Nurturing a Knowledge Environment for International Construction Organizations Through Communities of Practice

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Abstract

Purpose – The purpose of this research is to explore and test conceptual issues of how communities of practice (CoPs) are a recognized means of transferring knowledge.
Design/methodology/approach – Analysis of data, derived from reflection upon experience gained by close full-time engagement on three complex, large-scale engineering construction projects.
Findings – Five emerging themes that help to explain how CoPs may be nurtured to increase the effectiveness of project management are revealed: creating a knowledge environment, discovering and recruiting potential members, information sharing, time for communicating, and motivation and rewards.
Practical Implications –The development of CoP's requires time and the creation of a knowledge environment. In the complex world of international construction, most projects are unique physical undertakings, have teams that have never worked together before, have a limited duration, with participants located in numerous countries. Thus, there is a natural tension between the need and the reality that requires strong cross-cultural leadership, and special techniques, if CoP's are to be utilized.
Original Value of the Paper – This paper practically illustrates, based on rigorous organisational literature theory largely missing from the engineering community, how CoPs can be actually nurtured and used. The metaphor used to illustrate this should resonate strongly with construction engineers and designers.
Keywords: Communities of Practice, Project Management, Knowledge Management
Paper Type: Research Paper

1 Introduction

The purpose of this paper is to offer suggested techniques that may be employed to address the challenges of building and nurturing communities of practice (CoPs) in a global construction context. The key theme that emerges from both a general reflective practice learning study, specifically focused upon three complex construction-engineering projects, is the need for developing a knowledge environment. This can enhance learning within and across projects and in turn, it may help project teams to provide feedback knowledge to their host organisation.

The resource based view (RBV) of the firm, seeing an organisation as a collection of resources (objects) deployed to accomplish business goals (Grant, 1991), has been steadily challenged. Firms are increasingly being analyzed from a knowledge-based view (KBV) of the firm. This perspective holds that organizational success is better explained through the knowledge that it and its people deploy—thus making knowledge a key resource (Grant, 1996). Further, a dynamic capabilities view (DCV) of the firm has emerged to make sense of exactly how resources and knowledge are applied in uncertain, turbulent, complex, and volatile situations. This view holds that business success results from the innovative way that resources, particularly knowledge, are marshaled to rapidly respond to complexity (Spender, 1996; Teece, Pisano and Shuen, 1997; Eisenhardt and Martin, 2000; López, 2005). All three views of the firm stress knowledge, and an organization's capacity to learn and apply learning, as being pivotal to business success.

Organizations need to develop dynamic capabilities that are enmeshed with the creation and maintenance of a knowledge environment. Thus, it is vital for project management teams to advance project management effectiveness through using tools that help them share knowledge and dynamically adapt and use that knowledge

One tool for knowledge management that has been offered is the CoP. A CoP is defined as "groups of people informally bound together by shared expertise and passion for a joint enterprise" (Wenger and Snyder, 2000). There has been increasing interest in the concept of CoPs in relation to the construction industry, for example see Peansupap and Walker (2005a), Fernie *et al* (2003) and Jewell and Walker (2005). CoPs are being recognized as a strategic asset that needs nurturing (Storck and Hill, 2000). To achieve this, organizations need to create a knowledge environment that supports CoPs and their knowledge creation, transfer and use activities. Further, supporting technology and processes needs to be put in place to nurture CoPs (Walker, 2005). Knowledge management (KM) can be seen as the management of knowledge stocks and flows in a dynamic environment (Bontis, Crossan and Hulland, 2002) and so a metaphor that facilitates the visualization of this process could be useful. This paper presents a metaphor of KM as a pipes-and-valves system to describe the knowledge flow process, together with theoretical and actual examples of CoPs.

The paper is structured as follows. First the relevant literature is reviewed. Drivers of CoP creation and maintenance and supporting techniques to develop and sustain CoPs are then discussed using actual examples and then concluding comments are offered.

2 Supporting Theory

2.1 – The Importance of Creating a Knowledge Environment

A knowledge environment provides the foundation for a learning organization to discover, share, and create knowledge. For a knowledge environment to exist, the management of the firm must demonstrate leadership by inculcating trust, empathy (caring), power allocation, and effective communications (von Krough, 1998; von Krough, Ichijo and Takeuchi, 2000). This can be effectively achieved through CoPs associated with the firm. A knowledge environment thus nurtures a special feel or sense of a place where knowledge is valued, appreciated, and effectively deployed. Nonaka and Konno (1998) use the Japanese word *ba* to describe an environment where knowledge work is undertaken as part of normal business. They describe *ba* as an ecological/organic process that spirals through the Socialization, Externalization, Combination and Internalization (SECI) cycle.

In the *Socialization* phase of the SECI cycle, tacit knowledge is shared and exchanged. However, explicit knowledge often does not have an accompanying explanation of the context of that

knowledge. While explicit knowledge may be conveniently available, it is of less value than sound tacit knowledge because tacit knowledge embeds context. The output from this process *externalization*, involves turning value-added tacit knowledge into an explicit form—this includes documentation, explanation or recording the cumulative experience of the situation under consideration. This allows knowledge *combination* to occur where new knowledge is combined with existing knowledge stocks to make the result explicit. This also leads to people *internalizing* the knowledge whereby they experiment and then reshape in their mind how this knowledge is of use and how it can be usefully deployed. Essentially the SECI model is a learning model as well as a knowledge creation model and the cycle continues in a spiral rather than a circular mode. The effectiveness of the knowledge environment will be determined by the degree and consistency of the leadership and supporting human interaction infrastructures.

