

KNOWLEDGE MANAGEMENT PRACTICES OF CONSTRUCTION PROJECT MANAGERS

Esther Ly¹, C.J. Anumba² and P.M. Carrillo³

*Centre of Innovative Construction Engineering, Department of Civil & Building Engineering,
Loughborough University of Writing, Loughborough LE11 3TU, UK*

The construction industry delivers large, expensive, custom-built facilities at the end of a construction process. It is a strong, knowledge-based industry that relies heavily on knowledge input. As result, the concept of knowledge management (KM), which saves much time and energy and prevents “Reinventing the vehicle”, has been increasingly popular in recent years within the industry, and is being recognized to achieve higher client satisfaction, better timing & cost control and innovation. However, owing to the time constraint and cultural practice of the construction industry, capturing and transferring project knowledge have not been well achieved. Moreover, good knowledge management does not result from the implementation of sophisticated or tailor made KM tools, human factors play an important role. Meanwhile, research and development had mostly focused on organizational KM; therefore, this paper aims to review current personal KM adoption by construction project managers, which is an untapped area for current KM development.

Keywords: personal knowledge management, project managers, construction industry.

INTRODUCTION

Knowledge management is as old as the existence of human beings (Lytras and Pouloudi 2003, Wigg, 1999). Nicou et al. (1994) stated that the prime commodity for a professional is brainpower and knowledge provides as a competitive strategy that goes beyond products and services. Business focus keep evolving, it changed from people focus in the 70s to team focus in the 80s, then followed by process focus in the 90s to knowledge and adaptability focus in the 20s now (Convey, 2004). Prusak (2001) stated that globalization is the most obvious and clearest culprit. Mertins et al.(2003) noted that a critical mass of researchers, academics, businesses and knowledge workers has been reconfigured, restructured and consolidated into a coherent framework to address current and future research needs for knowledge management. Besides, the increasing number of organizations implementing or interested in the implementation of knowledge management (KM) demonstrate the importance of managing organizational knowledge (Al-Ghassani et al., 2002).Wigg (1999) noted that KM will continue to evolve and draw support from many theoretical and methodological areas.

Generally speaking, knowledge can be defined as a mixture of experiences, practices, traditions, values, contextual information, expert insight and a sound intuition that

¹ cvel@lboro.ac.uk

² CJAnumba@lboro.ac.uk

³ pmcarrillo@lboro.ac.uk

provides an environment and framework for evaluation and incorporating new experiences and information (Convey, 2004). The definitions of KM are numerous, and a possible reason for the vagueness and ambiguity in defining KM seems to be that the word 'Knowledge' means different things to different people (Hlupic et al., 2002). Knowledge comes in two basic varieties, explicit and tacit, which are also known as formal/codified and informal/uncodified knowledge (Harrington 2004, O'Dell 2004, Carrillo et al. 2004, Koskinen 2004). O'Dell (2004) stated that about 20% of what an organization contains is explicit, explicit (formal/codified) knowledge is easier to document and share. While the other 80% of what an organization knows is tacit (informal/uncodified) knowledge, it is harder to articulate, steal and transfer, but it leads to competency and a higher competitive advantage.

This difficulty in articulating the knowledge was studied by Disterer (2002), who noted that there are considerable individual and social barriers exist to articulating and documenting individual knowledge and experiences. He argues that analysis of failures and mistakes would be very valuable, but usually an open and constructive atmosphere to articulate and analyze errors is missing. Khalfan et al. (2002) noted that many practitioners and researchers have acknowledged the limitations of current approaches to managing the information and knowledge relating to and arising from a project.

Extending these difficulties to the KM case, Carrillo et al. (2004) found from a survey to identify the main barriers in implementing KM strategies, that the main reason for KM implementation barriers was the lack of standard work processes. Lack of time is another identified significant factor, given the project based nature of construction organizations, this is most obviously demonstrated in the lack of detailed post-project reviews that involve the entire supply chain and the subsequent dissemination of lessons learnt (Carrillo et al. 2004, Robinson et al. 2001).

