Learning Process and Using IT in the Naval Industry

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Abstract: This paper analyses the nature of the impact of learning on the adoption of information technologies (IT) and vice versa in the naval sector. It is necessary for a shipyard to acquire new knowledge, distribute it, interpret it, and store it enabling the use of Information Technologies by internal and external agents. For this reason, a model must be found in order to examine the impact of IT on the codification of knowledge considering external agents (customers, suppliers and retired personnel) and internal agents (engineers, workers and managers) in the shipyard. The authors investigate the implementation of IT through a learning process in the naval industry through a case study. The authors collected data through interviews and presented a model depicting linkages between agents of a shipyard organization (customer, suppliers, engineers, workers, directors), knowledge-related processes (codification, storage, reutilization) and benefits. Following discussion of the model, authors conclude that acquiring external knowledge is beneficial and facilitating interactions between agents increases the benefits for the shipyard organization. In the study it is possible to appreciate that acquiring and distributing knowledge from external agents is a previous step to the codification of this knowledge using Technological tools. Only considering this sequence, it is guaranteed a knowledge update by internal agents in the shipyard. During the last few years the naval industry has been modernized in defence matters and a lot of money has been spent in IT. That is why it is necessary to assess the use of IT and learning in this sector as well as to analyse the knowledge learning process and systematisation used in the naval industry during the different phases required for construction. Finally, the results have implications for managers of the shipyard when they make a choice as to the organizational capabilities to target in order to ensure the effective adoption of IT.

Keywords: phase, shipyard, naval industry, relationship, reutilization, internal and external agents

1. Introduction

Applied scientists and engineers work for the Navy in technology development, in the design of certain critical components, to ensure safety and to determine the appropriate tradeoffs regarding performance, schedule, and cost. To carry out this work submarine engineers and designers must possess special knowledge beyond that required for building most other kinds of warships. Many systems must be designed for greater compactness and quietness than is needed for surface vessels, in this way, it is possible for these systems to resist the physical pressure of operations at sea. That is why the design process of a submarine is a task to integrate knowledge and complex technologies which must work simultaneously and which need the complement of the knowledge of the different agents related with the shipyard. Also, several organizations have focused rather on creating suitable conditions such as better working environment, improved use of information communications in order to stimulate the knowledge sharing behavior (Kukko and Helander, 2012). In this work framework, the lack of suitable knowledge and experience of the staff could lead to an increase in construction costs due to changes or failure to adapt the uncompleted designs.

Moreover, despite the fact that the Spanish Naval Industry invests time and resources in order to obtain certain knowledge, it takes an average time of 5 years to carry out controlled random tests. A great deal of this highly valuable knowledge gets lost due to several reasons, including, for example, either the lack of agreement between those who generate the knowledge, or staff rotations within the shipyards which make it impossible to obtain an overview of the construction process of a submarine, since people take fragments of that knowledge with them. In this situation, certain mechanisms must be developed in order to preserve knowledge in the Spanish Naval Industry and therefore to make it so that such knowledge can be reused for the local and global development of shipyard activities (Willcoks & Sauer, 2000). Also, in the knowledge management processes topic, knowledge sharing has been seen as one of the most important (Chen 2011) and other studies conducted by Sandhu et al. (2011) investigating knowledge sharing in the public sector found that the employees have positive inclination towards knowledge sharing.

It is impossible to exactly plan all mechanisms that the people can use to exchange knowledge, or to understand the way they learn from one another. Consequently, members in a community can find their own ways to interact (Maracine et al., 2012) where the people have decisional independence

