STRATHCLYDE BUSINESS SCHOOL

Management Science
Theory, Method & Practice

Effective Virtual Teams Through Communities Of Practice

Chris Kimble, Feng Li and Alexis Barlow

Research Paper No. 2000/9

Chris Kimble is a Lecturer at the Department of Computer Science, University of York, **Dr Feng Li** is a Senior Lecturer and **Alexis Barlow** a Phd candidate at the Management Science Department, Strathclyde Business School, Glasgow, Scotland**.**

Abstract
This paper examines the nature of virtual teams and their place in the networked economy. It presents a framework for categorising virtual teams and argues that fundamental changes have taken place in the business environment which force people and organisations to operate in 'two spaces' simultaneously: the physical space and the electronic space. It highlights some of the issues of trust and identity that exist in virtual teams and argues that, due to certain barriers, only a small proportion of these teams reach a satisfactory level of performance. Using the evidence from two recent sets of studies, it highlights some of the barriers to effective virtual team working and demonstrates the critical importance of trust and social bonding to the functioning of such teams. It reports on the use of a 'Community of Practice' in a virtual team and argues that this may provide one mechanism for overcoming some of the barriers. Finally, it argues that many of the problems stem from a lack of understanding of the new geography of the information economy and that, rather than accepting the notion that 'geography no longer matters', continued efforts must be made to understand the relationship between the physical world in which we live and the electronic world of virtual team working.

Research News
Join our email list to receive details of when new research papers are published and the quarterly departmental newsletter. To subscribe send a blank email to managementscience-subscribe@egroups.com.

Details of our research papers can be found at www.mansci.strath.ac.uk/papers.html.
Management Science, University of Strathclyde, Graham Hills Building, 40 George Street, Glasgow, Scotland. Email: mgtsci@mansci.strath.ac.uk Tel: +44 (0)141 548 3613 Fax: +44 (0)141 552 6686

INTRODUCTION

Globalisation is an issue currently affecting many organisations and is one that has profound implications for the nature of work (Manheim 1992; Sachs 1995; Karimi and Konsynski 1991; Ives and Jarvenpaa 1992). In order to work effectively in an international setting companies are increasingly turning to trans-national teams (Castells 1996; Lipnack 1997; West 1997). These are seen as an effective and flexible means of bringing both skills and expertise to bear on specific problems. Working in a distributed environment will affect teams in that they will lose many of the opportunities for informal collaboration and knowledge sharing. Working in a more internationalised context places further strains on the way a team works as they not only have to cope with geographical distance, but also time, culture and possibly language differences.

Many barriers to the effective functioning of virtual teams have stemmed from the creation of a new electronic environment that co-exists with the physical environment in which the teams operate; in particular from the unquestioned assumption of the 'death of distance' and the 'end of geography' in the information economy (Li and Williams 1998). The evidence from case studies and from previous research has clearly indicated that geography matters in the information economy (e.g. Hepworth 1989; Goddard 1992; Li 1995; Li and Williams 1998; Jarvenpaa and Leidner 1998; Kimble et al 2000; Hildreth et al 2000). It will be argued in this paper that to understand fully the barriers to virtual teams it is necessary to examine the main features of this new virtual environment and its relationship to the physical working environment. In particular the assumption that 'geography will no longer matter in the information economy' must be dismissed and nature of the new geography of the information economy must be fully appreciated.

In the new economy knowledge is increasingly seen as central to the success of organisations and an asset that needs to be managed (Boersma 1996). Since the 1980s, many organisations have taken steps to outsource, downsize and deskill in an effort to remain competitive (Davenport 1998; O'Dell 1998). Outsourcing, downsizing and programmes of planned redundancy all mean a reduction in existing staffing levels and as people leave, they take with them a valuable stock of corporate knowledge. This can be both knowledge of how the work is done in practice, and knowledge of a particular domain (Sachs 1995). Domain knowledge can be relatively easy to replace but t he knowledge of how a company operates is built up over many years and can be irreplaceable, at least in the short term. In addition, many organisations now have to cope with the increasing internationalisation of business which forces' collaboration and knowledge sharing across both time and distance. There is now an urgent need for new ways of thinking about how knowledge is shared in such groups.

