Co-operative work practices and knowledge sharing issues: A comparison of viewpoints

E.W. Coakes\textsuperscript{a,\*}, J.M. Coakes\textsuperscript{a,\**}, D. Rosenberg\textsuperscript{b,1}

\textsuperscript{a}Westminster Business School, University of Westminster, 35 Marylebone Road, London NW1 5LS, UK
\textsuperscript{b}Royal Holloway College, University of London, Egham, Surrey TW20 0EX, UK

Abstract

In this paper, we set out to explore the organisational knowledge that evolves from virtual co-operative work experiences. Through case narratives we demonstrate issues that can arise and using the four theoretical viewpoints of sociotechnology, knowledge management, organisational communication theory, and Computer Supported Collaborative Work (CSCW) we develop practical insights into the organisational complexity of computer-supported and virtual teamwork. This complexity, we argue, requires a novel combination of work design factors including participation-related design and computer-supported tools. The outcome is improved communication and a fuller application of organisational knowledge that enhances the design and operation of co-operative work.

1. Introduction

The introduction of advanced information and communication technologies into the workplace has brought to light the importance of teamwork in day-to-day activities. It has also demonstrated the need for increased understanding of what makes teamwork effective. In particular, we need to understand what resources teams need to collaborate and communicate in both co-located and remote settings. Based on this understanding, we need to find ways of providing the appropriate resources as an integral part of the design of a modern, location-independent workplace.

One of the key aspects of effective teamwork is the ability of individuals to share knowledge within and between teams. Several factors influence knowledge sharing, ranging from social and organisational to individual and profoundly personal. In some domains, such as finance and accounting, there is very little knowledge sharing, as illustrated by a statement from an experienced colleague to a novice “if you don’t know it, read a book, don’t ask me!” For individuals in organisations where knowledge is regarded as part of their competitive advantage (both organisational and individual), there is little motivation or indeed encouragement to share knowledge. In other domains, such as construction, where key activities cannot be carried out on an individual level, teamwork is the main form of day-to-day activities. Consequently, collaboration and communication is regarded as important so that both organisational and individual resources are directed to supporting collaboration in the workplace.

In computer-mediated communication more attention has to be given to designing the technology resources for the location-independent workplace so that it enhances collaboration and communication across geographical divides. An approach to the study of technology-enhanced workplaces has to bring together multi-disciplinary research that incorporates all of the organisational, individual, and technology aspects of collaboration and communication. This paper therefore seeks to answer the following questions:

- What makes teamwork more necessary than before in the working environment, particularly the virtual world?
• What are the barriers to knowledge sharing within projects and virtual teamwork that frequently cause this teamwork to fail?
• Is there a better way of addressing teamwork and collaboration issues, by combining several theoretical approaches?

We use case-based data to assist in developing our arguments relating to issues and drivers which has been collected with the use of ethnographic methods from the Sustainable Accommodation for the New Economy (SANE) and secondary sources as appropriate. We ground our cases in the working world of projects, in particular construction projects, as practical work in this industry is always team-based and increasingly virtual.

It is frequently argued (e.g. Mumford, 2003) that the process of trial and error or, as it may also be thought of as being, failure, redesign, and success, can be significantly improved through designing (Knowledge Management) systems using sociotechnical design methods.

Each new system needs to be learnt by the users, and there is evidence (Handzic, 2007) that “people tend to use simplifying knowledge acquisition strategies as the amount of stored knowledge artefacts increases” (p. 79). In fact, the more stored knowledge there is, the less performance increases (Cook, 1993; Handzic, 2007; Olshavsky, 1979; Payne, 1976).

Issues are also created by a dispersed project structured organisational form. It is easy to learn within projects, but difficult to share across projects, aggravated by the ‘not invented here’ approach which relates to a perception that knowledge or solutions created elsewhere, are not relevant (Dyan, Pasher, & Dvir, 2006). Additionally, there may be a perception (within an ageing workforce) that, the effort of learning a new system that is going to be supplanted in due course, is not worthwhile. As Grillitch, Müller-Stingl, and Neumann (2006) point out, it is important (socially) to emphasise the necessity of optimising project processes and to “give the opportunity to learn from already realised projects” (p. 176).

This paper is structured into four main sections: firstly we discuss the experiences of co-operative work practices and identify the drivers towards knowledge sharing in the work of project and virtual teams; in the next section we look again at these drivers and derive issues for project teams and teamwork, illustrating our arguments with practical case examples; we then combine the understandings developed to try to find ways to alleviate the issues for the work of virtual teams; finally, we draw conclusions and recommendations.

2. Experiences of co-operative work practice and knowledge sharing issues

A number of authors (Nicolini, 2002; Walker, 2002) have argued that the impact of soft skills on project success has received little attention in the literature and research. Indeed researchers, it is said, have lost sight of the holistic nature of projects and the complexity of the relationships that exist within them. They have been seduced by the wholly logical approach derived from classic Tayloristic notions of scientific management (C/S/B/S, 2000) however Walker (2002) criticises the sociotechnical approach for being too simplistic in its views and far removed from real-life complexity. Yet he also argues that that whilst technology has provided significant advances, the organisation and management of the social aspects are equally important. Research (Vroom, 1964) has stressed the importance of individuals in projects as their independent attitudes affect projects in delivery of the outcomes, but Walker argues that this individualism must be subordinated so that the overall aim is achieved. Sociotechnical principles (Cherns, 1976, 1987) identify a number of critical areas in participative work and we draw on this work to assist in explaining the identified issues in project (team) work in the construction environment. We also contend that the management of knowledge is such an inseparable part of project work that it is an essential part of any such discussion.