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and specific ethical. Authors such as Lin and Lee (2005) state that sharing knowledge is important in the innovation process within the business context. In order to share knowledge, organizations can provide results and benefits in two main different ways: 1) by sharing the solutions provided by external agents and 2) by redefining or adapting information technologies through the effect they have on the organisational context. Nobody questions the capacity of information technologies and the need of introducing these valuable tools in any company; however, having access to great amounts of information is not enough. Furthermore, it is necessary to collect all that information and use it so it becomes useful to those having access to it. In the learning in submarine design program, it is important to consider different situations: a) approximately 10% of the practical knowledge of a technical engineer requires several years experience in the job in order to develop it; b) there is no engineering syllabus in Spanish universities in order to provide the shipyards with that knowledge; and c) the number of workers is decreasing in certain areas. All these circumstances imply a consequent loss of knowledge or hinder the development of managers by means of hiring and temporary training or new hiring with all the costs involved in the design of a submarine. It is important to consider that organizational knowledge is an outcome of organizational learning (Juceviciene, Edintaite, 2010). Although the information knowledge, judgment, and intuition that comes through successive generations, affects the company's innovative capacity (Beck et al., 2011) and organization must continue creating new knowledge to replace any knowledge that has become invalid or obsolete (Leung et al. 2009).

For these reasons, it is necessary shipyards to acquire, distribute and use practical knowledge from submarine designers and builders as well as the interpretation and renewal of that knowledge already collected and learnt as routines, diagnosis systems, rules and applied procedures can be clearly inferred. To do so, certain formal mechanisms can be established, such as: discrete transactions, cooperative understanding, long term contracts or property (Ellram, 1991). However, in spite of the importance of formal mechanisms, the relationship in a shipyard has evolved in recent years as a response to the environment which is increasingly competitive and requires the use of informal practices (Imrie and Morris, 1992). Therefore, formal and informal learning mechanisms are crucial in order to obtain a competitive advantage over other shipyards devoted to submarine construction (Hannan et al., 1996).

Also, in order to design a conventional submarine, five phases are required: conceptual design phase, preliminary design phase, contract design phase, detailed design phase and production phase. Although all these phases require certain knowledge and are very important for the final design of the submarine, the learning mechanisms and the types of knowledge generated are different for each phase. The required learning mechanisms for each phase are specified in the following paragraphs.

During the Conceptual Design Phase the new submarine's purpose, principal operating and performance characteristics, and basic dimensions are defined. Initial estimates are developed for the cost of building the conceptual design. For this phase, the acquisition of knowledge is necessary. Furthermore, Cohen (1998) states that the new knowledge is not only acquired from outside the organization, but also from outside the reorganization of existing knowledge itself, within the organizational memory. Later on, initial exploratory researches give way to a Preliminary Design Development Phase, during this phase, future threats and missions are assessed and weighed up in relation to the availability of future technologies suitable for carrying out the required missions. It is obvious that a great deal of this information is also acquired by means of the collaboration of internal and external agents. For example, thanks to the collaboration of suppliers we can encourage, persuade, deal and learn about the future requirements and requests of current customers (the Spanish Navy) or potential ones (Navies from other countries) (Kaplan & Norton, 2000).

In the Contract Design Phase, the top-level requirements are transformed into contract specifications for detailed design and construction of the submarine. Subsystems are defined, initial analyses and testing are completed, projected costs are established, and an initial set of ship specifications and contract drawings is prepared. A request for proposal is issued so the shipyard can respond and negotiate the price. In this phase the codification of knowledge is essential, it is necessary to find some way of transferring the knowledge in the Spanish Naval Industry in order to make it available to external and internal members of the company. Failure to transfer the knowledge is likely to have a negative impact on the performance (Shane et al., 1995). For this reason, efficient and secure knowledge sharing is critical to the success of this third phase (Chen et al., 2001). After this, in the Detailed Design Phase, the shipyard initiates a phase in which the contract drawings and ship

specifications of the contract design phase are transformed into the functional documents of the different installations and drawings necessary to construct, outfit, and test the submarine - with the codification of knowledge being a necessary factor. In order to review own and existing knowledge, IT tools facilitate the update and review of procedures, rules and processes in the Spanish Naval Industry.