Although this difficulties in implementing KM strategies, Convey (2004) explain why it's worthy adopting them. He suggested several reasons why projects fail, from which insights of managing a project properly and successfully can be discovered. They are summarized as below:

- Failure to adhere to committed schedule caused by variances, exceptions, poor planning, delays, etc.
- Poor resources utilization due to unavailability of proper skills, poor time utilization and misalignment of skills and assignments.
- Improper management of project portfolio as a result of selecting project wrongly, inability to identify high risk projects, poor control over interdependence between projects.
- Loss of intellectual capital due to the lack of means for knowledge, staff leaving the organization.

Once the benefits of KM are highlighted, in the next section we discuss its importance in the construction industry.

KNOWLEDGE MANAGEMENT IN CONSTRUCTION

Kelleher and Levene (2001) highlighted some good practice examples of KM adoption; industries that benefited from KM adoption include consultancy, consulting firms, financial services and oil companies. A study conducted by Ernst and Young in

1997 among 431 US and European companies found many reported benefits from having organised KM programs (Koenig and Srikantaiah, 2003). They include increased innovativeness, enhanced efficiency, better decision making, faster responsiveness, enhanced flexibility, improved quality, reduced duplication of effort and greater employee empowerment.

The construction industry delivers large, expensive, custom-built facilities at the end of a construction process. This is a strong, knowledge-based industry that relies heavily on the knowledge input by different participants in a project team (Carrillo et al., 2004). Earlier one, Robinson et al. (2001) found that only a relatively small proportion of construction organizations have implemented KM systems. Carrillo et al. (2003) noted that in a recent survey of construction organizations, about 40% already have a KM strategy and another 41% plan to have a strategy within a year; 81% perceived KM as having the potential to provide benefits to their organizations, and some have already appointed a senior person or group of people to implement their KM strategy. Though there is an increasing awareness of the importance of KM concept, it still takes some time for the construction industry to invest on it as the construction industry always needs to face increasing demands as shown in the below figure.

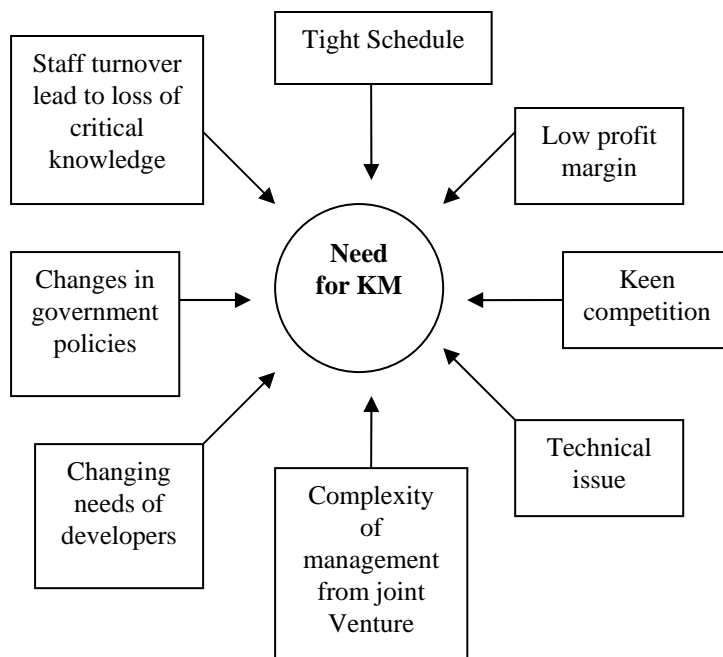


Figure 1. Factors contributing to the need of KM in the construction industry

PROJECT MANAGEMENT

Project management is key for obtaining improvements in business processes, and most organisations that are not performing well in it have demonstrated a high failure rate of projects (Covey, 2004). Key stages of a project are the Initiating, Planning, Executing, Controlling and Closing stages. Each stage has their unique characteristics, and these stages may overlap one another, which is more obvious for large-scale projects, in which re-planning works are highly possible within the entire project duration. As engineering projects increase in complexity, the benefits of project management become ever clearer (AMEC, 2005).

