new perspectives in terms of managing the systems working and reworking. That is, the articulation of people with machines that may support the decision making or facilitate routine processes. However, the socio-technical approach was not correct in terms of supporting the adherence between the development of information technologies and the users of it (BOSTROM; HEINEN, 1977). Into socio-technical systems, the technical part is concerned with the technology but with the way in which structures create the environment for social work and in part is concerned with the characteristics of the indigenous people linked to this type of system. In this sense, the question would be how to link information systems in the form of socio-technical systems.

Henceforth, it is considered as premise that knowledge transfer occurs only between people. When the flow of knowledge happens from people to machines, it is understood as information transfer (ROBERTS, 2000). Moreover, knowledge is part of the humankind of people to develop activities. However, this knowledge creates controversy within the development of information systems, since the user is compelled to use a system that was not developed in his/her patterns of behavior. This problem already was shown by (BOSTROM; HEINEN, 1977) when they states that: "*The major reason Management Information Systems (MIS) have had so many failures and problems is the way systems designers view organizations, their members, and the function of an MIS within them*."

In this sense, the role of knowledge in mitigating this problem is fundamental, because the experience - in the form of experimentation - or repetition of a process leads to its enhancement. Considering also that the structure of a system depends on human decisions, as well as selection of machines (technology) to be used. However, there are characteristics inherent to human beings that are hardly elicited by simple observation. Therefore, to develop research in this direction will require the cooperation of the stakeholders (AVISON et al., 2001); more aligned with the collaboration of stakeholders involved in the social system whose approach has been presented; e.g. in the form of a Collaborative Practice Research (CPR), a specific form of action research (MATHIASSEN, 2002) that seeks to use the contributions of Tavistock Institute on socio-technical design (MUMFORD, 1983).

On the socio-technical perspective, the "technical" part not refers to an IT approach but an interaction of the individual with the structures of the environment and how it cooperates to make comfortable the realized work. In that sense, this paper is concerned with the role of the IT within the tacit knowledge transfer and how to diminish the harmful of diffuse information in this dimension.

Thus, this paper presents a case study within a knowledge intensive organization that drawn a specific problem. The need for disseminate specific knowledge in order to training operators in skills aligned with the core business, but with the difficulty of are not able to modify the organizational structure because it was so difficult to underpin emerging limitations from specific knowledge. This problem did emerge because information technology limitations and because the difficulty of share specific knowledge when it is related to skills that need to be experienced to be transformed in lessons learned.

This way, a socio-technical system approach is evaluated to solve a problem presented above. The case results shown how the information technology and the *know-what* aid in the construction of a stable and functional job structure.

2. Knowledge/information transfer: the causes

Currently, the role of information technology (IT) in the context of knowledge management takes special significance, since large part of communications uses this type of technology as a channel for information transfer. However, some limitations of the technologies have been noted throughout the process. For example, (MCDERMOTT, 1999) states that: "The great trap in knowledge management is the use of concepts and tools for information management systems design knowledge management…" by referring to the fact that "knowing" is an act merely human and cannot be piped or carried by computers or other technologies.

Knowledge management, as a discipline, involves human decisions, with the support of IT for storing and encoding information surrounding and produced within an organization as part of the own development of non-routine and routine tasks. Thus, the most of decisions, within the knowledge management, remains under human responsibility (WALSHAM, 2001). And one of those responsibilities, on the decision-making, involves the ability to formulate an appropriate strategy for the use of certain technology. So, it is possible to connect properly to those who produce the information – or the code – with those who really need and know what to do with that information – or how to decode it – (JENNEX et al., 2003).

So the technology must play two roles in the management of knowledge: a) storing data and information and, b) retrieve data and information. So that, the investment over IT, for implement a particular IT will be closely linked with the expected support from it.