Finally, the Production Phase of the submarine starts before all drawings are complete. Production is limited by the drawings that are available, and changes to arrangements and specifications can lead to reworking during the construction process. In this phase, it is important to use the knowledge learnt, which should have been stored because it is "difficult to determine a priori what knowledge will be required by whom and when for delivering the right knowledge, to the right person at the right time and the right place (Woodman & Zade, 2012). The shipyard can use multiple tools to store knowledge and re-use it. However, the most used are IT (Arjonilla & Medina, 2002). IT also help this individual knowledge to be transformed into social knowledge, this transformation is due to a social process between groups and individuals (Nonaka & Takeuchi, 1995). The IT are a key factor which enables competitive advantage, by cementing relationships (Rambo & Beahler, 2003) and technological infrastructure including a wide range of information and communications tools and applications facilitate knowledge processes (Handzic, 2011).

Considering the previous paragraphs, the aim of this paper is to analyse the knowledge learning process and systematisation used in the construction process of a conventional submarine.The methodology followed consisted in more than 100 interviews to people linked to a naval shipyard. The most important contribution of the work is that it considers the different points of view of the different agents related with the shipyard (customers, suppliers, retired people, engineers and managers) on the usefulness of knowledge and IT which facilitate its creation and management.

2. Method and results

The research method used was a case study because it is a useful methodological strategy of scientific research for the generation of results which enable the strengthening, growing and development of existing theories or the emergence of new scientific paradigms. Consequently, it contributes to the development of the research performed. Furthermore, the case study strategy is used owing to the great possibilities it offers for the research and explanation of current phenomena in their real environment (Yin, 1989; Eisenhardt, 1989).

Previous researches confirm that the activity of the company is a relevant factor with regard to the incorporation of information technologies in organizations because the training and use of them is directly related to the intensity of knowledge generation by a sector (Meroño et al., 2005). In this regard, Kotler (2000) suggests that when information is fragmented within the company it is difficult to obtain a favourable answer and, as a result, the development of the company will suffer. Hagel and Armstrong (1997) state that by implementing new and flexible technologies communication building will be enabled. That is, people work online and learn about work. This a traditional point of view adopted by the biggest organizations. See for example Gold et al (2001) and Malhotra (2005).

Only a few doubt that information technologies have an important impact on the current economic framework. Actually, it is possible to start seeing some of the changes caused by these technologies in the design of processes, business models, markets size and limits or even in the competitive dynamics within a sector (Porter, 2001).

Also, the presence of a transfer culture and of a context where knowledge is to be adapted to the company performance are preconditions and the knowledge resulting from these processes is subject to subjective interpretation and to the presence of agents who make business or communicate. Therefore, it is suggested the need to transform social knowledge into an objective knowledge thanks to information technologies. It is easily transferable and reusable knowledge either by internal or external agents or by computers themselves.

Therefore, and considering that previously stated, we will try to check if with the evidence provided by the case study it is possible to prove the propositions of this research:

Proposition 1: The relationship with external agents by which the company acquires knowledge has a positive effect on the knowledge codification by internal agents.

Proposition 2: The relationship of internal agents who codify knowledge has a positive effect on the use of information technologies.

Proposition 3: Information technologies enable the different agents to reuse knowledge which has a significant effect on the development of the company.
The research was done in the last three years coinciding with the final phase of the detailed design phase and the beginning of the production phase of the new submarine in construction for the Spanish Navy. According to that established by Yin (1989), the results were analysed by different authors independently and from different perspectives. Moreover, the shipyard of Cartagena has been chosen because it is important in the Spanish Naval Industry and it is a competitive shipyard where the future submarine is being constructed.

Several weeks of interview sessions were conducted. More than 100 people were interviewed and the workers, managers and engineers belong to the internal agents of the company. Interviews were semi-structured and conducted face-to-face. No interviews were taped, but extensive notes were taken during and after the interview and the interview notes were typewritten into protocols and coded.

Before the interviews, we asked the computing department and different leaders in the company who all confirmed to us the different IT tools used in the company and the different applications of the different tools. After this first interview, technologies were classified into three groups:

- Internet tools which give access to information on products and services instantaneously and without moving.
- Collaboration tools which promote the use of work networks to provide collaboration groups with the ability to dynamically gather a high amount of information units.
- Tools for collective use which group together the commercial automation applications and online areas for customer service. These tools at the disposal of external agents by the companies improve the commercial relationships between companies and supply chains.