A knowledge environment in a global business should have a passion for creating; transferring and using knowledge generated through and with the project supply chain (including the customer) that spans national boundaries. Further, the call for flexibility and rapid adaptability lies at the core of a decade of business literature (Kanter, 1989; Teece *et al.*, 1997; Eisenhardt and Martin, 2000).

Firms need strong leadership (trust, power, empathy, and communications) to create and manage a knowledge environment. Also, to create and nurture a knowledge environment, business leaders need to demonstrate the importance of knowledge to the business, and instill the pursuit and sharing of knowledge as a passion into everyone in the firm. In addition, they must allow time for people to share their knowledge (von Krough *et al.*, 2000).

2.2 – The CoP Concept

The concept of CoPs is not new. Lave and Wenger (1991) describe CoPs in terms of situated learning and draw upon diverse examples from tailors in India to United States (US) corporations. The concept is rooted in groups of people sharing stories/parables as a means of transferring tacit knowledge and making sense of situations. Nishida (1958) said of Zen thinking that "one cannot grasp life by learning and knowing, but only by practicing". Wenger (1999) echoed this idea saying that knowledge is a matter of participating. Lave and Wenger (1991) argue that knowledge and practice cannot be separated in the transfer of knowledge between individuals. Therefore, effective CoP's will find root where groups of people share common interests and/or responsibilities. Hildreth *et al* (2000) cite observations made by Brown and Duguid (1991) that CoP members share a common sense of purpose and a need to know what other members know.

Hildreth *et al* (2000) also found in their studies that in distributed environments (global firms for example) the need for face-to-face meetings was important to maintain group cohesiveness. Also, regular electronic communications was used to refresh contacts. Wenger (1999) observed that there are two reasons why CoP's have not become prevalent—they are not easy to build, and that nurturing them requires substantial effort. However, since CoPs are organic by nature, they can spring up at times and places that run contrary to a firm's goals and objectives. An organization cannot directly dictate the structure and processes that define a CoP. Brown and Duguid (1991) state that communities are emergent from the process of an activity, and that a key issue for organizations is the detection and support for communities. According to Hildreth *et al* (2000), CoP's are formed by informal contact between members, and people who are doing similar work – CoP's have a common set of interests and are self motivated, not directed. Storck and Hill (2000), however, present a case where Xerox corporation effectively established and nourished a CoP to help it diffuse information technology (IT) through an alliance, as well as citing other examples of corporate sponsored CoPs—

nevertheless, they stress the relationship between the sponsored CoP and its members is one of being a supportive facilitator rather than a controller.

A number of construction companies around the world have established CoPs many use software tools such as a form of 'yellow pages' that identifies experts who can be contacted to answer specific technical questions. For example Peansupap and Walker (2005a) indicate how three major Australian contractors with global projects underway use CoPs both across the organization for technical knowledge support but also within project organizations for more local problem solving activities. Jewell and Walker (2005) also provide a case study of the United Kingdom (UK) contractor Carillion Plc using a software tool Sigma Connect^{tm} to link people with expertise at a number of levels. There are a growing number of contractors now deploying CoPs. In an Italian study, Gherardi and Nicolini (2002) considered the ways that CoP's interact – focusing on the perspectives of foremen, designers, contractors on safety. They found that discussions typically included discourse in practice, and discourse on practice (i.e. what happened and why it happened).

3 Research Method and Approach

The research approach used for work reported upon in this paper is primarily reflective practice based upon considerable experience in complex global construction projects. Reflective practice (Schön, 1983) has a long established acceptance in the management literature as a valid research methodology. Its original roots lie in action learning through change management (Lewin, 1947) and sensemaking, literally contemplating and reflection upon action in order to make logical sense out of events (Weick, 1995;2001). This approach has facilitated more formal research methods revolving around reflective practice, either as passive observer or more active participant in change cycles (Coghlan and Brannick, 2005), or being more intimately involved in the process through experiential learning. Coghlan and Brannick (2005) present a model of experiential learning as experiencing something, reflecting upon that experience, interpreting and making sense of what was experienced and taking action based on the interpretation. This process can be repeated for planning an action, taking the action, evaluating the action, diagnosing the evaluation in order to repeat the process. It is perfectly permissible to be a full participant in such a study (Coghlan, 2001). Sense (2005) in a recent project management study, was involved in very close contact with, and interacted with others participating in a knowledge transfer change initiative.

Data gathering sources for such studies vary. Much of the data can be gathered as observations, unstructured interviews, frequent casual and short dialogue with participants, and access to documentary data such as minutes of meetings, company procedures and project documentation sources (Sense, 2005). Much of the data for this paper was drawn from informal sources and dialogue that makes tacit knowledge explicit. The major danger to validity of this type of data is that it is subject to bias and misinterpretation, and so numerous different sources need to be accessed to ensure triangulation of data occurs, as well as careful clarification of interpretations made by the researcher to interviewees offering that data.

The principal researcher undertaking the study reported upon here has been intimately involved in project management roles in many countries on complex major engineering construction projects for over 25 years. The nature of the complexity included working in locations where the political and social environment was underdeveloped (compared to so-called western economies), thus much of the knowledge required to get tasks done needed a lot of local contextual knowledge. Three case studies were chosen from the principal researcher's international contracting emersion experience to illustrate the nature of problems studied. These case studies, described below, are representative of the knowledge transfer challenges experienced between teams from mixed culture backgrounds where this researcher participated in solving practical problems. Field notes of observations, data

from informal interviews with project participants and access to more formal data from project documents were used for analysis. Themes and conclusions were subsequently validated with colleagues and formed the basis of discussions through mentoring and coaching activities so that while details were not specifically validated, themes and conclusions were. Thus the data represents a distillation of both explicit and tacit knowledge.