Already with regard to knowledge management: traditionally there are suggested the existence of two dimensions of knowledge: tacit knowledge and explicit knowledge (NONAKA, 1994; POLANYI, 1966). Explicit knowledge is that it is easy to code, put on paper, images, pictures, drawings or other, in the manner that is easy to transfer this kind of

knowledge through few detailed explanations. While tacit knowledge is seen as that one people have internalized and it is difficult to transfer because it contain the practice developed over time through individual experiences, values, ideas and emotions, (GOURLAY, 2002).

Thus, the interest of organizations in managing their knowledge is focused into these two dimensions of knowledge. For example, (HANSEN, M.T. et al., 1999) suggest that organizations choose the knowledge strategy by align the IT investment with the type of knowledge they use primarily for developing their activities.

However, joint user with an information system suggests the interaction of a person and a technology that should provide the two functions mentioned above (storage and retrieval); i.e., the formation of organizational memories within the working people context or repositories of information produced around the environment of technology development.

Therefore, if considered that the knowledge transfer is possible only between people, then technology, media, software and other stuff, -- intended for store information --, act as mediators in the process of knowledge transfer between people, shaping an organizational memory structure (Figure 1).

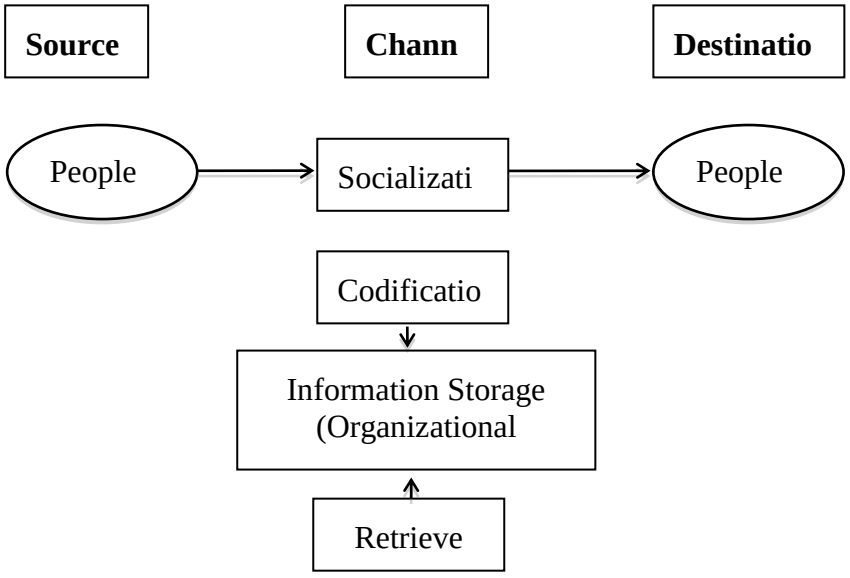


Figure 1: Knowledge/information transfer within organizations

Hence, knowledge can generate cycles of transformation from tacit to explicit and vice versa. But when the flow happens from people to information systems, the process is not about knowledge transfer but transfer of information; from people to a storage medium or temporal repository, differently from the formation of the human memory.

2. The tacit knowledge approach

The main characteristic that human memory holds is the reuse. So that, knowledge contained, into the human as well as artificial memory, must offer the possibility to be used in different processes and tasks. However, reuse is part of the inheritance of each individual; the experience developed is a characteristic that each person living alone. Thus, when observing the process of creating or pertaining to the development of strategic activities for an organization, the experience is seen as "knowledge about management" in the sense that is knowledge about manages results rather than manage processes. This is because: a) the difficulty of sharing the tacit element of knowledge involves socialization practices that have no indicators to verify the quality of data supplied from one person to another, i.e. cannot be specified or tested in any scientific way (JOHANNESSEN, 2001) and, therefore it is not followed the process but is waiting for effectiveness of learning or "starting processes", and b) because often the speaker interprets the message differently to that which would be passed, precisely because of the reuse of individual knowledge. A practical case, of this one, is presented by Howells (1996); this author suggests that to manage the intangible values, within an organization, they must be explained first. These intangible assets are patents formal license purchases, research and other sources, as well as informal communications. They all have a high degree of *tacitness*, so that, it will be possible to manage one of them, only when they are formally explicit (FALCONER, 2006; HOWELLS, 1996; ROBERTS, 2000).