Knowledge Management (KM) is an approach that claims to tackle many of these issues. Several views of knowledge have been explored in Knowledge Management (KM) literature most of them in the form of mutually exclusive or complementary pairings. For example, tacit/explicit (Nonaka 1991; Nonaka and Konno 1998); tacit/focal (Sveiby1; Conklin2); know-what/know-how (Seely Brown and Duguid 1998); cognitivist/constructionist (von Krogh 1998) and work in practice and domain knowledge (Sachs 1995). In contrast, Leonard and Sensiper (1998) view knowledge as a continuum rather than as opposites. They regard the two extremes as tacit knowledge, which is unconscious knowledge held within people's minds, and explicit knowledge, that is knowledge which is codified and structured. They observe that most knowledge exists somewhere between the extremes. It is the softer, more tacit aspect of knowledge however that is more difficult to manage. Effectively managing and sharing knowledge is difficult enough in co-located teams but distributed environments pose even greater challenges. This is an area that is under explored and organisations are under pressure to begin to think about how knowledge will be shared in such environments.

DESCRIBING VIRTUAL TEAMS

The concept of the virtual team is not clearly defined and it often overlaps with concepts such as the virtual or networked organisations, the virtual workplace, virtual communities, electronic commerce and some forms of teleworking (e.g. Igbaria and Tan 1997; Grimshaw and Kwok 1997; Hightower et al 1997; Knoll and Jarvenpaa 1997; May 1998). In some cases, the term virtual team is used interchangeably with the virtual organisation. In this paper we use the term the virtual organisation to refer to the inter-organisational arrangement where a group of independent organisations work towards a common goal usually, but not exclusively, using telecommunications and information systems (Chesbrough and Teece 1996).

For the purposes of this paper, we will use the term virtual team to mean a micro-level form of work organisation in which a group of geographically dispersed workers is bought together to accomplish a specific organisational task using Information and Communication Technologies (ICTs) (Benson-Armer and Hsieh 1997). Workers can come from the same or different organisations depending on the nature of the task (e.g. Townsend et al 1998; Lipnack and Stamps 1997; Li and Gillespie 1994) and its members may be separated by physical or temporal borders (Lipnack and Stamps 1997; Cantu 1999; George 1996; Jarvenpaa and Leidner 1998).

In order to classify all of the different possible situations the following scheme is proposed based on eight possible scenarios. Four belong to the situation where team members work for the same organisation while the other four belong to the situation where team members are from different organisations (see Fig 1). In the former situation, expertise may be drawn from members of the same organisation, e.g. production planners and production operatives (Kimble 1995). The latter situation is more common in projects that require the participation of consultants or external assessors, or, in Business to Business activities such as those involved in B2B e-commerce. Further classifications can be made on physical proximity, i.e. whether or not team members are local to each other or are geographically separate. Additional classifications are determined by work-cycle synchronicity, i.e. whether or not members interact in the same or different time periods.

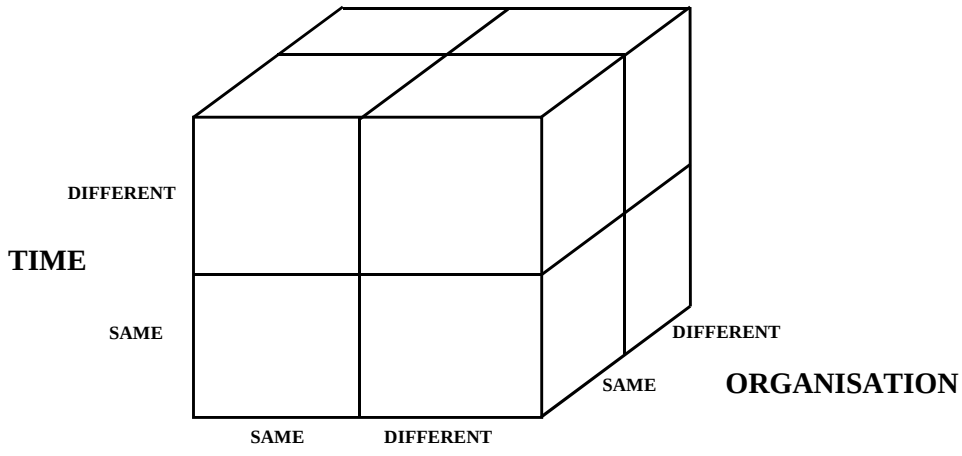

Figure 1: A classification of virtual team working

As will be illustrated throughout this paper, the spatial and temporal separation of team members can significantly effect the effectiveness of virtual teams, both within the same organisation and when working between organisations.