Additionally, we would argue that the organisational climate has a number of drivers through its complexity (global marketplaces, increasing customer power and so on) that affect the way that organisations need to structure themselves and organise their work.

Looking holistically at projects we consider these organisational drivers to be the following:

1. An increasingly geographically dispersed work environment;
2. An increasingly complex environment;
3. The need for quick and efficient decision-making (Du Plessis, 2005);
4. The increased volume of knowledge available to organisations;
5. The problems related to knowledge attrition (Du Plessis, 2005);
6. The continual development of new technologies including the internet.

In the sub-sections below, we consider each of these drivers and their impact on organisational work within projects, informed by the sociotechnical principles as identified by Cherns (1976, 1987).

2.1. Driver 1: Geographically dispersed work environment

The first sociotechnical principle we draw on relates to the boundary location (of work) in the context of geographically dispersed working environments.

This principle relates to official and unofficial work boundaries. In any organisation, social networks operate underneath the official work team and departmental boundaries. These social networks hold those colleagues who are most trusted in central positions within the...
knowledge sharing activities (Coakes & Smith, 2007a, 2007b, 2007c). An organisation should endeavour to discover these hubs of trust and knowledge and either incorporate them into the activity boundary or ensure that they are not excluded from it. In Gallivan and Depledge (2003), it is argued that trust is a necessary prerequisite for success in working in partnership with others but that too much trust can leave one member of the ‘partnership’ vulnerable and too much control (of the relationship and boundary) can lead to distrust, cheating, and other problems. Trust being “a willingness to make oneself vulnerable to potential harm from another party” (p. 162 and Gallivan, 2001). Jackson (1999) argues that a thorough appreciation of team processes is required in order to encourage the processes of boundary management, knowledge transfer, trust building, and cultural appreciation within teams, and that this should be supplemented by face-to-face interactions.

Teamwork, whether semi-autonomous or not, has major issues to overcome. The style of operating and decision-making needs to become participative; this can be difficult for some managers and staff to cope with. Within the team there can be tensions and conflict. Not all teams work well together, and personality clashes do occur and need to be dealt with. Mullen and Copper (1994) argue that the more time groups spend together, the more their cohesiveness grows and develops, and that commitment to the task affects this cohesiveness. Ciborra (1993) adds to this by showing that team identity and enculturation have a significant effect on the group cohesiveness. Through familiarity, he argues, a team builds a collective way of solving problems and thinking and thus sense-making. But as a group matures, practices may become habituated and boundaries of activity are narrowed (Weick & Roberts, 1993). Hutchins (1993, 1995) adds to this argument the idea that team members’ expertise and special knowledge bases are shared within a ‘good’ team and so skills and capabilities of members overlap. This idea is central also to the sociotechnical school of thought which argues for autonomy within groups as a way of building these skill overlaps and developing team members’ abilities.

Additionally, we hear from Allen (1984) and Sapsed, Bessant, Partington, Tranfield, and Young (2002) that teams require access outside their immediate task and process boundaries in order that they may acquire external knowledge.

One extremely important factor in the work of teams is virtuality. Much of the theory on how teams operate is based on the concept of co-location. Without co-location, many argue, teams find it more difficult to enculture new members and to trust and thus share knowledge. However, there is also research (Kahn & McDonough, 1997) which indicates that there is not a direct relationship between co-location and a team’s performance. Nevertheless, it is clear that teams that operate in a geographically dispersed work environment have more difficulties in communicating and thus in building trust. Geography forms a significant boundary for work.

2.2. Driver 2: Complex environment

A number of issues relate to today’s complex and ever changing environment. In particular:

- The collaborative nature of project and teamwork;
- The need for specialisation;
- The need to communicate with and between experts; and
- The changing legal and ethical environment (Demaid & Quintas, 2006).

These additional issues imply that a number of perspectives need to be used in order to make sense of how knowledge is, or could be, used.

García and Vaño (2002) argue that the issues surrounding the complex environment can be summarised and condensed into two major challenges: that of dealing with the global marketplace; and that of trying to manage an organisation’s knowledge. Knowledge, it is frequently argued, is the intangible resource that can give an organisation competitive advantage (Erikson, 2002; Smith, 1998; Tebbutt, 2000) that can be sustained (Alexopoulos & Theodoulidis, 2003; Bontis, Dragonetti, Jacobsen, & Roos, 2001; Liedtka, 1999) and is difficult to duplicate (Coakes & Smith, 2007a, 2007b, 2007c). It therefore follows that the collaborative nature of the workplace ought to provide a rich environment for the development of Intellectual Capital (IC) within an organisation, as knowledge will be required to make sense of, and to develop methods for, collaborative work. This is of course complicated by the lack of standardised work practices in many complex projects with a dispersed personnel, which means that such knowledge as is developed may not be relevant for sharing (Carillo Corrillo, Robinson, Al-Ghassani, & Anumba, 2004) and may not permit the development of a knowledge stock for the purpose of innovation (García & Vaño, 2002). Yet conversely, project work based knowledge, when shared and contextualised, may provide the basis for improved business performance.