Our starting point was the model shown in Figure 1. This model begins with the process of acquiring the knowledge from external agents to the shipyard. After that we continue with the process of knowledge codification, it is very important that the acquired knowledge is distributed and interpreted by the shipyard's agents; and efforts should be made to conserve it. The knowledge should be stored by means of IT so that it can be reused correctly during production phase and in the future submarines design. In the model, the need for feedback of the knowledge by the different agents of the shipyard has been considered. It should be noted that the process of organizational knowledge creation is a never-ending, circular process that is not confined to the organization but includes several interfaces (Nonaka, 1994).

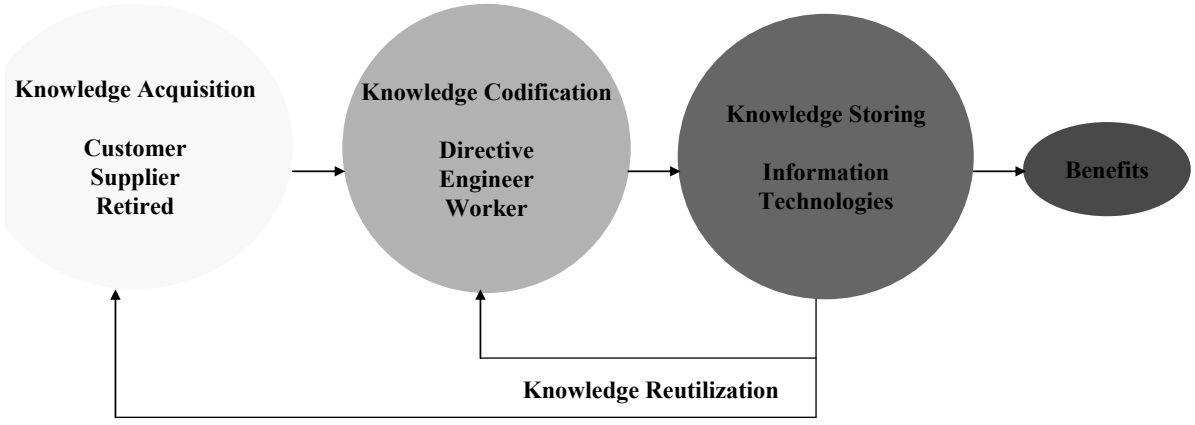

Figure 1: Circular knowledge model (source: Own Elaboration)

The most important contributions are specified below, including the type of agent, in this study, 12 different people belonging to the main customer of the shipyard were interviewed; they did not declare any problem with the technical infrastructure of the company. However, they only had access to approximately 15% of the IT tools used by the shipyard. They affirmed that they would like to use more tools because although they have direct contact with members of the shipyard they could not see different designs and documents, and they also affirmed that although the Navy people evaluate

different documentation received from the shipyard, they need more detailed information to help and give different ideas to the shipyard to improve the different designs and develop the equipment included in the vessels. Also, the Navy people manifested a favourable position to the use of IT after receiving the product, this means that by using IT they would be able to solve every type of problem and interchange knowledge with shipyard internal agents.

Also, forty-four workers belonging to different offices and workshops of the shipyard with more than 10 years experience working in the company were interviewed, and they emphasized the experience of the employees and the possibility of distribution and application of their knowledge in activities related with the organization. These ideas were attractive for them and motivating in order to learn how to use new tools and create new processes to develop their work. Furthermore, the interviewed people highlighted that personal motivation was reinforced when they knew that the shipyard took into account their opinions and suggestions about acquiring external knowledge. On the other hand, some of the workers complained because only 20% of them had access to the different IT used by the shipyard. In their opinion, the lack of access to IT by all the workers was the reason for their unhappiness and the possible reason for the loss of knowledge. They suggested a suitable access to IT which would enable them to have a better interaction between them and the intermediate level engineers. Some underlined that this improvement would produce benefits for the rest of the shipyard because the relationship between departments would be improved.