Thus, knowledge per se provides a problem in its tacit dimension.

A. First, because the explicit dimension of tacit knowledge can generate different understanding for each listener. That is, explicit knowledge is one that is easy to pass, primarily because the person who explains the message has experience or domain on the message that he/she is trying to transmit. However listeners can internalize the explicit knowledge linking it with their own experience or their knowledge reuse domain.

B. Another problem – related to the tacit dimension of knowledge – is that information technologies have limitations that to store information (FALCONER, 2006; MCDERMOTT, 1999; WALSHAM, 2001).

Thus, it is considered the premise that information technology cannot store knowledge but only information (Table 1, examples are related to the software development arena, because is the focus research). Hence, the problem of IT support for activities – related to the management of tacit knowledge – becomes more visible.

Knowledge Dimension	Type of information	IT Support	Example
Tacit	Not coded	Without defining	Write an algorithm
Explicit	Coded	Databases Social Networks	Font code Business rules

		Web 2.0	
Reuse	Tacit	Only support human decisions by interaction	Organizational culture Software environment

Table 1: Dimensions of knowledge vs. dimensions of information.

In a more comprehensive way, tacit knowledge can be understood as the information that has not been codified or placed in any physical environment where it could be retrieved and referred to here as non-coding information, whereas tacit knowledge could be recovered by means of IT. This not coded information could remain in this status for three reasons: a) the individual decides not to explicit the information, b) the individual fails to clarify the information, since it is an experience developed and internalized by him or, c) the individual shares information with their counterparts in non-verbal code, i.e., the information is so widespread that it is the domain of a group and need not be verbalized or is part of another language (or gestural body for example). The latter form of not coded information is known as group tacit (ERDEN et al., 2008).

Moreover, in the case of explicit knowledge, it is relatively simple to put information elicited from that dimension and afterwards put this information into physical or electronic storage medium in the aim to thereafter let it available through the same medium (ROBERTS, 2000). If knowledge was made explicit and can be understood by other people, then it is possible to indicate that knowledge was encoded and, henceforth, other people can decode the message, thereby setting an explicit knowledge transfer. And if the transfer channel is a particular technology, then there is a transfer of coded information from people to technology, being stored at this point and being able to be recovered by decoding in the future. This strategy of knowledge management is known as “codification” and interestingly originates smaller investments in IT when compared with the strategy of working with not coded information or "socialization" (HANSEN, M T et al., 1999).

In case to manage tacit and explicit knowledge together by experience and by controlling the resources that has the skills to undertake activities, it is suggested, here, that the information remains tacit. As suggested by (FALCONER, 2006): tacit information is represented by one that is "unspeakable" or it was not "spoken" because it was formulated via an individual experimentation or maybe because the organizational culture encourages not diffusing information.

The information can also remain tacit for security reasons. For example, the results of internal reviews or detection of errors within a group within the organization as well as the results of a survey that seeks to innovate in a product. Thus, the information has a tacit ambivalence of belonging to two dimensions of knowledge.

3. Knowledge transfer

Within the organizations context these both dimensions of knowledge are used in knowledge management. But, the interest of this work is the tacit knowledge and the interference of information technology in the process of knowledge transfer. The context of converting knowledge can be summarized in the scheme proposed by (Nevo 2003, p. 13) (Fig. 2). Where the process of socialization is not just a formal conversation between people, but an understanding between people who seek to share experiences conducive to the development of learning processes. This happens not only as a transfer with sharing tacit knowledge between people, but also as sharing practical knowledge as a community of practice (NEVO, 2003). For example, weekly meetings when it comes to matters that concern the practices developed within the enterprise or specific projects.