The complex environment also requires the increasing use of teams to undertake development work. Knowledge cannot be individualised as a single person cannot absorb all the knowledge domains required for product or service development and innovation (Hobday, 1998; Marshall & Sapsed, 2000; Sapsed et al., 2002). Globalised learning is required in a globalised organisation where complex decisions are needed to be made.

2.3. Driver 3: The need for quick and efficient decision-making

The globalised economy within which so many organisations operate means that decision-making cannot be
centralised but must be devolved to the (sub) group that operates closest to the ‘problem’ source. An economy that operates at all hours implies that there is no longer time for decisions to be passed on ‘up the line’, neither is it appropriate to take these decisions out of the context of the environment in which the questions arose, or where the knowledge of the background of these issues is held.

This driver relates to the sociotechnical principle of empowerment and devolution of power and authority. It is also related to the principle of variance control whereby people should be able to inspect, challenge, and control—that is to make decisions—about their own work and its quality or fitness for purpose (Cherns, 1976, 1987; Coakes, Willis, & Lloyd-Jones, 2000).

2.4. Driver 4: The increased volume of knowledge available

As seen above, empowerment is a key sociotechnical principle and is also connected strongly to leading edge practices in the construction sector (Price, Bryman, & Dainty, 2004). It is not, Price et al. argue, a panacea for problems, but rather is the key to unlocking other performance enablers including that of managing knowledge.

Scarborough et al. (2004) state that learning boundaries develop around projects and that learning becomes ‘nested’ within the project and thus not exploited across organisational boundaries.

Here we see, therefore, that (physical) boundaries should not impede the sharing of knowledge. We must ensure that the physical environment as well as the organisational (social and cultural) environment is structured so that knowledge can flow freely and easily to its required destination. Flows of information and knowledge are important, in that communications must be received where they are of most use; below we comment further on this principle. This concept contrasts the accepted need for increased information sharing, with the negative effects of power motivated control of information channels.

The difficulties with this concept are two-fold: firstly, there is the idea of not giving too much control to management through information. Workers may have no choice as to how much information is passed on, as technology such as MIS and organisation-wide systems such as Customer Relationship Management (CRM); Enterprise Resource Planning (ERP) and so on, are designed in such a way that control over information resides in the system and with the system designers and analysts, rather than in the workforce. This design both reinforces the idea that information should not be retained locally but also means that management can control, through system design and implementation, who sees what and when. The organisational authority structure will dictate how the system is designed and who has control over both the information structure and the information management. Secondly, it should always be remembered that autonomous working does not suit all personalities. Many workers are satisfied with, and actively seek, strong management direction and have psychological issues with taking decisions.

2.5. Driver 5: The problems related to knowledge attrition

In project-based organisations we see that coherence in the working team is often not maintained, indeed, teams will form and reform according to need. Thus, social capital is difficult to both develop and maintain (Bresnan, Goussevskaia, & Swan, 2004). Social relationships are seen as a resource that enables firms to exploit their IC and thus also innovative potential. In co-operative work, social capital becomes increasingly important, yet also more difficult to capture due to the volatility of the work environment. Therefore, we see knowledge attrition.

Additionally, Styhre, Josephson, and Knauøedler (2004) argue that organisational learning is underdeveloped in construction projects; Ozorhon, Dikmen, and Birgonul (2005) suggesting that knowledge collection and storage is common but exploitation is generally weak. It is difficult to exploit knowledge within team members as project teams are generally formed anew for each new project and thus social capital needs to be redeveloped each time.

2.6. Driver 6: The continual development of new technologies

Ruiz-Mercader, Meroño-Cerdán, and Sabater-Sánchez (2006) argue that the use of ICT for knowledge creation, distribution, or use, is limited by organisational culture. Such tools only perform these functions when an organisation is conditioned to learn.

Whilst groupware has been implemented in many organisations for knowledge collection and distribution, Gunnlaugsdottir (2003) argues that appropriate implementation is required in order that the software might meet expectations. Sociotechnical theory here would argue that only participation in design and development of the application (Mumford, 1996) can successfully meet these stakeholders’ expectations. “The design and development of electronic technologies, for example, often results in products that are not (or not easily) usable in work settings, leading to arguments for collaborative or participatory design processes that would incorporate end users’ local knowledge of work practices relevant to the technology in question” (Cook & Yanow, 1993, p. 394).

As project teams are continually changing membership, the familiarity with various technologies will also change and thus need to be learnt again. The more often technology changes, the more difficulties arise for users and thus issues within projects can be blamed on the technology (see Jarvenpaa, Shaw, and Staples (2004),
whose paper includes comments such as

I find it very hard when there is no communication ... I don’t know if it is because of technology failing, or people not coming in to work or what.

and

I was away for a few days and everybody thinks I died or something (from team members they were research- ing)—here it is a lack of social capital that is the problem, not the technology.

3. Drivers and related issues

In Section 2, we presented a number of drivers—here we look again at these drivers and derive issues for project teams and teamwork (and the construction industry at large) from them. Table 1 below shows these issues as derived from the literature review in Section 2. In this section, we also present example narratives showing the issues we derive from the drivers, at work.

We will now present a number of case examples taken from larger case work to illustrate the issues derived. We will then use the relevant theoretical lens to view the examples and demonstrate an understanding of how

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<td>The dynamic economy can undermine traditional organisational structures through the need for empowerment</td>
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<tr>
<td>The continual development of new technologies</td>
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the illustrations came about and can be viewed as typical. We consider these issues and drivers using illustrations in the form of narratives taken from research undertaken into project work. Each narrative illustrates and develops the application of one or more of the issues. Commentary on the meanings of these narratives is considered in Section 4.