The first case was a US$150 million Saudi Arabian power facility. This project had a project structure similar to Figure 1 (see section 4.1 below). In this case Company A was a consultant firm similar to a Project Manager or a Construction Manger, and Company B was a consortium of two companies. The second case was a US$500 Million power project in Thailand with a similar project structure, but where the Customer performed the work. The third case was a US$1.2 billion power project in India with the Customer (in this case the end user a consortium of three companies and a government agency) having Company A as the Project Manager, Company B was a consortium of three companies, and a Company C was a Development Bank. Each project had a team on the project site, and remote-location virtually interacted teams in other countries. The virtual aspect of the teams and CoP's will be discussed later in this paper.

4 Supporting Techniques for Creating and Sustaining CoPs

The supporting theory section established that organizations that wish to harvest knowledge and innovation must create an environment of trust, empathy, and effective communications. The type of procurement structure chosen will often determine the vibrancy of each, and the attitudes displayed by the customer can further serve to forbid, restrict, hinder, or inconvenience communications.

4.1 - Knowledge Pipelines

It may be useful to visualize how procurement systems can support effective knowledge transfer (flow) using the metaphor of a hydraulic system.

FIGURE 1 HERE

Figure 1 depicts a metaphor of knowledge transfer taking place through knowledge flows between contract parties. Thus, it presents knowledge pipelines for a basic procurement structure on a contract that requires two basic types of service in order to complete the project objective.

In this structure there is no contractual relationship between Company A and Company B, but there are contractual agreements between each of them and the Customer. In the construction industry Company A might be the designer and Company B the Constructor. In the information technology (IT) industry Company A might be the programmer and Company B the hardware supplier. In more complex procurement structures, Company A might be an end user, and company B might be a consortium, partnership, or alliance of firms. In these more complex structures the Knowledge Pipeline structure is repeated to include more and more valves and filters depending upon the procurement structure existing between the respective companies.

The pipelines (customer to company A and customer to company B) that pass information and knowledge are installed by the contract agreement, and described in the general and special conditions. The pipeline (horizontally company A to company B) relies more heavily for definition of how to transfer knowledge and information between Company A and B to construct the project after contracts have been awarded. For example if Company B is a constructor, the contract agreement with Customer A might contain instructions that Company B is to submit payment

requests to Company A rather than the customer. Control over decisions for the precise amount to pay, however, resides with the Customer. Most contract agreements include General and Special Conditions. General Conditions generically describe how the companies will conduct business (financial, legal, bonding, management techniques, etc.) and the explicitly permitted and implicitly (sometimes explicitly) prohibited communications. Special Conditions describe special circumstance for a specific project. For example, Special Conditions might include specific requirements for implementing a project in Kuala Lumpur. If the same Customer undertook the same project in Johannesburg, the General Conditions might be exactly the same, but the Special Conditions would be specific to the location. Many Companies strive to standardize the General Conditions so that they can maintain some basic consistency in the business approach, and they then use the Special Conditions to customize the business policies to the particular location. The General and Special Conditions describe the procurement structure and the responsibilities of the parties under the contract agreement. Procurement Filters are thus created by the Customer and are greatly influenced by the procurement structure selected.

Figure 1 also shows a Company Filter that is determined by the individual company (customer, designer, contractor, supplier, etc.). The culture of the company can often affect communication that is permitted and encouraged. The Company Filters also include ethics, market forces, personalities etc.—some firms are open to improvement and change, others believe that they lead their professions and deserve to be followed; some firms are authoritarian, while others democratic; some firms empower their employees, others discourage personal risk taking; some firms are culturally diverse, others are not. The endless varieties of corporate cultures that exist determine the degree to which communications are actively encouraged or passively discouraged. Issues of profit, risk and power (to mention but a few) also filter information that is shared. There are perhaps three possible options to implement a change that the customer desires. First, if Company A is doing the design and sees that a change will provide a means of correcting an associated design flaw without the other two parties being aware of this, then there could be a desire to withhold this information from the other parties – risk avoidance. Second, if Company B, a contractor, knows that there is one option that reduces their subsequent work, they might likewise push that agenda – increased profit. Third, if both of these ideas were made known, without risk of criticism or retaliation, then an innovative solution may be possible for all of the parties to pursue.

The valves shown in Figure 1 are controls on the information and knowledge that can flow between the parties. The customer to some extent, by reason of the General and Special Conditions, can control all valves. Valves can also be controlled by exercise of the customer's power to punish or reward, or by their right to change the contract agreement. However, the companies can also control the respective Company Valves. For example, Company A is a contractor that may cease providing information to the customer and/or Company B if it feels threatened by an impending lawsuit.

4.2 – CoP Examples and Possibilities

Using the Knowledge Pipelines and theory of CoP's and based upon experience from the three international case study projects as a foundation, techniques that can be used to take advantage of the formation and nurturing of CoP's can now be addressed.