Twenty-three people of different companies were interviewed, ten of whom had worked with the shipyard on other projects previously. As with the customers, regarding the technical infrastructure of company, the suppliers declared that they have no problem, but complained that they could access only a few internal IT tools of the shipyard to be able to adapt their work to the philosophy of the company. At the same time, twenty-seven people were interviewed who had been working a minimum of eight years in the shipyard, practically all the intermediate level engineers had good technical infrastructure and access to 80% of the IT tools used by the company. Some of them could not have access to classified information or to information from other departments. But the real problem is that the intermediate level engineers emphasized that they did not have all the knowledge they wanted because a lot of subordinates did not have access to the IT used by the company. They also stated that a lot of meetings with the customers could be removed, mostly considering their periodical and informative characteristics. As curiosity, seventeen ex-workers of the shipyard were interviewed; they were between 59 and 68 years old. In the interview, we detected that retired and pre-retired people were unaware of the evolution of the technical infrastructure in the company from the time that they had left the company.

In the opinion of those interviewed, a great deal of their knowledge had not been transmitted to new generations in recent years because they had not had the opportunity to do so. Finally, nine managers were interviewed belonging to different departments and they had worked a minimum of 20 years in the shipyard; managers had good technical infrastructure and access to all information and were an interface between intermediate level engineers and other managers of different departments.

In our interviews, we discovered that they were aware of the fact that customers, suppliers, workers and retired workers hardly knew the different applications used by the shipyard and that the managers and engineers knew almost all the applications although they admitted that they did not use some of them. They also underlined that it was logical that the retired and pre-retired workers did not know the applications, especially because the evolution of the company in the past years had taken place at the same time as many of them had retired and IT were implemented. Finally, they also confirm more benefits when they have more contact with external and internal agents.

3. Discussion and conclusions

Technical knowledge and practical experience are important assets in the design of a submarine, with the appropriate use of both we can prevent mistakes which would result in a great increase of the shipyard costs. But the problem with knowledge is that the person with the knowledge is the person who manages it. Our results confirm those obtained from previous researches, for example that by Harrington and Guimaraes (2005) who state that companies should acquire new external knowledge from their customers and to include it in their own knowledge already acquired within the organizational context. Then, this knowledge must be distributed from the company environment by enabling each community to make its explicit interpretation of it. (Bonifacio et al, 2002). An important contribution of the research is the model presented and the process proposed to codify knowledge

which is individual when it is acquired by the shipyard agents, and becomes social when it is codified. Through the analysis of propositions, results show that knowledge acquisition by means of the relationship and collaboration with external agents is a necessary step to detect the relevant knowledge that the implementation of information technologies require. This confirms what authors like Sinkula et al. (1997) stated when speaking about the processing of market information as a necessary condition for knowledge management. The relationship and collaboration with external agents is the previous step to information processing. Consequently, those organizations that gain knowledge from their external agents not only prove the efficacy of a new business direction, but also have enough potential to design their own information technologies based on what customers really need and want in order to achieve a sustainable competitive advantage.

These conclusions also support the points of view of Fahey et al (2001) who state that the process to acquire, codify and use organizational knowledge provides a solid grounding for those companies significantly contributing to understand and facilitate the transformation of operating processes in e-business. Only if these high-tech solutions are combined with human creativity and knowledge, a company will be able to create a real competitive advantage in the market.

Other contribution is which process is to be considered to codify knowledge. Codified knowledge is created as a consequence of the interaction with external agents, internal agents and computers. Stored knowledge will be reused by external members of the company such as customers and suppliers. This knowledge will help us keep information feedback with customers and suppliers in order to meet their requirements and enable us to know how these customers assess products and services. This knowledge will also help us enable the organization to adapt the end product and service to the requirements of customers. It is justified that an open learning context must promote the acquisition of knowledge from external agents to the shipyard. Must be redesigned the IT tools taking into account the advice from internal and external agents of the company because a good use of IT increases the product and services.