A study was carried out by a research team at Royal Holloway College, University of London, working on the SANE Project. The SANE project was hosted at Royal Holloway University from 2001 to 2004. SANE was a European Community funded research programme intended to look at the impact of the new economy on people, process, place, and technology, on new ways of providing workplaces, both physically and virtually (SANE, 2004). The research brought together a number of specialists from diverse disciplines to produce a unified model for sustainable workplaces. Ethnographic studies were conducted across five organisations in three countries, the participant organisations being in the construction field. (Note that additional explanatory cases are drawn from appropriate literature.)

A Computer Supported Co-operative Work (CSCW) emphasis brought a variety of methods and approaches of investigation and analysis that are not traditionally applied to work and technology. For example, ethnography was developed originally as a means of examining the lives and customs of other cultures. More recently, it has been applied by the computer science and information systems community to look at social interaction around technology (Button & Sharrock, 1997; Heath & Luff, 1991; Hughes, Randall, & Shapiro, 1992) and has become a valuable and commonly used tool in the analysis of workplace activity for systems design (Harper, 2000; Heath & Luff, 1991; Hughes et al., 1992; Myers, 2004; Rogers, 1993; Schmidt, 2000).

Ethnography is characterised by data that is gathered from a range of sources, and emphasis is placed on its study within a context. Unlike the experimental method, the ethnographic approach allows the analyst to reveal complexity, rather than stripping it away. Van Maanen (1979) describes it as being used to uncover and explicate the ways in which people in particular work settings come to understand, account for, take action, and otherwise manage their day-to-day situation (p. 540).

In nature, it entails bringing something from the setting to the analysis, and the fieldworker attempts to understand the way that activity is understood and practised by its participants rather than through its explicit procedures. The intention therefore of ethnographic analysis is often to show how work is organised (Hughes et al., 1992) by the team. The detailed investigative work permitted by an ethnographic approach to data collection, allows the fieldworker to examine how the group integrates and regulates both the formal and informal aspects of their work (Perry, Fruchter, & Rosenberg, 1999). The ethnography of communication is particularly relevant in this context (Savin-Troike, 2002) as it provides a coherent
methodological approach to the study of people in naturalistic settings, so that the ethnographer can capture their environment from their perspective.

The analysis of interview and observational data in the SANE project was performed in several stages, from summarizing the data, through discovery of key relationships between data, to developing and testing propositions in order to construct an explanatory framework—why the workplace actors do what we have observed them to do, as illustrated below.

3.1. Driver 1 and the issues of appropriate work boundaries and knowledge sharing

Let us take the case of a project director leading a team of project managers with diverse expertise and distinct contributions to the project. During a construction project building a major shopping centre, the management team developed a shared project board that contained all the latest information about developments on the site. The board was originally divided into seven sections, each focusing on different aspects of site work (delivery of materials, timelines, scheduling, and other aspects of day-to-day coordination of team activities). Individuals were observed printing a document and pasting it on the board “in case someone needs the information when I’m not around”. As the board was placed on the wall along the main passageway, everyone was able to access the information in passing and to engage in impromptu discussions about a particular topic of shared interest. The board thus served not only as a repository of site information, but also as a focus for local interactions. It soon became a cultural object, and was increasingly called “the wailing wall” according to the Legend of the Project. The Legend says:

there once was a site manager who came to the office, walked to the glass wall overlooking the site to see what was going on out there. He then walked to the project board to see what should be going on out there, and cried in front of the ‘wailing wall’.

However, one informant described briefly how in the course of 1 week he may be working from home; or from a client’s premises; travelling to the client’s site; working in the Institute of Directors (mostly meeting people); and then at some point coming into the office “so that everyone can have a piece of me”. Clearly, the shared informational resources such as the wailing wall are not accessible to such a worker solely through the physical form. A mobile worker requires access to such resources across technology, organisational, and social networks in order to balance the various work activities required of him/her.

3.2. Driver 2 and the issues surrounding the collaborative nature of project work

Here, the example is where David and his team are 2 years into an 8-year project to build an airport terminal building. David’s own organisation bid jointly with another for the client contract, and both organisations now share responsibility for its completion. David’s firm act as designers for, and advisors to, their associates in the other company who, in turn, supply the communications and IT infrastructure for the building.

The design team discuss the project regularly with the debate often being lively and involving a free exchange of ideas and views. It can, as David says, become quite heated, and this “apparent” breakdown in communication between team members can lead to misunderstandings and give an unfavourable impression to the client …

It can be quite challenging at times to have the client sitting so close to you, because we had an incident last week, where a few designers had a heated argument around the table, the client is sitting there watching them, and afterwards she said isn’t this a terrible thing? But we said, well, this is what the designers do and if they don’t have arguments, they are not doing the job, basically. You know … one person got up and kicked the chair, walked away and … that is what the designers do, they have arguments during the projects, that is healthy and normal, but it can be quite oppressive if the client is sitting there watching you do it.