There are success factors identified to help achieve project success. One of the examples of success factors for project management is summarized by Quarry (2004). He stated that successfully project planning includes availability of written specifications on outcomes, budget, timeline documented and agree, choice of best structure, obtaining required authority, estimation of cost & resources realistically, learning from previous experience and risk assessment with contingency plans. According to Mawdesley et al. (1997), activities as monitoring and record keeping are important in providing vital information for project control, but they are often seen as chores and are not carried out as systematically or as thoroughly as they should be. Masterman (2002) noted that usually the constraints are physical and he listed many sources of risk when implementing construction projects. They include changes from client, government regulatory authorities, project funding and other financial matters, design, local conditions, construct. In conclusion, dissemination and usage of existing knowledge is critical and the success of projects depends heavily on the right combination of knowledge and experiences (Disterer, 2002).

THE PROJECT MANAGER (PM)

The Project Manager is a special type of professional with very special skills and training (Convey, 2004). In the construction industry, project managers manage, coordinate, and supervise the construction process from the conceptual development stage through final construction on a timely and economical basis. They are responsible for coordinating and managing people, materials, equipment, budgets, schedules, contracts, and safety of employees and the general public (Bureau of Labour Statistics, 2005). In order to manage project teams successfully, the project managers should manage themselves, be good role models, select the right people with appropriate skills and experience, and know how to manage the people issues (Masterman, 2002).

PERSONAL KNOWLEDGE MANAGEMENT (PKM)

Management of personal information and knowledge at work is at the core of personal productivity but has only recently become the focus of many businesses (Davenport and Conway, 2004). Personal Knowledge Management (PKM) is a set of processes that a worker needs to set up in order to get the best out of his/her knowledge during his/her daily activities. Firestone (2005) described Personal Knowledge Management as an activity that people perform in order to improve the problem recognition, formulating attempted solutions and error elimination activities. While Dorsey (2004) stated that PKM should be viewed as a set of seven major problem-solving skills that have both a logical or conceptual as well as physical or hands-on component. They are retrieving, organizing, presenting, sharing, evaluating, analyzing and securing. Firestone (2005) also stated that PKM can overlap with interpersonal KM, group-level KM and organizational KM. PKM has often been considered as the missing block in most KM plans within knowledge intensive organisations (Davenport and Prusack, 1997 and Schreiber and Harbo, 2004).

The PKM activities can be classified in the following way (Firestone, 2005):

- Building relationships with others practicing PKM
- Producing knowledge about personal knowledge processing
- Storing and organizing knowledge about personal knowledge processing

- Crisis handling
- Resource allocation
- Changing knowledge processing rules

Having known the skills and activities of PKM, in order to develop a PKM system, the first step is to learn about one’s habit in managing their knowledge. A survey was conducted by Jones and Thomas in 1997 (Tsui, 1997) to reveal the popularity of PKM tools and the results are shown in Table 1. This provides an idea how people manage their knowledge. It can be noted that paper-based form of recording knowledge is still most commonly used, and electronic tools like Personal Digital Assistant (PDA) are also adopted. Other than the more traditional tools listed below, an increasing number of people are familiar with IT-based tools, such as internet, intranet, company database, MS office software, etc. Davenport (2003) commented that though people have lots of electronic devices, such as desktop computer at home, laptop computer on travels, personal digital assistant (PDA) and a typical cell phone, but none of them communicates very well with each other. Therefore, PKM is an art that needs to be further explored and developed such that it helps to maximize the value of knowledge that one possesses.

Table 1: Popularity of general PKM tools used by average person (Tsui, 1997)

Personal Digital Assistants (PDA)	To Do Lists	Address Books	Personal Organizers	Pocket Diaries	Appointment Books
5%	29%	22%	20%	17%	7%

Relating to the PKM applied to the construction industry, Egbu et al. (2002) noted that the advent of partnering, alliances, joint venturing, Private Finance Initiative (PFI) and Prime Contracting initiatives has necessitated even further collaboration and knowledge sharing in this industry. Carrillo et al. (2004) noted that many companies recognize that KM needs to be delivered through a number of complementary tools, and it is important to realize that not all the tools that support KM are IT tools, so companies are better advised to first identify specific KM problems and then determine the most appropriate tools, rather than first identifying a tool and then finding a problem to solve. It is believed that the PKM tools required by different Project Managers from construction parties like clients, architects, consulting engineers and contractors could be different and the basic principles should be more or less similar.