As previously articulated, the published thinking regarding CoP's is that they are generally self-selecting, self-governing groups of people with common goals and interests, and that companies may have a supportive but non-intrusive role in their formation (Wenger, McDermott and Snyder, 2002). Therefore, CoP's cannot be directly controlled if they are to function effectively. However, as with other facets of Project Management, there are wide possible ranges of effective practices that can be

implemented. A company may encourage the formation of CoP's rather than take an initially passive approach of attempting to identify them.

FIGURE 2 in HERE

Figure 2 provides a matrix of standard functions on international capital investment projects. Different markets, such as IT, may have different functions, but the model presented could be appropriate to many industries. The three case study projects actually had additional offices in six other countries, but for readability reasons the locations to just two countries have been summarized. First, there are possible CoP's forming in a co-located single company as is the case with the design functions for Company A (column 1 rows 4, 5, 6 and 7) that are intra-company/co-located. These CoP's are perhaps the most obvious possibilities for interpersonal interaction is frequent, and in a common language. The three case study projects in fact had multiple offices in the USA for the same Company.

Second, the Project Manager group (third row for columns 4, 5 and 6) is a potential CoP formed from co-located multiple companies or inter-company/co-located. These CoPs often form as a matter of necessity due to the remote location from their home offices and the need to develop a local support group. The Electrical Design CoP (column 3 row 5 and column 6 row 5) is formed around people in the same disciplines, in the same company, but in different locations, or intra-company/ virtual. Procurement staff (column 2 row 8 and column 4 row 8) would form a CoP for people with the same discipline interests but from different inter-company/virtual companies. A CoP made up of Cost/accounting people (across row11) in multiple companies and multiple locations presents another possibility.

The third example is where the Ethnicity of individuals forms the basis for a CoP (column 1 row 13 and column 6 row 13). This is similar to the case of the Cost/Accounting people. In all cases the possibility exists of a CoP forming that crosses management levels within a firm.

Information and knowledge sharing that occurs within CoP's is often restricted by the position or power that CoP members have. Clerical people in a CoP would likely be from common power strata, designers from another, project managers from another, and so on. When CoP's form across power strata, there are added dimensions to the information and knowledge sharing—members can see aspects of the project that they otherwise would not have access to. For example a sponsor may be unaware of the type of problems that a designer may be encountering and similarly the designer may not understand the challenges facing the Sponsor. This added dimension offers richness to the communications that is not present when the CoP is from a single power stratum.

To recap, types of CoP's identified above include intra-company/co-located, intra-company/virtual, inter-company/co-located, and inter-company/virtual. Also, a CoP from any of these groups could also cut across the power strata's in the companies. The effectively infinite possible combinations can be obvious or subtle.

5 Examples and Illustration of Communities of Practice Needs

The literature suggests that CoP's are self-forming, self-directed, and self-motivating and that the nature of a CoP leads team members to trust one another, and induces their willingness to share information. Companies can, however, encourage the creation of CoP's but should nurture them after they have formed (Wenger *et al.*, 2002). Procurement structures influence the possibility of CoP's formation and determine whether or not they can be nurtured. Five major themes of CoP's

needs that emerged from analysis of the data that was based upon observation, reflection on experience and conversations with colleagues over the years are now explored: a knowledge environment; discovery of potential members; information sharing; time to communicate, and project motivation.

5.1 - Knowledge Environment

For CoP's to form there must first be a knowledge environment – consider CoP's as seeds, and the knowledge environment as fertile ground. Experience has shown that CoP's can form in barren conditions (Bid Enacted, Fixed Price) but only when the members are strongly pulled together. For example on the project in Saudi Arabia, an inter-firm/co-located CoP formed around diving in the Red Sea. The groups formed to create a way to escape from the demands of the project for a short time, in one of the few physical activities possible in the Kingdom. To use the seed analogy, the CoP formed through stubbornness and survived like weeds growing in concrete pavement. Wenger *et al* (2002) stress that for a knowledge environment to exist it takes a leadership commitment on behalf of all companies involved in the project.

CoP's formed on the project in Thailand in a different manner. Staff from each of the companies responsible for receiving materials for the project found that they had a number of practical interests in common. The Customer's Thai practitioners were motivated to join the team to learn about cutting-edge procedures and methods. Company A practitioners were interested in maintaining control over the materials needed for construction, and Company B practitioners were motivated to keep control over the spare parts that would be needed during operations. The CoP formed out of mutual dependence and grew into a group that took their lunches together and often met after work to socialize. The CoP was effective and knowledge was transferred between the practitioners. Although there was not a strong knowledge environment, project leadership encouraged the formation of the CoP and nurtured the group's activities.

5.2 - Discovery of Potential Members

The discovery of potential members of CoP's is the next challenge. Figure 2 indicates that there are certain groups that could naturally form CoPs, for example the electrical engineers. On the project in Thailand the Thai nationals tended to form their own ethnic group, as did the British and USA expatriates. A word of caution is necessary on this point. When people form CoP's from an ethnic, language, political, or religious perspective, it is important to monitor the group. It is possible for a clique to form, or worse still, a group that embraces homogeneity or segregationist leanings. However, experience shows these groups are the easiest to form and unfortunately can serve the opposite goals from those of creating a knowledge environment. Nevertheless, such groups can be linked with other groups. This approach used on the Thai case study project was to synergize linked CoP's—this proved to be very productive for the project.

An initial consideration for the discovery process is simply enabling people on the project to know who the other people on it are, and to learn something about their job and background. The Indian case study project used a roster of participants that included their name, business address, business phone, fax, email information, and position in the company. This also included a brief biography about each person in a standardized format, completed by each person, and reviewed by the Project Managers. These included information about the citizenship of the person, languages that they speak, their avocations and interests, and their religious beliefs.