THE BUSINESS ENVIRONMENT FOR VIRTUAL TEAMS: LIVING IN 'TWO SPACES'

Before discussing the findings from the case studies, it is necessary to explore the changes in the nature of the business environment. The convergence of computing and telecommunications has led to core activities being reorganised around information. An essential aspect of virtual teams is their ability to exploit the features of this new electronic environment.

Since the late 1980s, numerous studies have been carried out on the geography of the information economy (e.g. Goddard 1992; Hepworth 1989; Li 1995). One of the main conclusions is that to understand the new spatial dynamics of corporate activities we need to shift our focus from the geography of space (geographical separation) and place (the unique characteristics of particular socio-cultural settings) to the geography of flows (Castells 1985; Hepworth 1989; Goddard 1992). ICTs allow information to be accessed from, or transmitted to, remote locations instantly (Hepworth 1989). Therefore, the locational patterns of the (networked) information cannot truly represent the geographical patterns of its use.

Hepworth (1989) advanced the concept of 'communicability' to interpret the movement characteristics of networked information capital and its spatial dynamics. This concept highlighted the qualitative difference between the geographical mobility of information through computer networks from alternative conceptions of capital mobility (e.g. the physical relocation of fixed capital or physical travel by information workers). An essential aspect of virtual teams is to exploit the features of the electronic space. The emergence of the electronic space however does not mean the significance of the physical space has decreased. Many characteristics of the physical space will continue to affect the operation and development of organisations. As Harvey (1989) argued, with the support of advanced information systems organisations are increasingly able to exploit minute geographical differences to good effect. Small differences in what the space contains in labour supplies, resources and infrastructures become of increased significance. An important paradox is that the less important the spatial barriers, the greater the sensitivity of capital to the variations of place within space, and the greater the incentive for places to be differentiated in a way that is attractive to capital. In other words, geography has never been more complicated, or more important, to organisations and individuals.

The neglect of space and place is surprising given the inherent geographical nature of information systems. In a recent study Li and Williams (1998) argued that with the rapid development and proliferation of ICTs, and the firm establishment of the information economy, organisations increasingly have to operate in 'two spaces' simultaneously - the physical space and the electronic space. These two spaces are not mutually exclusive and they sometimes overlap with each other in the organisation and execution of activities, but many rules governing these two spaces are fundamentally different. To survive in the information economy organisations must not only exploit geographical differences and overcome geographical constraints in the physical world, but they also have to exploit opportunities and face threats in the new electronic space (Lombard and Ditton 1997).

The co-existence of 'two spaces' represents a fundamental change in the business environment. Although the electronic space has emerged since the telephone and radio were invented, it has only recently become essential to organisations and individuals as advanced information infrastructures have become available and the information economy becomes firmly established. In particular, distinct from the telephone which has improved the geographical flexibility of labour, data communications have increased the flexibility of both labour and intellectual capital (Hepworth 1989; Goddard 1992) and consequently the level of flexibility for organisations in terms of 'who and what locate where' has increased significantly. This is especially so given the growing importance of information in capital and labour formation.

Our notion of time is significantly affected by the emergence of the electronic space. An important dimension of the industrialisation process has been the standardisation of time in our work and social life. By changing the nature of the friction of distance, the question of time and its significance in our work and everyday life is also reopened. New flexibility and constraints

in time (e.g. time zones) for virtual team members are important issues that must be considered. In the new business environment characterised by 'two spaces' time is not only a constraint (e.g. nobody wants to work at three o'clock in the morning in order to collaborate with team members from other continents) but also a resource that can be exploited for organisational benefits. Global virtual teams can pass work-in-progress around the clock among the three main economic centres (America Europe and Asia). Even in the same time zone, work-in-progress can be suspended in time (stored) which gives virtual team members the chance to organise individual time more effectively.