3.3. Driver 3 and the need for quick decision-making and thus the empowerment of knowledge workers

About a decade ago, a company intranet was introduced to a consortium of construction companies in order to facilitate decision-making and empower construction managers to share knowledge and learn from one another. The key concept was the People and Information Finder (PIF), a multimedia prototype developed as part of the CICC project (Collaborative Integrated Communications for Construction, ACTS no. 017) focused on the development and use of interactive technology in the workplace, particularly in large-scale construction projects. It was motivated by the needs of people working in construction (and manufacturing industries), where poor communication in day-to-day activities which require continuous cooperation and coordination, causes serious problems (Fruchter, 1998).

Interactive multimedia technology is designed to improve communications and to offer a richer information environment for the repair of breakdowns and misunderstandings. Such a facility is particularly useful in agile project teams, where a stable organisational form is absent. One of the key roles for the PIF is to help those who need to learn about a given project and its organisation, in order to assimilate the project culture without disturbing the established flow of activities on the site.

In this context, the PIF can be viewed from several perspectives. As a technological artefact, it is a web page populated with information about its owners using standard web technology and programming in html...
underpinned by Java script. It represents a technological platform, more precisely, a configuration of communications technologies such as telephone, network technology such as the web, and advanced interactive technology, such as virtual and augmented reality. It thus provides an integrated service that helps the user to choose between various channels of communication, from voice link to videoconferencing, and to browse through a collection of similar pages created by different owners according to a pre-designed template.

The structure of a PIF web page (see Fig. 1) reflects the fact that within such work settings, information is normally obtained from people, from artefacts such as documents or databases, or from the real world where PIF owners live and work. The basic PIF page is divided into three main components. The first contains information that helps visitors to locate the owners in their physical space, such as name, address, phone number, and email address, as well as photographs and video images showing their offices, desks, and terminals. This makes it possible for the visitor to choose how to contact them, via telephone, ordinary mail, email, or videoconferencing. The second, nearest neighbours, provides information about the organisational space that a team occupies, giving information about accessing other PIF owners who are engaged in similar or related work. The third component describes the owners’ projects and activities, both present and past, comprising the part of the real world in which the owner’s work is done.

The PIF thus provides a uniform platform for accessing information about an organisation or a team in the construction industry, the people who work for it and the activities they engage in. The status of information ranges from personally owned (or private), which is accessible only to the owner, to the information that is distributed (or shared) between members of a group. Alternatively, information may be public (or visible), which the owner is willing to show to the general public or to a selected group of collaborators. This non-proprietary information forms part of the informational resources used by the organisation or the group as a whole. This work is discussed more fully in Rosenberg, Perry, Leervers, and Farrow (1997).

3.4. Driver 4 and the increased volume of knowledge and the need to distribute it more widely through organisations

This need to distribute knowledge more widely is taken as a given but not all knowledge is so easily transferred. As one construction site manager explained,

I deal with several kinds of knowledge: in my head, up my sleeve, in my desk, on my desk, on the F:drive (management reporting system), on the intranet, on the internet.

A glance at a workplace of an individual knowledge worker clearly shows the supporting informational resources that individuals have collected in the form of diagrams, documents, contact details, etc., from internal sources, plus external sources such as the media and websites or grey literature, that he may not mention to an investigator or an organisational official. These items are not a part of the formal system of communication but serve
an important purpose in informal, ad hoc interactions within and between collaborating teams.

A further example can be found in an article in The Independent newspaper (Sutcliffe, 2007) where the journalist describes his visit to a Trident submarine. As he says “The image that stuck with me was of the control desk—which in the event of Armageddon—the missiles would actually be launched. It was ... showing modest signs of wear (“one careful owner”), but the detail that really humanised it was the post-it note stuck to the display panel. The designers of the electronic display had thought of everything except for what was scribbled on that little square of pink paper—a perfect emblem of the way in which high technology and human needs will never quite marry.” (p. 5) where again we see (essential) knowledge that is not to be found in manuals but in people’s heads and requires to be transferred to the next operator and system designer.

3.5. Driver 5 and the problems related to knowledge attrition and the difficulty of developing social capital

It is estimated (Kasi & Koivuniemi, 2006) that over the next few years, the construction industry will be losing a large percentage of its skilled workforce (see also Kasi, 2005). Knowledge will therefore be lost along with the workforce and the construction industry has sought a number of (technical) solutions in order to preserve this knowledge.

However, many have failed to work as anticipated. The solution for one organisation (Kasi & Koivuniemi, 2006) was to add site visits so that site personnel and HQ staff could exchange experiences. These experiences were then documented and captured within a technical system.

But face-to-face interaction also has limitations related to time and space, with ever increasing workloads and project timing pressures, finding the opportunities for social processes can be limited, and there is a need for identifying when social interaction should take place, in what context, and how it can best be disseminated to achieve the objectives in other words, there is a need to identify what Kasi (2005) calls the critical intervention points.

3.6. Driver 6 and the continual development of technology and thus the need for continual learning

In the case above, we also find that the knowledge management system developed went through a number of iterations. Organisations will need to discover often through trial and error, which systems based on which technology, will best suit their users and stakeholders. Technical innovation in this field is also frequent as it is still a relatively new area for software design. In addition, as we have already seen, time is under great pressure for business, and the necessity to put aside time for learning and incorporating new processes into working lives can be difficult to achieve.

Jewell and Walker (2005) describe the many iterations of the Sigma Connect software in an exploration based project organisation. The software was originally introduced as a method of promoting working relationships within business units. A pilot phase was initiated and then spread throughout the organisation. A merger followed and the system was now used to assist in integrating the two staff bases. Further functionality was then added to the initial ‘Yellow Pages’ expertise system to permit community of practice support. As the system was used voluntarily, it was never complete but there was social pressure within the organisation to participate.