METHODOLOGY

The research topic about personal knowledge management of construction project managers is very new, there is not much literature review regarding it. Therefore, face to face in-depth interviews with experienced project managers is the best way to obtain a good picture how construction project managers manage their knowledge. Five project managers working for large scale civil engineering projects were selected and the interviews were guided by a semi-structured questionnaire. In order to maximize the information collected within the interviews, the questionnaire used were sent to them in advance and many of them had feedback on it before carrying out the interviews. After collecting information from the interviews as presented below, an analysis of their current knowledge practice will be carried out and a framework to ease their development of PKM will be developed at a later stage.

FINDINGS

Five construction project managers with experience in project management of five to twenty years were being interviewed. The range of scale of project that they had handled is large and wide, the largest one can reach up to 3.2 billion pounds in a very large scale construction project. Their duties ranges from project management, administration, planning, change management, financial control to implementation of computer system. As knowledge management had gradually gained its recognition in the past decade, so it was not surprising that all the interviewees had heard of it. The definition of knowledge management varies for different people. Knowledge management is being viewed as the retaining, using and sharing experiences and knowledge learned and the transfer of best practices, thus it helps in the prevention of reinventing of wheel. KM is also being viewed as the management of experiences and tacit knowledge at a personal or organizational level.

Viewing from the personal perspectives of KM adoption, KM can lead to more efficient application of knowledge, enhancement of personal development and improvement. Good personal knowledge management is believed to enable better consideration of wider picture to resolve issues faster. From the project perspective, KM is considered as a tool to prevent re-inventing of wheel, improve efficiency and productivity and do things better to suit the need of information hungry clients. Besides, KM is important to capture lessons and experiences learned from other projects, such that they can be used to train up young or new comers. Project managers mostly agree that sharing of knowledge is a critical area of knowledge management, it can avoid the duplication of effort and hence results in better time management.

The knowledge that the project managers are interested in includes the understanding of different forms of procurement in pre-contract stage and factors that aid decisions, processes of design and construction, duties of different parties at different stages, contractual issues, etc. Other than that, an experienced project manager that has over ten years of experience in project management highlighted the need of understanding human behaviour, which is particularly crucial in negotiation and handling conflicts. He also noted the need of board knowledge of general theories in other professions and areas and the need of understanding of client environment. Therefore, other than hard skills like project control, planning, estimating, supply chain management, financial control; soft skills in dealing with client, people is also important to fulfil the demanding need of a project manager.

The result that is in common for busy executives like project managers is that they rely much on the company intranet to obtain information and contact persons that they need and many companies have delegated staff to update information on the intranet. Besides intranet, extranet is also provided for site staff that could not access to the company's server on site. Intranet serves not just as a good source for obtaining information; it is also helpful in sharing knowledge by posting standard documents and discussions in online forums. Though sharing on intranet is a very easy and efficient way, it needs to build trust to facilitate the use of this channel. Face to face internal meeting or forums organized by professional bodies is also a good channel for sharing knowledge and experience. Forum is believed to be a good starting point to build up the community of practice. A project manager also noted that his company has even set up a knowledge management interest group recently, as it is quite new, so it has not been functioned properly.

There are many other ways that a project manager can use to acquire the knowledge they need. By 'live and learn' and acquiring new knowledge and experience from the projects they handle is the fundamental one. Attending courses like CPD (continue professional development), company training, conference and presentation talks is another source. Besides, traditional way like going to the library, watching TV programs, reading journals, magazines like Project Management Today is still commonly adopted. Meanwhile, networking is recognized by senior project managers as a very efficient way to avoid stumbling and hence know-who in problem solving is highly regarded.