The Internet can be used as a useful tool for managing company-wide CoPs accessible to anyone on

similar projects (Jewell & Walker, 2005). It is, however, important that any web site used is refreshed regularly to update new information from the members, and to add or delete members from the project roster. As there are multiple companies involved, a single person should be made responsible for maintaining the roster. The roster system should include software to enable a person to search for others by the Figure 2 dimensions. Those deemed appropriate for the project roster, including title and company, can be "suggested" when members of the project perform the search. For example one may search for rock climbers and receive a listing of people who have shown that as an area of interest. The software should also include a search mechanism where people can post a request or invitation, providing a field so that their interest may be added to the system (interest in cooking for example). Once CoP's form, then the member can request that their CoP name (Electrical Tiger Team for example) is annotated onto their individual records. This enables CoP's to form have an identity and it provides a way for the leadership of the project to recognize contributions to the project.

5.3 – Information Sharing

The Nonaka and Takeuchi (1995) SECI model serves as a useful starting point in understanding how knowledge creation occurs as a flow of information that transforms tacit knowledge to explicit knowledge. There must be three ingredients: information, context, and reflection for knowledge to be effectively transferred. Information is plentiful, so often the problem is sorting through all available data. This helps explain the rise in popularity of Internet search engines, research search engines, and critical reviews of literature, plays, movies, and etc.

To use information effectively, people must be able to find what they need in a convenient and recoverable manner. For example if you are a on a project in India and need to know what American Society of Mechanical Engineers (ASME) codes exist for a boiler, you would like to find a site where this information exists as a start. Once you find the site and see the organization of the code, you may be able to determine which sections or sections apply to your question. You could then zoom in on these and read them, save them, or print them out. Suppose that the ASME code tells you that the Authorized Inspector must affix a stamp to each boiler. In learning about what an Authorized Inspector is, you discover that you must now learn about how Authorized Inspectors are assigned in Japan—the information chain continues. In this example individuals need to be able to locate information sources, search through them effectively, and save or print this information.

Another form of information is personal experience. On all projects, assigned people bring large amounts of varied experience with them. Often, companies will publicize their experience in tender documents with statements like "over 150 years of experience". Project personnel have experience that spans years, geographical locations, cultures, languages, technical expertise, education, and political experiences. Each person also has different people skills and attitudes, and different ways and speeds of learning. Thus, there is a wealth of information and knowledge that resides in the individuals on the project. The challenge is to identify it, and make it available and searchable. The roster described earlier provides one useful knowledge or information search opportunity. On joining the roster, each person is asked to identify (by the use of an established menu of keywords) their experience and their education in topic areas pertinent to the project. Thus, when the roster is placed on the project website the information is readily available for others.

Having available and searchable information also aids in the formation of CoP's. A CoP cannot form if the people do not know where or how to find others of like interests. The roster is a way to fulfill this need and CoP's provide the context for the information that people have or discover. A CoP offers the benefit of a group with common interests that share a common language (unique blend of

syntax and vocabulary associated with an area of interest) or context. Knowledge sharing can then occur much more readily because there is a common context for the group to assimilate information and transform it into knowledge. There are also synergies that exist for the group to then transform knowledge into innovation as graphically displayed in Figure 1.

The project website is another tool that has been developed recently by various software firms. Numerous software packages are designed to support CoP's. Ahlemann (1993) provides a useful study that reviews project management systems that rely on a project web hub for project information. The KM Review (Anon, 2004), provides information on a number of CoP packages including ERoom, Sitescape Forum, EPS, Enable2, Business Workspaces, Sigma Connect, Simplify, Lotus/IBM, and Microsoft. These software packages provide a basic operating environment that enables CoP's members to find one another and collaborate. However, experience and the literature (Peansupap and Walker, 2005b), indicates that a major consideration is the Internet connection speed, especially in some developing countries. If a system is slow, then it does not matter how sophisticated the software is, people will not be inclined to use it.

Once the CoP's form, then there should be a convenient and recoverable communication system. Regardless of whether CoP's are co-located or virtual, an easy-to-use and rich system needs to be provided for CoP's to flourish. A CoP discussion space e.g. discussion boards, needs to be created and maintained where discussions and communications are not readily available to those outside the CoP. The software should permit recording of the discussions for later reference. It is ideal if the software provides the capabilities for on-line audio communications, file sharing, whiteboard, and application sharing. These tools will provide the CoP with a rich environment in which to exchange views and ideas. They are critical if the CoP is a virtual one.

5.4 – Time to Communicate

While it is generally believed that productivity has been increasing over the recent decades, metrics generally do not take account of the actual hours worked, only paid hours worked (ACIRRT - Australian Centre for Industrial Relations Research and Training, 1999). It is not unusual in the USA, for example, for salaried workers to work 50 or 60 hours per week. On international development projects, experience shows that 60-hour workweeks are standard. A key question for project leaders is when do CoP's have time to communicate. Generally, people have two choices, personal time or company time.

Wenger *et al* (2002) argue that leaders need to support organizational and individual learning by setting aside time when people can participate in CoP's, reflect upon their work, trade stories and ideas with co-workers, or catch up on professional theory and practice. Setting aside a dedicated hour twice a week for people to think will serve companies well. If such time is scheduled and budgeted for by project leaders, people have the chance to fall into the learning habit.