This system was also used within a UK construction contractor whose business is developing into long-term projects (often 20–30 years) with an ongoing servicing and maintenance element. It is therefore extremely important that knowledge about project phases and the client is kept up-to-date over a lengthy period. As with the exploration company, a pilot was undertaken. But ‘equity’ and the need for each employee to feel that their knowledge and expertise were equally important caused an issue as the software was not available on site. This meant that additional computers were required to provide a knowledge centre for the site. There is also a financial incentive now for construction organisations to provide knowledge management activities—major UK government invitations to tender frequently now also include a question relating to how this is demonstrated within the organisation.

4. Combining the understandings to alleviate the issues

In this section, we add to the sociotechnical view of project behaviour issues in Section 3, and consider explanations from the viewpoint of communication theory. We also use understanding from the discipline of computer-supported work, in a drive to not only explain these issues and their origins, but also to discover how these fields might help alleviate these issues.

4.1. Driver 1: Dispersed work and the issues of appropriate work boundaries and knowledge sharing

“The complex and evolving national and international business, economic and political environments have seen (Flacker & Simsa, 2000) an eroding of boundaries, enhanced interdependencies and a greater variety of options for organisations (Steger, 1998)” (Coakes, 2006). Sociotechnical theory thus tells us that work boundaries in the terms of this principle, should not interfere with sharing of knowledge and experience.

As Cherns (1976, p. 789) put it: “the more the control of activities within the department becomes the responsibility of the members, the more the role of the supervisor/foreman/manager is concentrated on the boundary activities—ensuring that the team has adequate resources to
carry out its activities, co-ordinating activities with those of other departments and foreseeing the changes likely to impinge upon them”.

A computer-supported work commentary would add that task and work boundaries should be appropriate to the context of a particular collaborative activity. It is well known in the various project communities, especially in the construction sector, that communication and interaction are key factors in developing a successful (learning) organisation (Yin, 2006).

It should be recognised that overt and covert organisational structures interact to provide the appropriate channels for knowledge and workflows. Unofficial networks form around hubs of knowledge and task understanding. And Communication Theory states that boundaries should be appropriate to the particular communication zone. Trust is a result of boundary control.

“Gatekeepers’” are resources in an environment who control the flow of information and knowledge to maintain appropriate levels of privacy. These can be unofficial actors in the network as well official. Unofficial actors may often be more trusted than the official actors as they are chosen by consensus amongst the participants in the activity. As Simons (1995) additionally says, it is important to ensure that empowerment and control are balanced such that there is sufficient control to prevent failure but that this does not lead to an empowerment failure.

Cherns (1976, 1987) comments here also on the power games that are rife in organisations and the temptation to intervene, harass, and usurp control that is offered by the provision of indiscriminate and unnecessary information to management. But we can also argue that reducing barriers to an information flow is likely to reduce potential conflicts, as people will then be working from similar information bases.

4.2. Driver 2: Complex environment and the issues surrounding the collaborative nature of project work

Yin (2006) argues that successful learning environments (in the construction sector) require communication and discussion as essential factors.

Theoretical writings from a number of authors have put forward the idea that there are a number of attributes that improve the task design for groups (Lehane, Clarke, Coakes, & Jack, 2003). These attributes are:

1. variety—multi-skilling prevents boredom and monotony and builds flexibility;
2. identity—building an identity encourages a sense of collective responsibility and self-regulation of variances;
3. significance—gives the motivation to care about the outcome of the work process and increases co-operation when the outcome is imbued with a sense of significance;
4. autonomy—this increases the ownership and responsibility of members to the process and also enables the group to make decisions under changing environmental conditions. The multi-skilling also enables them to flex attributes and change working practices to fit with the environmental changes;
5. feedback—understanding and knowing the results of work processes enables groups to monitor their progress against targets and improve their performance (Cohen, Ledford, & Spreitzer, 1996).

Groups balance homogeneous and heterogeneous factors in terms of skills, expertise, and stability. The right mix of expertise is clearly important and is related to the size of the group—the smallest possible number that includes all the relevant skills is easiest to co-ordinate. Such a group also needs to be relatively stable so that time is not lost orienting new members to culture, values and beliefs. Moore and Dainty (2001) emphasise that, according to the origins of team members, there are numerous boundaries that need to be crossed in order that teamwork can become effective. These include culture, accepted stereotypes for other professions (e.g. a librarian is always a spinster with black-rimmed glasses), and the power balance between team members.

Norms are thus an important part of self-regulating groups. An effective self-regulating group will have a high degree of agreement about what is acceptable behaviour within the group. They will also have the belief that the group is (and can continue to be) effective in the way that they perform, and co-ordinate their activities, and innovate as required. We need to remember (Handy, 1993) that all the team members will come to the team with personal hidden agendas and objectives, and that they will have a variety of emotional and social needs.

As per sociotechnical principles, self-regulating groups work best in an organisation with devolved decision-making structures and a significant amount of employee participation. These teams need power to make decisions. They also require information about processes, customers, competitors, organisational changes, etc., as they feel that they need them. They should be offered rewards that are related not just to performance but also to the development of capability. They will need training to develop the required expertise and skills and resources as required. Self-regulating teams then should be highly motivated, and learn continuously and share knowledge within the team. However, not all teams will be equal in their needs for interchangeable skills as this will depend on their function within the workplace Jackson (1999).