On the other hand, in accordance with the more than 100 interviews, the use of IT allows reusing existing designs and achieving a higher efficiency in the performance of workers and engineers. These circumstances may lead to a reduction of working hours and work with quality technology for the next design. Also, thanks to the use of IT, the relationships with external agents of the company can be reinforced. Maybe that is why the Spanish shipyards are trying to improve their results by means of investments in information technologies. The establishment of information technologies is a complex process influenced by many factors like what customers want and require (Chiasson and Lovato, 2001). Information technologies contribute to the creation of results but if the establishment of these technologies does now follow the process described in the model proposed, e.g. it is poorly planned and developed, it is to be expected that the results obtained will not be the same. That is, frustration will be generated in the agents in charge of using them owing to a wrong use and a delay in the individual development (Templer, 1989).

Results show that companies facilitating the interaction between customers and the information provided by IT and which are able to obtain Knowledge as well as to specify and internalize it increase their business results. This confirms that a company able to adapt their business processes quickly and which is flexible regarding the requirements of its “agents” will increase their financial results (Cegarra et al, 2006). That is, the shipyard will facilitate and encourage the use of information by the different agents to the extent of enabling them to take the initiative in the development of new products and processes, or modifying those already-established business processes as a reply to the demand. Also, it is very important to consider the relationship between knowledge codification and implemented information technologies. The results obtained confirm the opinion of Hsiu-Fen and Gwo-Guang (2005): they agree with the personal knowledge application circumstance that facilitates the workers to use the existing knowledge and to create new knowledge starting from codified knowledge. Both processes -codification and reutilization of knowledge- are necessary to adopt and are a good use of IT.

In addition, this research has justified that an open learning context must promote the acquisition of knowledge from external agents to the shipyard. The later distribution and use of that knowledge among the members of the shipyard is promoted and facilitated by the use of IT. According to these results, the Spanish Naval Industry must redesign their IT tools taking into account the advice from internal and external members of the company because they both help and provide knowledge to it. A

good use of IT increases the product and services complying with that stated by Dewett and Jones (2001) who state that: "the presence and good use of IT increase communication speed more accurately and facilitates the information communicated to be stored and classified easily and with lower costs".

Finally, if information technology systems are focused on knowledge from external agents, companies have more possibilities to increase business results. Besides, during the interviews we observed that the shipyard invests in those tools provided by the web. However, it does not properly use those tools providing a work social network and the virtual market and therefore the company is unable to optimize results. In short, in certain situations a social use of knowledge will enable the shipyard to adapt to market changes and in others to foresee those changes. However, from now on a change of direction would be advisable in many knowledge management activities towards the research of knowledge codification by mainly assessing information technologies, analysing why they are important and what are the most useful tools to codify that knowledge.

In the case analyzed the results suggest that it is important to say that giving the customers and suppliers greater access to the IT tools used by the shipyard, then these groups would be more satisfied before, during and after receiving the products. Also, customers could help the company in the design, use, safety, trials, etc., of the different equipment. Ultimately, the customers are the operators of the final product and have a vision and knowledge which can execute the knowledge existent in the shipyard.

Interviews also suggest that a larger quantity of workers should have more access to the different IT tools used by the company and can participate in the use of IT tools. In this manner, intermediate level engineers could access the knowledge from workers to develop the work better and ensure a better knowledge transfer to other departments, managers, and external members of the company. Completing the above, it is necessary for the engineers to have tools such as laptops at home to have access to the IT tools of the company and so be able to coordinate professional and personal life. Another measure to apply could be the consideration of incentives for targets of codified and upgraded knowledge which can be applied to managers as well. With regard to retired and pre-retired workers it is necessary that they have direct contact with the different shipyard members; access to the shipyard infrastructure; and access to IT tools used by the shipyard; since the importance of both the codification as well as the reutilisation of the knowledge should not be forgotten. Only when the technologically advanced solutions are combined with the human creativity and the knowledge, will the shipyard be able to create a real competitive advantage in the market.

4. Limitations and future lines of investigation

We know that this research has important limitations. The shipyard where the investigation was done is the only Spanish shipyard dedicated to submarines construction in Spain. For this reason, the shipyard may not be representative of other Spanish companies belong to the Spanish Naval Sector for types of products and services offered. Moreover, future lines of investigation of other sectors should be outlined.