Similarly, with the emergence of the electronic space, the nature and characteristics of 'place' have been radically redefined. At one extreme virtual place in the electronic space are being created enabling people physically located in different places to meet electronically (e.g. a virtual chatroom, an important tool for many virtual teams). In essence, space and place have converged into one. This is not to say that the physical place is no longer relevant to individuals and organisations. On the contrary, local characteristics will continue to affect the effectiveness of communications between people from different places, even in the 'virtual place'. Indeed, although in the electronic space the 'friction of distance' has been eroded other frictions of distance derived from differences between places (e.g. local culture and language) will continue to work. The new information age also creates a tension. Structural change creates an environment of instability for employees. New organisational formations are formed based on the pervasive use of networked communication media for economic and social activities. While people strive to reaffirm their identity in the new electronic environment (Castells 1996).

A new model based on telecommunications and transportation is needed to understand the new dynamics of the space economy. Even though distance between physical places for certain forms of intellectual capital can be overcome by telecommunications, geographical differences between places still need to be fully appreciated for people to work together effectively. This is highly relevant to virtual teams.

VIRTUAL TEAMS IN PRACTICE: IDENTITY AND TRUST IN VIRTUAL TEAMS

The issues of trust and identity are crucial for the effective formation and functioning of virtual teams. Identity plays a critical role in communication where knowing the identity of those with whom you communicate is essential for understanding interaction. Yet, when team members are separated by spatial and temporal borders, identity is ambiguous. Many of the basic cues about personality and social roles we are accustomed to in the physical world are absent.

In the physical world there is an inherent unity to the self. The body provides a convenient definition of identity: the norm is one body, one identity. Though the self may be complex and mutable over time, the body provides a stabilising anchor. The virtual world is different. It is composed of information rather than matter. Information spreads and diffuses; there is no law of the conservation of information. The inhabitants of the electronic space are diffuse and free from the body's unifying anchor. One can have as many electronic personas as one has time and energy to create.

Similarly, trust is also an important enabler of co-operative human action (McKnight et al 1995). Many authors highlight the importance of trust in the success of teams (Larson and LaFasto 1989; Katzenbanch and Smith 1993; Handy 1995; McMahan 1999). Without trust the management of a virtual organisation cannot be conceived:

> *"Trust is the heart of the matter. That seems obvious and trite yet most of our organisations tend to be arranged on the assumption that people cannot be trusted or relied on even in tiny matters … If we are to enjoy the efficiencies and other benefits of the virtual organisation we will have to rediscover how to run organisations based more on trust than on control. Virtuality requires trust to make it work: Technology on its own is not enough" [Handy 1995].*

Handy stresses that trust requires touch [Handy 1995]:

> *"A shared commitment still requires personal contact to make it real. Paradoxically the more virtual an organisation becomes the more its people need to meet in person. The meetings however are different. They are more about process than task more concerned that people get to know each other than they deliver."*

Jarvenpaa and Leidner (1998) conducted a study about the creation and maintenance of trust in global virtual teams whose members transcend time, space and culture. The study identified various actions and communication behaviours that favoured the creation of trust in virtual teams. They observed that those teams that were not focussed on a task reported low levels of trust, but recognised that task focus existed in parallel with a social focus. They also highlighted the importance of the first "online-impression" because the first messages of the team members appeared to set the tone for how the team interrelated. Greater trust was developed at the early stages of virtual teams through a balanced mix of social and task communication, enthusiasm, optimism and initiative. In the longer term, trust was greater in teams that developed set patterns of communication and responded promptly to other team members. Overall, communication that rallies around the project or task appears to be necessary to maintain trust. Although the picture presented by Javernpaa and Leidner cannot be extended to a more general situation, in most companies business teams have ways of combining face-to-face and electronic meetings in such a way that they do not entirely operate in a single "platform". With the increasing use of network communication tools this situation will not change; assuming the team has opportunity of face-to-face "team building sessions", a trusting environment can be built in this way could then be taken to computer-mediated environment.