Time will also ultimately need to be provided for conferences, continuing education, and what some firms call "off-sites" or retreats. There is a significant body of literature on the benefits for these activities that speaks to the rejuvenations, synergistic, and team-building rewards from such opportunities (Edvinson, 1997; von Krough, 1998; von Krough *et al.*, 2000).

5.5 – Project Motivation

Leaders are responsible for motivating their project team members. Good leadership builds trust, shows empathy, shares power, and communicates effectively (Goleman, 1998;2000). Effective

leadership imbues a desire to emulate the leaders' characteristics throughout the organization (Bass, 1985). Motivation is critical for Project Management success, for creating a knowledge environment, and for the creation and nurturing of CoP's (Wenger, 1999).

Maslow (1943) argues that people have five types of needs in a hierarchy including psychological (food, water, clothing, shelter, etc), safety (from harm disease, etc), social needs (love, belonging, approval, etc.), esteem (self-respect, status, etc.), and self-actualization (growth, achievement, etc.). Herzberg *et al* (1959) concluded that motivating factors for employees were achievement, recognition, the work itself, responsibility, achievement, and growth. McFillen *et al* (1988) surveyed USA construction workers and found that there were three key issues to be addressed in motivating or de-motivating people in this industry: clarity of expectations and task, interference with the work (lack of information, lack of planning, lack of leadership, etc), and intrinsic reward or punishment. Odusami (2002) found in his study that the most important skills for a Project Manager were decision making, communication, leadership and motivation, and problem solving. Ogunlana and Chang (1998) conducted a survey of projects in Thailand to test Maslow's hierarchy for construction in a developing economy. Their findings concluded that field workers function at the basic level due to their poor economic circumstances.

Providing rewards and recognition is critical to success. Hagenbeek (2001) describes the strategy employed by HBG (the company name) was to enable people to participate, challenge people to participate, and communicate success. By challenging people to participate it is possible to reach those that are self-motivated. They can easily see the benefits to themselves, the company, and the project, and are likely to understand the benefits from sharing information and knowledge. As long as a knowledge environment exists and the tools and time are provided, these people will contribute and participate of their own free will. Successes can be celebrated in a variety of ways to reinforce and recognize the contributions for this group of people. von Krough *et al* (2000) highlight examples that can include best information of the month, best knowledge transfer of the month (two or more kudos), best contributor of the month, etc. These celebrations can be no-cost options taking the form of a monthly web appreciation from leadership, added time off during the week, parking close to the office, etc. This type of motivation will capture those who are driven by recognition and self-fulfillment.

von Krough (2000) also suggests examples of tangible rewards for sharing knowledge that can include such items as lunches paid for the contributor(s) for a week, paid training that has been requested, a week of time off, etc. At the more extreme end of the scale, bonus offerings and promotions can be set aside for year-end celebrations. A fund can be established for the top three best knowledge transfers on the project from an individual and from a CoP (care should be taken to keep the motivation as wide as possible and not just focus on CoP's for many people will chose not to participate in one). One suggestion is to arrange a multi-company panel of people to evaluate the contestants. The options are only bounded by the imagination of an organization's leaders. Financial reward options could capture other large groups of people who have financial issues that they need to address. These rewards will serve to provide the motivation that they see as most important – as the earlier example of site laborers suggests. This will also serve to capture knowledge from those individuals who have a mixed set of needs that include rewards, recognition, and self-fulfillment.

6 Conclusions

The strategic management literature cited earlier, for example (Teece *et al.*, 1997), argues that knowledge is a valuable and strategic asset. The major challenge in any environment from business to academia is the creation of a knowledge environment that motivates the willing exchange of

information and knowledge. Based upon experience and preliminary research outlined in section 3 of this paper, the creation of a knowledge environment appears to be not significantly different from that found in agile firms. Such firms welcome change, are innovative, thrive on risk, and maintain the respect and admiration of their employees and the broader community.

The key theme highlighted in this paper is that CoPs deliver real value (through improved knowledge flows) to an organization, beyond immediate profit, from more effectively shared knowledge and expertise. However, CoPs cannot thrive without being nurtured by their host organizational bodies. A clear and simple visualization model of knowledge flowing like fluids in a pipe work system presented in this paper provides a metaphor that helps us to consider the valves, potential blockage points and release mechanisms that must be considered in effective knowledge transfer and use. Many of the five needs explored relate to people-issues. Of prime importance is for leaders to help create and sustain an environment that supports COPs. This includes: sustaining a knowledge sharing environment; facilitating systems to help identify COP members and support the formation of COPs; supporting staff to transfer knowledge through the SECI processes; providing the necessary slack in the system so that people have the time to participate and organize COPs; and finally, providing the necessary incentives and reward systems to motivate people to actively participate in COPs. This paper also provides experiential reflection, support by data from three case studies, which could help project leaders design an effective knowledge environment that advances the chances of nurturing an effective CoP.

One important limitation of this study that must be acknowledged is that the analysis provided in this paper is based upon reflective data sources. While the data is rich and based upon extensive experience gleaned from the principal researcher (and many other individuals involved in complex global engineering projects), it lacks any quantitative measures of benefits derived from the described CoPs. This is partially due to difficulties and current knowledge gaps in defining 'hard' productivity outcomes metrics for 'soft' inputs such as relationship qualities and knowledge transfer. Further research on developing productivity metrics for these 'soft' inputs would help to validate the value of nurturing CoPs on construction projects.

References

ACIRRT - Australian Centre for Industrial Relations Research and Training (1999). *Australia at Work - Just Managing?*Sydney Prentice Hall.