We considered reproducing our investigation into PYMES (Small and Medium-sized companies) to strengthen our article, leading to generalizing the results to other contexts. In addition, the comparison between big companies and PYMES should be carried out taking into account the management size, because several studies offer evidences about the relation between the IT and the size of the company (Brynjolfsson & Hitt, 1998).

On the other hand, the study has been carried out at national level. For this reason, to generalise the results can be difficult because if the geographical scope was wider or the study was made in another country or group of countries, we could obtain similar or different conclusions. We propose that the influence of institutional factors in the country in the implantation and use of the IT would lead to generalize the results.

Finally, it would be interesting to study how the different tools of the IT separately affect the business results.

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References

Arjonilla, S.J. and Medina, J.A. (2002). La Gestión de los Sistemas de Información en la Empresa. Ed. Pirámide.

Beck, L., Janssens, W., Debruyne, M. & Lommelen, T. (2011). A Study Of The Relationships Between Generation, Market Orientation, And Innovation In Family Firms. Family Business Review, 24, 193-196.

Bonifacio, M.; Bouquet, P. and Traverso. P. (2002). Enabling Distributed Knowledge Management: Managerial and Technological Implications. Computer, 3 (1), 23-29.

Brynjolfsson, E. and Hitt, L. (1998). Information Technology and Organizational Design: Evidence from Microdata, MIT Sloan School, Working Paper.

Cegarra, J.G.; Alonso, J. and Monreal, A.F (2006). Influencia del Uso de las Tecnologías de Internet en el Capital Estructural. Investigaciones Europeas de Dirección y Economía de la Empresa, 12 (3), 217-228.

Chiasson, M.W. and Lovato, C.Y. (2001). Factors Influencing the Formation of a User's Perceptions and Use of a DSS Software Innovation. Database for Advances in Information Systems, 32 (3), 16-35.

Cohen, D. (1998). Toward a Knowledge Context: Report on the First Annual U. C. Berkeley Forum on Knowledge and the Firm. California Management Review, 40 (3), 22-39.

Chen, Y. J.; Chen, Y. M. and Chu, H. C. (2001). Enabling Collaborative Product Design through Distributed Engineering Knowledge Management. Computers in Industry. 59 (4), 395-409.

Chen, C-C. (2011) "Factors Affecting High School Teachers Knowledge-Sharing Behaviors. Social Behavior and Personality", Vol 39, No.7, pp. 993-1008.

Dewett, T. and Jones, G.R. (2001). The Role of Information Technology in the Organization: A Review, Model and Assessment. Journal of Management 27 (3), 313-346.

Eisenhardt, K.M. (1989). Building Theories from Case Study Research, Academy of Management Review, Vol. 14, 4, 532-550.

Ellram, L.M., (1991). Supply Chain Management: The Industrial Organisation Perspective. International Journal of Physical Distribution and Logistics Management, 21 (1), 13-22.

Fahey, L.; Srivastava, R.; Sharon, J.S. and Smith, D.E. (2001). Linking E-business and Operation Processes: The Role of Knowledge Management. IBM Systems Journal, 40 (4), 889-907.

Gold, A., Malhotra and Segars, A. (2001). Knowledge Management: An Organizational Capabilities Perspective. Journal of Management Information System, 18 (1), 185-214.

Hagel, J.III. and Armstrong, A.G. (1997). Net Gain: Expanding Markets Through Virtual Communities, Harvard Business School Press, Boston.

Handzic, M. (2011). Integrated Socio-Technical Knowledge Management Model: An Empirical Evaluation. Journal of Knowledge Management, Vol 5, No 2, pp 198-211.

Hannan, M.T.; Burton, M. D. and Baron, J.N. (1996). Inertia and Change in the Early Years: Employment Relations in young, High Technology Firms. Industrial and Corporate Change 5 (2), 503-506.

Harrington, S.J., and Guimaraes, T. (2005). Corporate Culture, Absorptive Capacity and TI Sucess. Information and organisation, 15, 39-63.