The actions and behaviours that can foster trust identified by Javernpaa and Leidner (1998) must be considered if we want to keep the trust created in face-to-face team building sessions. Initially, teams developed trust based mainly on social communication (exchanging greetings, names, interests and other personal information). This social-based trust was based on expectations of how team members would actually perform. However, once a team started working other types of trust emerged depending of the results: action-based trust. At this stage the social-based trust was not eliminated, but has to be considered along with the action-based trust. The key point is not that different forms of trust exist, but the observation that face-to-face meetings in physical space fosters social-based trust that carries into the electronic space and, that once a team has started computer-mediated working, the role of action-based trust also needs to be considered.

Unfortunately, such views are still not fully appreciated in current business thinking. Utopian views about the 'end of geography' remain extremely influential even though they are often based on limited empirical evidence (e.g. O'Brien 1992) or futuristic predictions about the potential impacts of telecommunications (e.g. Martin 1978; Godfrey 1979; Toffler 1981; Mandeville 1983). Geography still matters, physical space and place are still fundamentally important to us at all levels of society and the economy, even in the information age.

CASE STUDIES

Using the evidence gathered from two recent studies this paper will first explore the concept and functioning of virtual teams and then highlight some of barriers to effective virtual team working. It will then demonstrate that a Community of Practice, if properly supported, may help to overcome some of these barriers thereby improving the effectiveness of these virtual teams.

STUDY ONE: THE EXPERIENCES OF TEN VIRTUAL TEAMS

This study consists of ten case studies of virtual teams in different organisations. The case studies demonstrate the wide applicability of virtual teams across sectors and the benefits they can afford organisations and individuals. They also illustrate some of the potential barriers to virtual working posed by the spatial and temporal separation of team members. Information was collected through face-to-face interviews combined with other forms of correspondence such as e-mails, faxes, company reports and telephone calls. Summary information about the case studies is given in Table 1 below.

	Main Activity	Organisation	Time	Place
Case 1	Software support	Same	Same	Both
Case 2	Software development	Both	Both	Different
Case 3	Software development	Different	Both	Different
Case 4	Law firm	Different	Same	Same
Case 5	Secretarial services	Both	Same	Different
Case 6	Research/consultancy	Same	Both	Same
Case 7	Market research	Different	Both	Different
Case 8	Medical services	Same	Same	Different
Case 9	Medical services	Same	Same	Different
Case 10	Phone enquiries	Different	Same	Different

Table 1: Some Background Information of the Case Studies

Background of the Ten Virtual Teams

The first example (Case 1) is a virtual team between a CASE tool (Computer Aided Software Engineering) supplier and their main customer in the UK. The supplier develops a diverse range of software applications for customers in aerospace and defence, telecommunications, electronics, energy, system software and manufacturing. As part of its services the company provides constant, high quality, technical support to its customers. In the past these services were maintained by the supplier by sending experts to the customers' premises, but a virtual team solution has enabled the company to formulate an effective way of supporting its customers with greater responsiveness and efficiency. This approach is complex and a high level of interaction between geographically dispersed team members is needed. By providing a software tool to support remote tele-interactions between an expert and the client, the previous physical co-presence of these people is replaced by tele-mediated co-presence. In doing so, the geographical flexibility of the experts and the responsiveness of services has been improved significantly. This is especially so in urgent problem situations (e.g. a system breakdown).

Similar applications were identified in two other companies: one is a team of software developers in Northern Ireland who develop software remotely for a main client in London (Case 2). The other is a team of software engineers (Case 3) working from their separate homes to carry out joint software development projects in a distributed fashion in Scotland.

Another interesting virtual team was identified in a large law firm with several offices in Germany (Case 4). With only small number of branch offices and limited number of clients, the provision of a full range of professional legal services in remote locations is expensive. In many such situations, the result is a poorer, less extensive service in rural areas. In this case, a virtual team solution was developed involving a main office and two branch offices in northern Germany. The intention was to not only enhance services in remote locations but also reverse the previous situation by having a range of experienced legal experts available in remote locations. Thus, a particular legal expert would not have to remain in the main office but could provide services from a branch office. This application requires good quality videophones and the ability to transfer copies or images of documents for simultaneous viewing. To maintain strong professional links between the legal offices, the system also supports the transmission of large volumes of case file data. Despite various difficulties, the system has significantly

improved the geographical flexibility of legal experts and the responsiveness and quality of services to customers.