4.3. Driver 3: Efficient decision-making and the empowerment of knowledge workers

In Duane and Finnegan (2003), the authors discuss the issues of empowerment and control in within teamwork in an intranet environment. Below we adapt their Table 3

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(p. 139) to an empowerment construct (for individuals working within teams) that aligns with sociotechnical principles in seven dimensions:

1. Direction—individuals have direction setting, and are oriented toward improving their own, and the team’s, performance (and achieving) set goals and objectives.

2. Freedom—individuals may operate within predefined boundaries of acceptable behaviour this giving them operational decision-making permission.

3. Influence—individuals can influence the organisational decision-making relating to their own job function and working conditions and thus “make a difference” (Scott-Morton, 1991).

4. Meaning—there is a fit between an individual’s own role and their own beliefs and values.

5. Competence—there is a belief in one’s own ability to perform a job role with skill, personal mastery, and an effort-to-performance expectancy (Thomas & Velt- house, 1990).

6. Support—the individual receives adequate support, resources and incentives to fulfil their responsibilities.

7. Accountability—individuals are held accountable for own activities and in teams there is a shared risk taking (Pastor, 1996).

Here, Cherns (1976) comments not only on the need for workers to be able to choose how to do their work but also deciding what tools or other resources are used. He also implies that by choosing their own methods of working, people should also take responsibility to ensure that they are making their work fit with, and perhaps stretch, their abilities. Work practices evolve in the course of co-operative work and people jointly generate knowledge and information in the course of collaborative activities.

The principle of devolved power and authority implies that each worker or team of workers, should hold budgets and control over resourcing, including perhaps the hiring and firing of staff for their purposes. This, of course, holds issues for those workers who require a strong authority and hierarchy and additionally, means that management have little control and perhaps little detailed knowledge of what is actually occurring. The extent to which this power and authority is devolved will of course, depend on organisational culture.

It is also argued that people should be allowed to inspect and challenge their own quality of work and make their own judgements and decisions as to how to improve—to continuously learn. This describes ideas that are also manifested in job-enrichment schemes and in the use of Quality Circles. In the literature of job design and job enrichment (see for instance, Butteriss, 1971) responsibility for outcomes and knowledge of results leads to increased worker motivation, high quality performance, and increased quality. In addition, one must consider that today’s knowledge workers are increasingly mobile, and thus not subject to the traditional level of managerial control over their day-to-day activities.

4.4. Driver 4: (the increased volume of knowledge) and the need to distribute knowledge more widely through organisations

The increased amount of knowledge within any organisation working in the current complex and changing environment is well known. What is however, arguable, are the ways in which the organisations can cope with obtaining and sharing this knowledge so that future organisational members can benefit from past experiences.

Capturing project knowledge and learning from the past is difficult because of the diversity of potential and actual knowledge that is or could be available, and the multiplicity of forms in which it is manifested. Project based learning, according to Scarbrough et al. (2004) tends to be of a practice based nature and comes from autonomy. Knowledge integration and thus the ability to transfer and share knowledge runs into learning boundaries as a result, and constraints tend to develop around projects which inhibit communications. Below we highlight some of the key points from the literature that show how this can be managed.

1. Simple project extranets can be used, for instance, to capture and present an organisational memory and may also be used for communication and collaborative work. Ozorhon et al. (2005) claim that (Turkish) construction contractors are successful in the collection and storage of knowledge but are at the same time, very weak in exploiting this organisational memory.

2. In addition, we find that many innovations are project based and therefore project limited and not shared around or not applicable to the firm (Miozzo & Dewick, 2005).

3. Projects are discontinuous and temporary and we find that learning there is often haphazard and informally derived (Styhre et al., 2004) and not recorded so that organisational memory is not enhanced by this learning. Collaboration activities, according to Ingirige and Sexton (2006) (in the construction sector), need to be an essential part of daily routine rather than a possible action for ‘slack’ time. But specialisation and this need to communicate, increase both cost and time (Demaid & Quintas, 2006) as well as uncertainties. Good communication, we would argue, can alleviate mistrust and other team anomalies that might result from early impressions leading to later (mis) behaviour (Morris, 1994).

4. Decentralisation, the short term emphasis on project performance and distributed work practices, complicate the potential and actual distribution of project based or project developed knowledge (Bresnan et al., 2004). What we do see, according to Price et al. (2004) is a link between empowerment—a core sociotechnical
principle—and leading edge practices in the construction industry. Empowerment is not, they argue, a panacea for industrial problems, but rather a performance enabler of such processes as knowledge management which require management understanding and action. However, this is problematic as project-based learning is largely practice based (see above) and thus learning boundaries (Scarborough et al., 2004) are de facto constructed which prevent the seepage of knowledge and understanding from within the project to the wider organisational community. The establishment of such boundaries is antipathetic to a sociotechnical point of view.

5. Project-based organisations such as construction firms are collaborative by their nature but, according to Gyampoh-Vidogah, Moreton, and Proverbs (2003) for historical, cultural, and legal reasons have not developed a desire, in the main, to use collaborative ICT tools. The industry culture is such, they claim, that stand-alone departmental systems are the norm and each function maintains its own independence in all aspects of information retrieval and exchange. This despite the fact that, as Fernie, Green, Stuart, Weller, and Newcombe (2003) also say, project managers in construction are looking to learn from other industries in how best to manage project knowledge.