In this scheme of knowledge transfer happens to people from other people, however, there are other sources of information, like medias and repositories. The processes of externalization and internalization appear along with the need for explicit knowledge, as suggested by (NONAKA, 1994). Once, knowledge can be converted into information, much as if it comes from other sources can be stored or distributed within a community by encoding the inputs.

The need to outsource knowledge provides the expertise to show that: the knowledge gained can be verbalized and therefore can be shared between people or using the media for this purpose. However, internalize part of an individual process that closes the cycle of knowledge transfer.

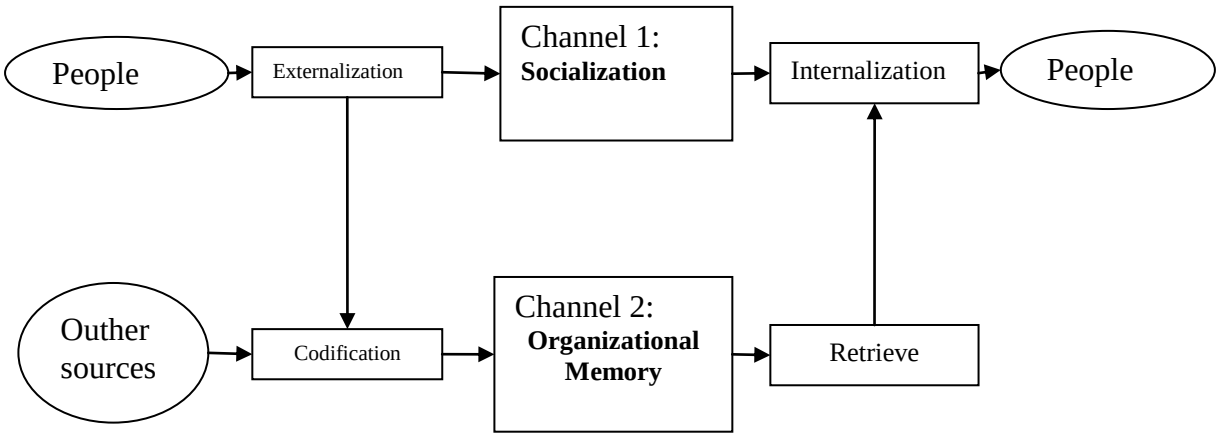


Figure 2 – Channels for knowledge transfer within organizations. Source: (NEVO, 2003)

In the formulation of an organizational memory, explicit knowledge is relatively easy to codify and organize in order to be placed on information systems to help their retrieve when needed. However, the codification of tacit knowledge can mean the development of specialized software (ROBERTS, 2000), and/or techniques associated with artificial

intelligence. Yet the organizational memory – as a knowledge repository – remains like a black box when it comes to assessing the possibilities of extracting information that will help train other members in knowledge or skills develop through experience.

The problem that becomes evident is that knowledge is always usable, however the information, if reusable, always brings the risk of not being reused properly, for example, when recovered by someone other than the person who saved the information.

More specifically, the explicit knowledge that is easily codified, can be reused in the form of information, but when retrieved is likely to be converted into tacit. And on the other hand, tacit knowledge is built primarily through experience, so that the reuse of knowledge in this way depends on the ability to be explained by the keeper. Or as quoted in (RUS; LINDVALL, 2002): "*The major problem with intellectual capital is that it has legs and walks home every day. At the same rate experience walks out the door, inexperience walks in the door.*"

And in the scheme of IT, this problem implies that it comes to managing knowledge and information with the same technology (BLUMENTRITT; JOHNSTON, 1999). However, management of tacit knowledge needs human support, since experience is stored differently from the way of storing data. Hence, within organizations, the difficulty of reusing tacit knowledge is tied to the limitations established in the use of IT. To some extent IT can replace the functions that were originally inherent from individuals, but the reason for what an action is performed in spite of another continues to be domain of individual who use the technology.