Ahlemann, F. (1993). *Comparative Market Analysis of Project Management Systems*. IPMA Conference, Moscow**:** CD-ROM, 8pp.

Anon (2004). "What is the best software supplier for communities of practice?" *KM Review*. **7** (2): 4.

Bass, B. M. (1985). *Leadership and Performance Beyond Expectations,* , Free Press, New York.

Bontis, N., Crossan, M. M. and Hulland, J. (2002). "Managing An Organizational Learning System By Aligning Stocks and Flows." *Journal of Management Studies*. **39** (4): 437.

Brown, J. S. and Duguid, P. (1991). "Organisational Learning and Communities of Practice: Towards a Unified View of Working, Learning, and Innovation." *Organisational Science*. **2** (1): 40-57.

Coghlan, D. (2001). "Insider Action Research Projects: Implications for Practicing Managers." *Management Learning*. **32** (1): 49-60.

Coghlan, D. and Brannick, T. (2005). *Doing Action Research in Your Own Organization*.Second.London Sage Footprint.

Edvinson, L. (1997). "Developing Intellectual Capital at Skandia." *Long Range Planning, Elsevier Science Limited*. **30** (3): 366-373.

Eisenhardt, K. M. and Martin, J. A. (2000). "Dynamic Capabilities: What are They?" *Strategic Management Journal*. **21** (10/11): 1105-1121.

Fernie, S., Green, S. D., Weller, S. J. and Newcombe, R. (2003). "Knowledge Sharing: Context, Confusion and Controversy." *International Journal of Project Management*. **21** (3): 177-187.
Gherardi, S. and Nicolini, D. (2002). "Learning in a Constellation Of Interconnected Practices: Canon or Dissonance." *Journal of Management Studies*. **39** (4): 419-437.
Goleman, D. (1998). "What Makes a Leader?" *Harvard Business Review*. **76** (6): 92-102.
Goleman, D. (2000). "Leadership that Gets Results." *Harvard Business Review*. **78** (2): 78-90.
Grant, R. M. (1991). "The Resource-Based Theory of Competitive Advantage: Implications for strategy Formulation." *California Management Review*. **33** (3): 114-135.
Grant, R. M. (1996). "Toward a Knowledge-Based Theory of the Firm." *Strategic Management Journal*. **17** (Winter Issue): 109-122.
Hagenbeek, J. (2001). "Creating and Marketing Connections at HBG." *Knowledge Management Review*. **4** (5): 28-32.
Herzberg, F., Mausner, B., Snyderman, B. (1959). *The Motivation to Work*.New York Wiley.
Hildreth, P., Kimble, C. and Wright, P. (2000). "Communities of Practice in the Distributed International Environment." *Journal of Knowledge Management*. **4** (1): 27-38.
Jewell, M. and Walker, D. H. T. (2005). Community of Practice Perspective Software Management Tools: A UK Construction Company Case Study. *Knowledge Management in the Construction Industry: A Socio-Technical Perspective*. Kazi A. S. Hershey, PA, Idea Group Publishing**:** 111-127.
Kanter, R. M. (1989). *When Giants Learn to Dance: Mastering the Challanges of Strategy, Management and Careers in the 1990's*.London Simon & Schuster.
Lave, J. and Wenger, E. C. (1991). *Situated Learning - Legitimate Peripheral Participation*.Cambridge Cambridge University Press.
Lewin, K. (1947). "Frontiers in Group Dynamics." *Human Relations*. **1** (1): 5-41.
López, S. V. (2005). "Competitive Advantage and Strategy Formulation: The Key Role of Dynamic Capabilities." *Management Decision*. **43** (5): 661-669.
Maslow, A. H. (1943). "A Theory of Human Motivation." *Psychology Review*. **50**: 370-396.
McFillen, J. M., Maloney, William F. (1988). "New answers and new questions in construction worker motivation." *Construction Management and Economics*. **6**: 35-48.
Nishida, K. (1958). *Intelligibility and the Philosophy of Nothingness*.Honolulu East-West Center Press.
Nonaka, I. and Konno, N. (1998). "The Concept of 'Ba': Building a Foundation for Knowledge Creation." *California Management Review*. **40** (3): 40.
Nonaka, I. and Takeuchi, H. (1995). *The Knowledge-Creating Company*.Oxford Oxford University Press.
Odusami, K. T. (2002). "Perceptions of Construction Professionals Concerning Important Skills of Effective Project Leaders." *Journal of Management in Engineering*. **18** (2): 61-68.
Ogunlana, S. O., and Chang, Wei Pien (1998). "Worker Motivation on selected construction sites in Bangkok Thailand." *Engineering Construction and Architectural Management*. **5** (1): 68-81.
Peansupap, V. and Walker, D. H. T. (2005a). Diffusion of Information and Communication Technology: A Community of Practice Perspective. *Knowledge Management in the Construction Industry: A Socio-Technical Perspective*. Kazi A. S. Hershey, PA, Idea Group Publishing**:** 89-110.
Peansupap, V. and Walker, D. H. T. (2005b). "Factors Affecting ICT Diffusion: A Case Study of Three Large Australian Construction Contractors." *Engineering Construction and Architectural Management*. **12** (1): 21-37.
Schön, D. A. (1983). *The Reflective Practitioner - How Professionals Think in Action*.Aldershot, UK BasiAshgate ARENA.
Sense, A. J. (2005). Cultivating Situational Learning Within Project Management Practice. PhD, *Macquarie Graduate Shool of Management*. Stdney, Macquarie University**.**

Spender, J.-C. (1996). “Making Knowledge the Basis of a Dynamic Theory of the Firm.” *Strategic Management Journal*. **17** (Winter Issue): 45-62.