Hsiu-Fen, L. and Gwo-Guang, L. (2005). Impact of Organizational Learning and Knowledge Management Factors on E-business Adoption. Management Decision, 43 (2), 171-188.

Imrie, R. & Morris, J. (1992). A review of recent changes in buyer-supplier relationships. Omega international journal of management science, 20(5/6), 641-652.

Juceviciene, P. and Edintaite, G. (2010) Study-Relevant Organizational Knowledge of an Academic Department, Social Sciences, 2, (68), 16-25.

Kaplan, R.S. and Norton, D. (2000). The Balanced Scorecard: Translating Strategy into Action (The Balanced Scorecard), Gestion 2000, Barcelona.

Kotler, P. (2000). Marketing Management, Prentice-Hall, 11th Edition Upper Saddle River. New Jersey.

Kukko, M. & Helander, N. Knowledge Sharing Barriers in Growing Software Companies. System Science (HICSS), 2012 45th Hawaii International Conference on, 4-7 Jan. 2012 2012. 3756-3765.

Leung, Nelson K. Y., Lau, S. K. and Fan, J. (2009) "Enhancing the Reusability of Inter-Organizational. Knowledge: an Ontology-Based Collaborative Knowledge. Management Network", Electronic Journal of Knowledge Management, Vol 7, Issue 2, pp 233-244.

Lin, H.F. and Lee, G.G. (2005). Impact of Organizational Learning and Knowledge Management Factors on E-business Adoption. Management Decision, 43 (2), 171-188.

Malhotra, Y. (2005). Integrating Knowledge Management Technologies in Organizational Business Processes: Getting Real Time Enterprises to Deliver Real Business Performance. Journal of Knowledge Management, 9 (1), 7-28.

Maracine V., Iandoli L., Scarlat E. and Nica A.S. (2012) "Knowledge use and Sharing into a Medical Community of Practice; the Role of Virtual Agents (Knowbots)", Electronic Journal of Knowledge Management, vol. 10, issue 1, pp 64-81, [online], http://www.ejkm.com/volume10/issue1.

Meroño, A.L.; Soto, P. and López, C. (2005). Examining E-business Impact on Firm Performance through Web Site Analysis. 26th McMaster World Congress, Hamilton, Ontario, Canada, Enero 19-21.
Nonaka, I. (1994). A dynamic Theory of Organizational Knowledge Creation. Organization Sciencie, Volume 5, Issue 1, 14-37.
Nonaka, I. and Takeuchi, H. (1995). The Knowledge-creating Company. How Japanese Companies Create the Dynamics of Innovation. Oxford University Press, New York.
Porter, M. E. (2001). Strategy and the Internet. Harvard Business Review, 79 (3), 62-78.
Rambo N. & Beahler C.C. (2003) Knowledge-based Information and Systems. In: Public Health Informatics and Information Systems (eds P.W. O'Caroll, W.A. Yasnoff, M.E. Ward, L.H. Ripp & E.L. Martin), pp. 352–375. Springer, New York.
Sandhu, M. S., Jain, K. K. and Ahmad, U. K. (2011) "Knowledge sharing among public sector employees: Evidence from malaysia ", International Journal of Public Sector Management Decision, Vol.24, No.3, pp. 206-226.
Shane, S.A.; Venkataraman, S. and MacMillan, I. (1995). Cultural Differences in Innovation Championing Strategies, Journal of Management 21 (5), 931-952.
Sinkula, J.M.; Baker, W. E. and Noordewier, T. (1997). A Framework for Market-based Organizational Learning: Linking Values, Knowledge and Behavior. Journal of the Academy of Marketing Science, 25, 305-318.
Templer, A. (1989). Human Resource Managers and the New Technology Agenda. Journal of General Management, 15 (2), 73-80.
Willcocks, L. & Sauer, C.,(2000). Moving to E-business. Random House Business Book, London.
Woodman, M. & Zade, A., (2012). Five Grounded Principles for Developing Knowledge Management Systems. EJKM.
Yin R.K. (1989). Case Study Research: Design and Methods. Sage, Thousand Oaks, CA.