4. Socio-technical systems and information systems

Socio-technical systems has its origins on the work of people working joint with machines and in the search of better adherence between the individual and his/her job. Pan & Scarbrough (1999) do a well review of the socio-technical approach and also advocates for validate the link between individual knowledge and technological structures. Follow them, knowledge is going to take relative importance within the construction of a socio-technical system for four reasons: a) despite of great number of papers about the role of the IT within the knowledge management arena, is still recognized the holistic interplay between social and technical factors; b) is within the individual where it is possible to find the essence of the firm; c) compatibility between social and technical mechanisms are the key to understand client requirements and; d) the understanding of the social and technical factors lets to diminish the asymmetric view from the epistemic nature of them.

Specifically on the IT arena, a socio-technical perspective looking for an understanding between how to manage and which are the appropriate tools in order to aid in the decision support process. Or, other cases, how to use and reuse specific knowledge from the individuals whom social environment shape specific mechanisms of work. e.g., communities of practice. Or, maybe the problem arise from the design of specific managerial information systems (MIS) as (BOSTROM; HEINEN, 1977) indicate when affirm that in the perspective of the human resources, the individual is looking for better conditions within his/her job but he/she will be adapted with the environment, only, when the information system structure will

be compatible with his/her needs, but such a condition is so difficult – into the IT arena – to happen because: a) the decision-makers are not getting enough of the right information and; b) the person is not very efficient information processor.

Hence, clearly the socio-technical systems offer a significant harmful for the managerial concerns. In this sense, considering that the role of information technology and communications is to aid the transformation from tacit knowledge into explicit and which thereafter can be shared (ROBERTS, 2000), the focus of the information systems, within the socio-technical approach, is the relationship of IT as a structure for development of activities and processes including human decisions, on one hand. And on the other hand, the same technologies as structures that promote a job environment, in order to help develop activities and processes of day-to-day, in order to facilitate calculations and rework. The aim is, specifically, to understand the way in which IT could support the processes of training experience by building a structure of socio-technical work. Because, from the managerial perspective: planning expects the final product; the objectives hopes a result in the future and not by take into consideration the step by step that will be happen during the activities. And this happens in a parallel manner in the acquisition of IT – specifically in the famous paradox of computers –, the perception of purchasing a particular technology is to solve a problem or make improvements in the working process s. But in the process of deploying these new technologies, the sense of alignment from people to machines, it should be the opposite perception. So that it is necessary to take in consideration two sides; one into role of IT and another into the role of the managerial of resource knowledge and the created structures in order to influence the formulation of individual and collective experience. Henceforth, this dyadic view is treated by the case study.

5. Methodological concerns

Socio-technical instrumentation has not a visible implementation within organizations because is most aligned with the form of doing a job and the form in which groups organize themselves to solve or underpin routine and non routine process approaches. It involves knowledge from two sources: individual and group. Hence, in order to evaluate the characteristics of a socio-technical system it is presented an example of the practical implementation about how to disseminate group tacit knowledge, – i.e., knowledge embedded and shared by a little group – because was necessary train more people to meet increased demand for an arising service. This case configures a case study (not a case research like a methodology) that appeared in the middle of diagnosing procedures about other research objectives. So that the methodological procedures used to compile de data was intended to be raised using the procedures of in-depth interview (GEPHARD, 2004; MYERS, M; NEWMAN, 2007).