Generally, project managers do not set special criteria for capturing their knowledge. A senior who had project management for over 20 years and is now a director noted probably more than half of the knowledge in Civil Engineering is tacit. He concerns universality as the criteria for knowledge capture, since knowledge captured should have high value for sharing, if it is too particular, it might be difficult to apply. Another director who had project management experience for over fifteen years highlighted the importance of base data, he believes 'garbage in, rubbish out', so base data should be consistent and flawless.

Many of them noted that they use a combination of IT and non-IT tools. Owing to time constraint and the incompatibility of the existing tools, project managers do not have a sound personal knowledge management system. MsProject, Outlook, PDA, notepad, FrontPage, PowerPoint, Excel, intranet, internet are typically used. However, much of the tacit knowledge and experience is still remain inside the head. Among the IT-tools, intranet is good as it is frequently updated, but it is not structured enough to facilitate searching and retrieving of information. As highlighted above, intranet also has another problem; it does not have review process, quality of base data remains a big concern. Moreover, street credibility is found dangerous in engineering. Therefore, experienced project managers are alert in selecting information.

For non-IT tools, they include directory of people, know-who contacts, cupboard for filing documents. The weaknesses for non-IT tools are that they are not easy to retrieve unless there is a very good document control system that is being updated frequently, and hard copies like books are heavy to carry around. No matter what IT or non-IT tools are being used, the general problem encountered by project managers is the lack of time in filing and classifying data. In fact, sound classification of data is not easy to achieve for many project managers. Among the project managers being interviewed, there is a senior project manager who is fond of exploring ideas to better manage and share his experience and knowledge, he has set up his own webpage to post important pieces of work, paper and articles that had come across for personal use and sharing. He even developed hyperlink to link up keywords for easier searching. One project manager noted the expectation to be able to access to the internet in the underground. Besides, voice recognition is a function that is not available in managing knowledge, other than reading, listening to tapes is one of the suggested ways of acquiring new knowledge.

CONCLUSIONS

Knowledge Management has proven its importance in practice and many international organizations have significant amount of investments in better managing their knowledge and encourage sharpening the competitive advantage from their intellectual assets. Project Managers of the construction industry have different practices in the Personal Knowledge Management, while they are constantly under the

pressure to deliver the project on time and cost. The adoption of the correct PKM tools by the Project Managers would lead to improved results in the project and reduces the risk of its failure. It is found that the more senior the level of a project manager, the more the emphasis is put on know-who, and the more they are willing to share their knowledge as they believe the mutual benefits earn from sharing. Moreover, it is highlighted that experience and practice needs certain infrastructure to be applied properly, core competence is hard to copy, so sharing of knowledge even with direct competitors might not be a threat. Nevertheless, project managers are more willing to share knowledge and experience in technical and managerial areas. Marketing, pricing and company strategy remain as sensitive and confidential and are not available for sharing. Owing to the tight project schedule and the increasing complexity of construction projects, project managers are willing to improve their personal knowledge management skills and would like to explore software that might help them in management of their knowledge. However, that intention is not realized mostly due to the lack of time and the high license cost of many software at both personal and organisational level. Besides, a senior project manager noted that he expects flexibility in approaching projects, and standardization should be avoided for experienced project managers. He agrees with process, but not with procedures. Similarly, personal knowledge management should be adjusted according to individual preferences and meets different needs.