Storck, J. and Hill, P. A. (2000). “Knowledge Diffusion Through "Strategic Communities".” *Sloan Management Review*. **41** (2): 63-74.

Teece, D., Pisano, G. and Shuen, A. (1997). “Dynamic Capabilities and Strategic Management.” *Strategic Management Journal*. **18** (7): 509-533.

von Krough, G. (1998). “Care in Knowledge Creation.” *California Management Review*. **40** (3): 40-54.

von Krough, G., Ichijo, K. and Takeuchi, H. (2000). *Enabling Knowledge Creation*.Oxford Oxford University Press.

Walker, D. H. T. (2005). *Having a Knowledge Competitive Advantage (K-Adv) A Social Capital Perspective*. Information and Knowledge Management in a Global Economy CIB W102, Lisbon, 19-20 May, Franciso L Ribeiro P. D. E. L., Colin H. Davidson, Charles O. Egbu, Branka Dimitrijevic, DECivil, **1:** 13-31.

Weick, K. E. (1995). *Sensemaking in Organizations*.Thousand Oaks, CA Sage.

Weick, K. E. (2001). *Making Sense of the Organization*.Oxford Blackwell Publishers.

Wenger, E. C. (1999). “Learning as Social Participation.” *Knowledge Management Review*. (6): 2-6.

Wenger, E. C., McDermott, R. and Snyder, W. M. (2002). *Cultivating Communities of Practice*.Boston Harvard Business School Press.

Wenger, E. C. and Snyder, W. M. (2000). “Communities of Practice: The Organizational Frontier.” *Harvard Business Review*. **78** (1): 139-145.

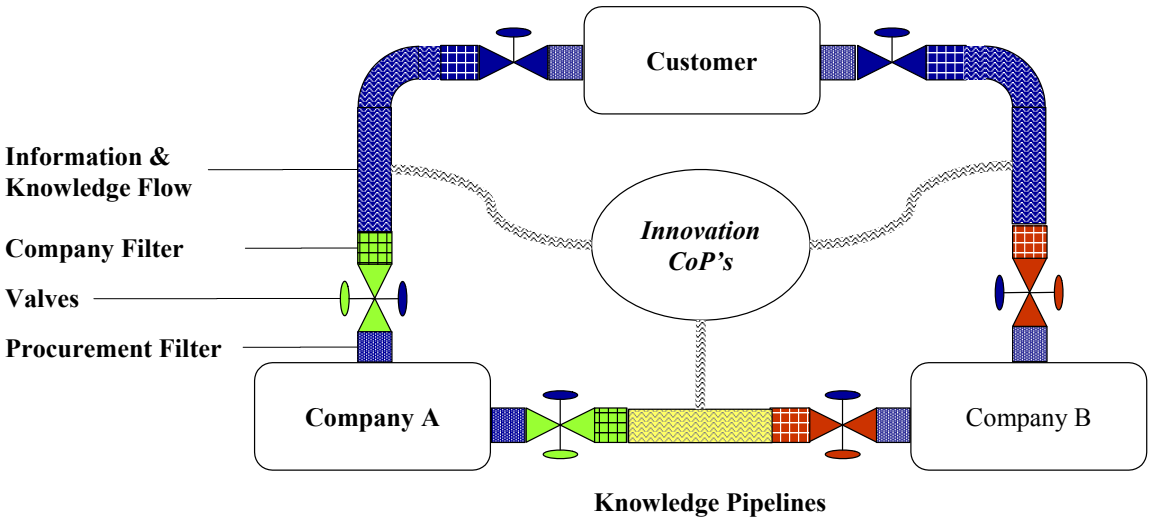

Figure 1 A Knowledge Pipeline Metaphor

Millions of Possible CoP's

Company A USA Office	Customer USA Office	Company B USA Office	Company A India Office	Customer India Office	Company B India Office
CEO	CEO	CEO	Managing Director	Managing Director	Managing director
Project Sponsor	Project Sponsor	Project Sponsor	Project Sponsor	Project Sponsor	Project Sponsor
Project Manager	Project Manager	Project Manager	Project Manager	Project Manager	Project Manager
Mechanical Design	Mechanical Design	Mechanical Design	Mechanical Design	Mechanical Design	Mechanical Design
Electrical Design	Electrical Design	Electrical Design	Electrical Design	Electrical Design	Electrical Design
Civil Design	Civil Design	Civil Design	Civil Design	Civil Design	Civil Design
Process Design	Process Design	Process Design	Process Design	Process Design	Process Design
Procurement	Procurement	Procurement	Procurement	Procurement	Procurement
Scheduling	Scheduling	Scheduling	Scheduling	Scheduling	Scheduling
Quality	Quality	Quality	Quality	Quality	Quality
Cost/Accounting	Cost/Accounting	Cost/Accounting	Cost/Accounting	Cost/Accounting	Cost/Accounting
Clerical Support	Clerical Support	Clerical Support	Clerical Support	Clerical Support	Clerical Support
Ethnicity	Ethnicity	Ethnicity	Ethnicity	Ethnicity	Ethnicity
Avocation	Avocation	Avocation	Avocation	Avocation	Avocation
Religion	Religion	Religion	Religion	Religion	Religion

Figure 2 Possible CoPs for a Hypothetical Global Construction Organisation