6. Case study: Software testing

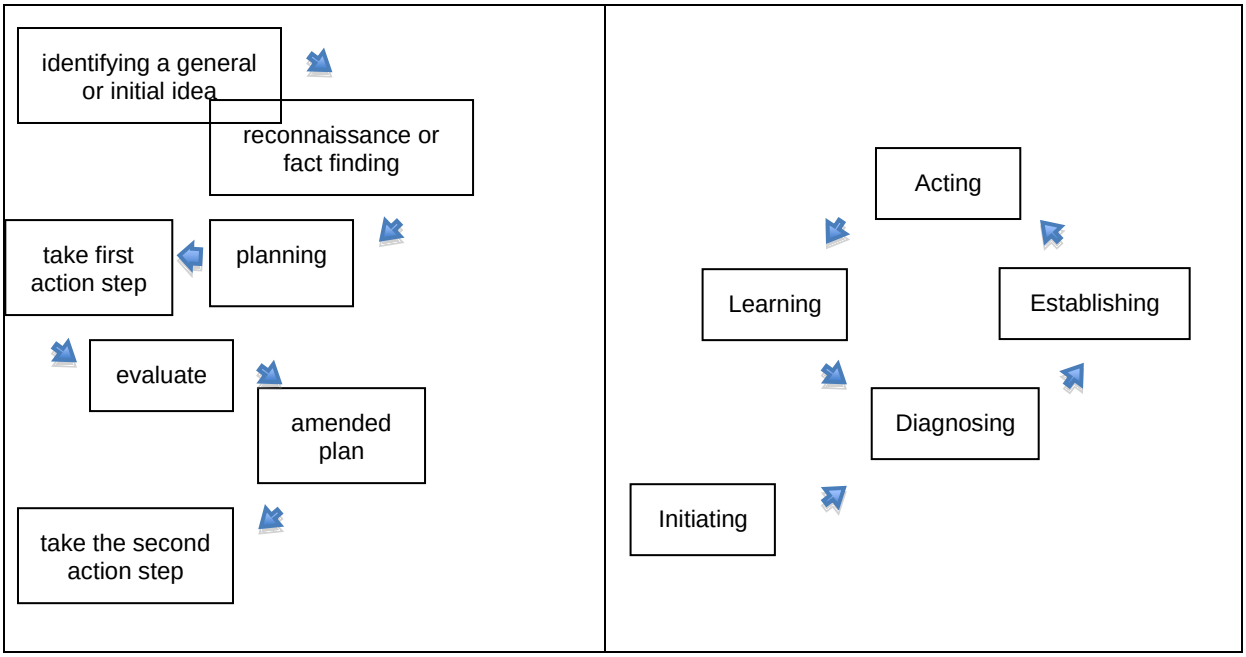
The example comes from a firm that performs software testing as core activity. The case is referred to a solved problem involving knowledge sharing when the beginning of its

operations. The process of software testing looks like software development process. The difference is the objective of each process. Follow the Myers (2004) definition: "*Testing is the process of executing a program with the intent of finding errors.*" It appears like an opposite process to develop software by the steps of the applications of software testing are the same, other words, to create need the same steps to destruct.

Henceforth, consider the process of software testing quite similar to the process of software development in the sense that the followed steps are similar, although the ultimate goal is a little different. It is more easily visible by looking to de IDEAL model (Figure 4, right side).

By other hand, it seems the process of development software and testing software looks like an action research process (Figure 4). Because, it has an initial phase and afterwards is going to create cycles in order to enhance the process as a whole (RIDING et al., 1995). The scheme, of figure 4, suggests that action research activities contrasted with current and emerging needs by demanding structural solutions that starts with the recognize and diagnosing of a specific problem. Thus, a strongly identified problem in software development is the difficulty of having a reuse of knowledge used to produce it. This problem appears when it comes to reuse the quality practices of product development like used in mass production, or repetitive operations (BASILI; CALDIERA, 1995).

In the case, the testing software firm was a start-up, so that, it has a little group of stakeholders undertaken all the problems involved into the process of testing software. So on, this little group did create a trust level and confidence environment. It looks like a community of practice in action, but it is not, it is a people creating a socio-technical system by developing a specific job inserted into a specific work and remaining in a global sector.



Action Research. Source: Adapted from (LEWIN, 1946)	IDEAL model: Source: Adapted from (MCFEELEY, 1996)

Figure 4: Action Research and improvement model of software development.

The problem appeared like a business opportunity. The case of the "millennium bug" appeared like the chance of testing a lot of software in order to diagnose if it had not experienced troubles to change the date from two for four digits. This way, it was necessary to increase the technical manpower to perform the testing software process, because the suddenly arising demand. And it had to make it as soon as possible. What they can do?