REFERENCES

- Al-Ghassani, A.M., Robinson, H.S., Carrillo, P.M. and Anumba, C.J. (2002) *A framework for selecting knowledge management tools*. Internal report, Department of Civil and Building Engineering, Loughborough University, UK.
- Allan, B. (2004) *Project Management Tools and Techniques for today's ILS professional*. Facet Publishing, London, 180.
- AMEC (2005) *Project Management*. <http://www.amec.com/services> (Accessed 1/3/2005)
- Baldwin, M.D. (2000) *The Strategy of Succession Planning. Compass points featured article*. http://www.strategyletter.com/cp_0100/cp_fa.asp (Accessed 21/3/2004)
- Barth, S. (2004) *The Power of One. Knowledge Management Magazine*, Dec 2000. <http://www.destinationkm.com/articles> (Accessed 27/5/2004)
- BLS (2005) *Bureau of Labour Statistics*, U.S. Department of Labor. <http://www.bls.gov/oco/ocos005.htm> (Accessed 9/3/2005)
- Carrillo, P.M., Robinson, H.S., Anumba, C.J. and Al-Ghassani, A.M. (2003) *A Framework for Linking Knowledge Management to Business Performance*. *Electronic Journal of Knowledge Management*, Vol.1, Issue 1, 1-12.
- Carrillo, P., Robinson, H., Al-Ghassani, A. and Anumba, C. (2004) *Knowledge Management in UK Constructions: Strategies, Resources and Barriers*. *Project Management Journal*, Sylva: Apr 2004, Vol.35, Iss.1, p.46.
- Chun, W.C. (2003) *Personal Knowledge Management in the Information Age*. http://choo.fis.utoronto.ca/workshops/choo_PKM_2003sp.pdf, 19-22. (Accessed 20/7/2004)
- Conway, S., Sligar, C. (2002) *Unlocking Knowledge Asse*. US, Microsoft Press, 42.
- Covey, S.R. (2004) *The Five Pillars of Organizational Excellence*. *Quality Congress. ASQ Annual Quality Congress Proceedings*. Milwaukee: 2004. Vol.58, p.191, 11pgs.

- Davenport, T., Prusack, L. (1997) *Working Knowledge: How Organizations Manage What they know*.
- Davenport, T. (2003) *Serenity now. If Business don't find a way to help the knowledge worker manage information technology, today's confusion will lead to tomorrow's insanity*. CIO. Framingham. Aug 1, 2003, Vol.16, Iss.20, 1.
- Davenport, T., Conway, S. (2004) *Decoding Information-Worker Productivity*. Optimize. Manhasset. Apr 2004, 66, 3 pgs.
- Davies, A. (1999) *A Strategic Approach to Corporate Governance*. Gower, Hampshire, England, 11, 63-67, 92-93.
- David Skyrme Associates (2003) *Knowledge Management: Making Sense of an Oxymoron*. <http://www.skyrme.com/insights/22km.htm> (Accessed 26/5/2004)
- Deham, G. (2005) *Knowledge at Work*. <http://denham.typepad.com/km/> (Accessed 10/5/2005)
- DiPiazza, S.A. (2002) *Global CEO of Pricewaterhouse Coopers*. World Economic Forum.
- Disterer G.. (2002) *Management of Project Knowledge and Experiences*. Journal of Knowledge Management. Kempston:2002. Vol.6, Iss.5, p.512.
- Dorsey, P.A. (2004) *Overview of Personal Knowledge Management*. <http://www.millikin.edu/webmaster/seminar/pkm.html> (Accessed 14/5/2004)
- Egbu et al. (2002) *The Influence of Knowledge Management and Intellectual Capital on Organizational Innovations*. Internal report, School of the Built Environment, Faculty of Health and Environment, Leeds Metropolitan University.
- Foster, F. (1999) *Justifying Knowledge Management Investments*. Knowledge and Process Management. Vol. 6, No.3, p.154-157.
- Firestone, J. (2005) *Personal Knowledge Processing and Knowledge Management*. <http://radio.weblogs.com> (Accessed on 10/5/2005)
- Harrington, H. J. (2004) *The Five Pillars of Organizational Excellence*. Quality Congress. ASQ Annual Quality Congress proceedings. Milwaukee: 2004, vol. 58, p.191, 11 pgs.
- Hlupic V., Pouloudi A. and Rzevski G. (2002) *Towards an Integrated Approach to Knowledge Management: 'Hard', 'Soft' and 'Abstract' Issues*. Knowledge and Process Management. Apr/Jun 2002; ABI/INFORM Research, p.90-102.
- Kamara, J.M., Anumba, C.J., Carrillo, P.M. (2002) *A CLEVER Approach to Selecting a Knowledge Management Strategy*. International Journal of Project Management. Vol. 20, Issue 3, April 2002, p.205-211.
- Kelleher, D., Levene, S. (2001) *PAS 2001 Knowledge Management: A guide to good practice*. Price Water House Coopers, 84.
- Khalfan, M.A., Bouchlaghem, D.M., Anumba, C.J., Carrillo, P.M. (2002) *A Framework for Managing Sustainability Knowledge, the C-SAND Approach*. Internal report, Department of Civil and Building Engineering, Loughborough.
- Koenig, M.E.D., Srikantaiah, T.K. (2003) *Knowledge Management Lessons Learned*. Medford, New Jersey, Information Today, Inc., 127, 150.
- Koskinen K.U. (2004) *Knowledge Management to improve Project Communication and Implementation*. Project Management Journal. Sylva: Jun 2004, Iss. 2, p.13.
- Lytras, M.D., Pouloudi, A. (2003) *Project Management as Knowledge Management primer: the learning infrastructure in knowledge-intensive organisations: projects as knowledge transformations and beyond*. The Learning Organization. Vol.10, No.4, p.237-250.