For the management of knowledge to work well, the theorists argue there must be no organisational barriers to the sharing of information and knowledge. This would include the breakdown of power plays and resistance to knowledge sharing. It would also imply a minimum level of checks and balances by management.

4.5. Driver 5: (knowledge attrition) and the difficulty of developing social capital

It is also important to recognise that knowledge sharing is not always beneficial to individuals, or to organisations. For example, individual expertise is rarely shared if such sharing reduces the “market value” of an individual. Likewise, the sharing of information about accidents on a construction site could cause potential damage to the organisation if it “leaks out”. Organisational structures related to “power” often function to preserve and protect individual and group interests.

The control by the social system over what work should be done and by whom, under-specifies the ways roles and responsibilities are realised in practice. We make a distinction between “assigned” roles given in job descriptions and “assumed” roles that evolve in response to the profiles of particular teams in particular situations. It is impossible to generalise on the issues of autonomy, as this is not only determined by the organisational structures and cultures but is also influenced by the requirements of particular tasks. It is important to understand the relationship between autonomy and perception of risk, team loyalty and self-interest. The notion of local variance control implies that teams can deal with any issues as they arise according to their own (local) work practices and knowledge.

In addition, we find that individuals’ interpretations of their roles and the team consensus determine their behaviour, in terms of: taking the floor; the degree of participation and involvement; and expression of commitment. This means that we need to understand the relationship between autonomy and presence, especially in the case of mobile workers where organisational identity may be adversely affected by “loose” coupling between individuals and teams. Communication patterns and work roles within teams may be more fragmented in these situations. This affects how social capital and knowledge sharing may be developed.

4.6. Driver 6: (the continual development of technology) and the need for continual learning

Understanding the impact of technology in the real-life workplace has to take into account both co-operation and conflict between different interest groups as they arise through practice.

The nature of co-operative work is fluid and changing in nature. We must therefore design for unanticipated uses, as people adopt opportunistic strategies for adapting the functionality of the resources (including technological resources) to the requirements of a particular co-operative activity.

We know that knowledge is created when individuals interact and communicate and individual expertise and interests provide the background context to the task, while their coordinated actions provide the immediate work process. What we then need to ensure in the design of the technology used to support the individual and joint actions is that it must ensure that these actions are “visible” in computer-mediated settings. Actions and subsequent changes in work processes, etc. need to be made known to others in the system.

People require the necessary power and authority, in conjunction with the required responsibility, to decide what resources they need to undertake their work. Teams that work together should not only decide who should be in the team but also how this team should be equipped, trained, and rewarded. Communication methods should be internally agreed and utilised to their agreed level.
5. Conclusions

Teamwork within organisations is commonly undertaken to perform regular tasks and to complete projects. This teamwork can be either virtual or physically co-located. In either case, issues arise about how communication takes place, and what is meant by such communication.

In teamwork, it is commonly expected that knowledge of how to complete the task and knowledge from previous experiences would be shared with all other team members. Management envisage that staff communicate and collaborate in order to meet the established goals. However, this often not the reality.

In this paper, we explored a number of common communication and knowledge sharing issues that arise from project work. In particular we set out to explore the answers to three questions: “What makes teamwork more necessary than before in the working environment, particularly the virtual world?”; “What are the barriers to knowledge sharing within projects and virtual teamwork that frequently cause this teamwork to fail?”, and “is there a better way of addressing teamwork and collaboration issues, by combining several theoretical approaches?”

In looking at the working environment of projects we found that teamwork had become important because of six main issues: an increasingly geographically dispersed work environment; an increasingly complex environment; the need for quick and efficient decision-making; the increased volume of knowledge available to organisations; the problems related to knowledge attrition; and the continual development of new technologies including the Internet. The organisational environment, especially in relation to project work, requires teamwork in order to realise projects, yet teams have many issues to overcome before they can work effectively. We have argued that a location-independent workforce needs to share resources and knowledge in a virtual environment but also they need to learn from past projects so as to improve their success rate and manage their resources more effectively.

Issues we found were also created by a dispersed organisational form. We found that it is easy to learn within projects, but difficult to share across projects, aggravated by the ‘not invented here’ approach. This perception may of course be true in some instances and these processes may not improve this particular project due to its unique nature. However, this is the exception not the rule. Additionally, we found that trust is difficult to build when teams are not co-located and yet trust is necessary for valid knowledge sharing. The barriers, we argued, also included the lack of access to current information, misinterpretation of communications, difficulties in transferring knowledge and information, and the decay of those items. Knowledge management and communication theory underpin the discussions of how and why people share knowledge and skills and in what form.

We used the approaches of sociotechnology, knowledge management, organisational communication theory, and CSCW as lenses and multiple theoretical bases to better understand the complexity of participation in teamwork. This permitted us to better inform the design of work processes and the development of computer-supported collaborative and knowledge sharing teams. We identified, for instance, from consideration of the seminal principles of sociotechnical thinking as exemplified by Cherns, that autonomy within teams and project work promotes learning and knowledge sharing, which in their turn assist the team to perform more flexibly and appropriately. Participation in collaborative work design as promoted by both sociotechnical thinking and CSCW permits the consideration of views which results in enhanced communications and a fuller application of workplace knowledge in meeting project goals.

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