6.1 Initiating (identifying a general or initial idea)

People generating specific know-how in the aim of perform a specific task. That is, a little group of people establishing a specific organizational culture in order to share knowledge about a process like a continuum of a socialization process. This part of the systems represents the social arena.

Henceforth, it is necessary to involve most people intending to perform the same task but aiming to produce a "service in mass".

6.2 Diagnosing (reconnaissance or fact finding)

It is ease to transfer the notion of how to perform a software testing, but it is so difficult to transfer the notion of know-what and know-why the software testing is done in a specific way. So that, it is so difficult to attain that a new group of people will be able to perform a similar process.

6.3 Establishing (planning)

It was necessary to establish a social environment in order to take advantage from the attained knowledge and consolidate a methodological actions for improve the software testing process. –Methodology in this case is not referring to a research methodology but to a methodology to develop software—.

Establishing the next steps help the software testing firm to perform and diagnosis of the involved knowledge and the know-who was retaining the core knowledge. It will be important, because the fact of train people into an unaware, or little known discipline, demands of either skills: teaching and learning.

6.3 Action (take the first action step)

A software program based in a commercial database system was enhanced. This program aimed to train new personnel in order to perform a specific class of software testing: regression test. It was important, for the effects, the personnel understand how to do a software testing first than understand why the process was enhanced in this way, because the time decreased more quickly.

6.4 Learning (evaluate)

The most specific learning emerged from the own software program, because the intensive use of it generate databases of information or set of data, totally required into the testing software arena. The generated data configures a "testing mass", i.e. set of data required to perform software testing in different scenarios.

A socio-technical approach indicate that the firm configured specific conditions for let learning from the experience of a closed group, with specific jargon and embedded into a socio-cultural system. This group evolve to pertain to some class that has the ability to teach others how to do, know-what and has the plus of know-why. After the opportunity of the millennium bug, involved and trained people develop specific skills, related and not related to the fact of perform a regression test. Finally, the software program was transformed into a tool for training and also was intended to do demos for prospective clients.

6.4 Initializing again (take the second action step)

In concordance with the end of the history and with accordance with the start of a new history: one firm (client) suggests that was not able to understand the demo as a program if it has not part of the own firm. Hence, it was necessary to evolve a train software program (done in a commercial software database)… how to do it? In a second new cycle of the Action-Research/IDEAL model; the software was enhanced to work in a universal platform (like SQL), and the learning form this case makes part of another paper.

7. Conclusions

In order to understand how the tacit knowledge appears and how is possible to transform it into explicit knowledge. It is expected to understand the socio-technical behavior of the construction of knowledge-based structures, or the components of specific information system job related, also understand as business rules or correlated components of the software as a service.

This paper presents an example of a socio-technical approach for resolve a problem involving specific behavior and emergent opportunities and about how was performed the fact of transfer knowledge from a little group of practitioners for a bigger group of people who need to attain the understanding of the job to be performed.

The case study was presented like an action research cycle because it was seemed that the process followed in order to underpin the problem was similar to the course of actions took for the firm.

Finally, it is possible to affirm that knowledge and socio-technical perspective maintain some links that need to be investigated in the course of the activities related to managerial structures. Especially, within IT arena and software development business.

References

AVISON, D.; BASKERVILLE, R.; MYERS, MICHAEL. *Controlling action research projects.* Information Technology & People, v. 14, n. 1, p. 28-45, 2001.

BASILI, V.; CALDIERA, G. *Improve Software Quality by Reusing Knowledge and Experience.* Sloan Management Review, p. 55-64, 1995.

BLUMENTRITT, R.; JOHNSTON, R. *Towards a Strategy for Knowledge Management.* Technology Analysis & Strategic Management, v. 11, n. 3, p. 287-300, 1999.

BOSTROM, R. P.; HEINEN, J. S. *MIS problems and failures: a socio-technical perspective. Part I: The causes*. MIS quarterly, , n. September, p. 17–32, 1977. JSTOR.