- Masterman (2002) *Introduction to Building Procurement Systems*. London, Spon Press, 4, 9, 21, 23, 28, 60.
- Mawdesley M., Askew W., O'Reilly M. (1997) *Planning and Controlling Construction Projects, the Best Laid Plans*. Addison Wesley Longman, England, 258.
- Mertins, K., Heisig, P., Vorbeck, J. (2003) *Knowledge Management Concepts and Best Practices*. Berlin, Germany, Springer, 336-337.
- Murray, P.C. (2005) *Information, Knowledge, and Document Management Technology*.
- Nicou, M., Ribbing, C. and Ading, E. (1994) *Sell your Knowledge, the Professional Guide to Winning More Business*. Kogan Page, London.
- O'Dell, C. (2004) *The Executive's Role in Knowledge Management*. Huston, Texas, APQC, 1,3,4,11, 12.
- OGC (2004) *Project Manager*. <http://www.ogc.gov.uk/sdtoolkit/reference/roles/projman.html>
- Pearce, J.A. & Robinson, R.B. (2003) *Formulation, Implementation, and Control of Competitive Strategy*. McGraw-Hill, 7-10, 39, 42, 130.
- PMBOK (2000) *A Guide to the Project Management Body of Knowledge*. Project Management Institute. Newton Square, Pennsylvania USA.
- Prusak, L. (2001) *Where did knowledge Management come from?*. IBM Systems Journal. Armonk. 2001. Vol.40, Iss.4, p.1003, 6 pgs.
- Quarry, A. (2004) *Project Management Success Factors*. <http://www.7dimensions.com.au> (Accessed 1/12/04)
- Robinson, H.S., Anumba, C.J. and Al-Ghassani, A.M. (2001) *Knowledge Management: Towards an Intergrated Strategy for Construction project organizations*. Department of Civil and Building Engineering, Loughborough University, UK.
- Robinson, H.S., Carrillo, P.M. and Anumba, C.J. (2002) *Perceptions and Barriers in Implementing Knowledge Management Strategies in Large Construction Organizations*. Proceedings of the RICS Foundation Construction and Building Research Conference, Glasgow Caledonian University, UK, p. 451-460.
- Rose K.H. (2001) *A Guide to the Project Management Body of Knowledge (PKBOK Guide)-2000 Edition*. Project Management Journal. Sylva: Sep 2001. Vol. 32, Iss.3, 58.
- Rwelamila, P.D., Talukhaba, A.A. and Ngowi, A.B. (2000) *Project Procurement Systems in the Attainment of Sustainable Construction*. Sustainable Development. Feb 2000, 8,1, ABI/INFORM Research, 39.
- Schreiber, T. and Harbo, K. (2004) *Information literacy and personal knowledge management*. Nord I & D, Knowledge and Change, 2004.
- Snider, K.F. and Nissen, E. (2003) *Beyond the Body of Knowledge: A Knowledge-flow Approach to Project Management Theory and Practice*. Project Management Journal. Sylva:Jun 2003, Vol.34, Iss.2, 4.
- Tsui, E. (2002) *Technologies for Personal and Peer-to-Peer (P2P) Knowledge Management*. CSL Leading Edge Forum (LEF) Technology Grant report.
- Wiig (1999) *Knowledge Management: An Emerging Discipline Rooted in a Long History*. Knowledge Research Institute, Inc.