ERDEN, Z.; VONKROGH, G.; NONAKA, I. *The quality of group tacit knowledge*. The Journal of Strategic Information Systems, v. 17, n. 1, p. 4-18, 2008.

FALCONER, L. *Organizational learning, tacit information, and e-learning: a review*. The Learning Organization, v. 13, n. 2, p. 140-151, 2006.

GEPHARD, R. *Qualitative Research and the Academy of Management Journal*. Academy of Management Journal, v. 47, n. 4, p. 454-462, 2004.

GOURLAY, S. *Tacit knowledge, tacit knowing or behaving.* Proceedings of Third European Conference on Organizational Knowledge, Learning and Capabilities, Athens, Greece.. p.1-24, 2002.

HANSEN, M T; NOHRIA, N; TIERNEY, T. *What's your strategy for managing knowledge?* Harvard business review, v. 77, n. 2, p. 106-16, 187, 1999.

HOWELLS, J. *Tacit knowledge, innovation and technology transfer*. Technology Analysis and Strategic Management, v. 8, n. 2, p. 91–106, 1996. Abingdon, Oxfordshire, England: Carfax Pub. Co., c1989-.

JENNEX, M. E.; OLFMAN, L.; ADDO, T. B. A. *The need for an organizational knowledge management*. 36th Annual Hawaii International Conference on System Sciences, 2003. Proceedings of the., 2003. Hawaii: IEEE.

JOHANNESSEN, J. *Mismanagement of tacit knowledge: the importance of tacit knowledge, the danger of information technology, and what to do about it*. International Journal of Information Management, v. 21, n. 1, p. 3-20, 2001.

LEWIN, K. *Action research and minority problems.* Journal of Social Issues, v. 2, n. 4, p. 34-46, 1946. Wiley Online Library.

MATHIASSEN, L. *Collaborative practice research.* Information Technology & People, v. 15, n. 4, p. 321-345, 2002..

MCDERMOTT, R. *Why information technology inspired but cannot deliver knowledge management*. California Management Review, v. 41, n. 4, p. 103-117, 1999.

MCFEELEY, B. *IDEAL: A User's Guide for Software Process Improvement.* Software Engineering Institute, 1996.

MUMFORD, E. *Designing Human Systems-The Ethics Method***.** E. Munford, 1983. Available on http://www.enid.u-net.com/C1book1.htm access on 14/03/11

MYERS, M; NEWMAN, M. *The qualitative interview in IS research: Examining the craft*. Information and Organization, v. 17, n. 1, p. 2-26, 2007.

NEVO, D. *Developing effective knowledge management system*, PhD These. *University of British Columbia*. *2003*

NONAKA, I. A *Dynamic Theory of Organizational Knowledge Creation*. Organization Science, v. 5, n. 1, p. 14-37, 1994.

PAN, S.; SCARBROUGH, H. *Knowledge Management in Practice: An Exploratory Case Study*. Technology Analysis & Strategic Management, v. 11, n. 3, p. 359-374, 1999.

POLANYI, M. *The Tacit Dimension*. Garden City, New York: Doubleday & Company, 1966.

RIDING, P.; FOWELL, S.; LEVY, P. *An action research approach to curriculum development.* Information Research, v. 1, n. 1, p. 1–6, 1995.

ROBERTS, J. *From Know-how to Show-how? Questioning the Role of Information and Communication Technologies in Knowledge Transfer*. Technology Analysis & Strategic Management, v. 12, n. 4, p. 429-443, 2000.

RUS, I.; LINDVALL, M. *Knowledge management in software engineering*. IEEE Software, v. 19, n. 3, p. 26-38, 2002.

WALSHAM, G. *Knowledge Management: The Benefits and Limitations of Computer Systems*. European Management Journal, v. 19, n. 6, p. 599-608, 2001.

ZARIFIAN, P. *Objetivo Competência: Por Uma Nova Lógica.* São Paulo: Atlas, 2001.