Similar virtual teams were identified in several other sectors. In France, a business services company (Case 5) set up an information system to support communications between its central office in Paris, three satellite offices in the suburbs and several regular clients. The system enabled direct communications, parallel viewing of documents and also parallel working on word-processed documents while in simultaneous voice and visual communications. This allows complex editing and formatting issues to be quickly resolved.

In southern Italy a system was developed to link together several academic and research institutions to provide, collectively, a full range of research training and consultancy services needed by industries (Case 6). In a market research firm (Case 7) a new system was developed to support the collaboration of a team of market researchers', consultants and managers working from their own homes. In Scotland, a system was developed between a large central hospital and a small clinic in a remote island (Case 8). Medical experts in the central hospital use the system to transmit high quality X-ray images together with other audio visual and text support to facilitate remote diagnosis. Similarly in Greece (Case 9), a new system was developed to provide full-time medical consultancy between a major teaching hospital in a large urban area and some small clinical units based in remote rural areas. The final case study was a homework based telephone enquires services in Portugal (Case 10) where an ISDN network was used to support the management and supervision of home-based work and the communications between co-workers to avoid isolation and to gain guidance.

These above case studies have illustrated the benefits to the organisations and individuals involved. However such new forms of work organisations are not problem-free; to achieve their full potential there are a number of difficult barriers has to be overcome. The barriers to virtual teams can be classified into two broad categories: technological and non-technological barriers (Lipnack and Stamp 1997; Benson-Armer and Hsieh 1997). Some of the most frequently encountered in the ten case studies barriers are examined below.

Technological Barriers

The evidence from the case studies clearly indicates that there are a number of technical problems ranging from unreliable systems and incompatible networks to 'slow' computers and traffic congestion during certain times of the day. Virtual teams require real-time multimedia communications incorporating voice, data, text, video and the use of a shared whiteboard. Essential to the use of such technologies is the development of an integrated broadband telecommunications infrastructure. Unfortunately, such infrastructure is often not available in certain areas and installing dedicated lines can significantly increase the cost to an organisation.

Although most communications functions of virtual teams can be supported by standard technologies today providing adequate technological support to virtual teams has been very difficult. This is especially so because new technologies and services are being rolled out constantly and people's expectations are high. Traffic congestion on a network causes delays and frustrations and the costs associated with using advanced telecommunications services can be considerable. Selecting the appropriate technologies and services is difficult and maintaining and upgrading systems demand considerable expert time and extra investment.

Finally, most equipment and software available today has been designed for use in a conventional office. Features of the conventional working environment that are vital to the effective execution of work in teams are taken for granted by designers and therefore are often not featured in the technologies and systems. When such technologies and systems are being used in a virtual team environment some of these features suddenly disappear from the working process and cause considerable difficulties for the organisation and the people involved. A re-orientation in the design of the information systems may be required if they are to be used effectively in supporting virtual teams.

Other Barriers

Compared with the technological barriers, organisational and cultural barriers are perhaps a more serious impediment to the effectiveness of virtual teams. Many managers still rely heavily on frequent visual contacts with employees to be reassured that their staff are working. However, the successful management of virtual teams demands trust and the development of new supervisory methods (Jarvenpaa and Leinder 1998; Grabowski et al 1998). Other barriers include the perceived disruption of virtual teams to corporate culture and the loss of employee's loyalty, especially in virtual teams involving people from different organisations.

One important issue that emerged from the case studies is that introducing virtual teams encompasses complex social, economic, managerial and psychological issues as well as organisational and technical processes. Some managers discourage or are uncomfortable with virtual teams because of their novelty and the problems they may produce in terms of management control and supervision. Trade unions are often hesitant to take a firm position before their full implications are understood. Workers may also find it difficult to abandon a familiar working environment and face the challenges of new technologies and new social and personal arrangements (Igbaria and Tan 1997; Lipnack and Stamp 1997).

From the case studies, the most challenging aspects of working in virtual teams is the issue of trust in new electronic environment. This is most clearly demonstrated by the examples where team members have to share work-in-progress electronically. For example, software developers (Case 2 and Case 3) are reluctant to share half-finished programmes with others. Similarly, consultants and market researchers are often unwilling to share half-written reports or supporting materials with colleagues (Case 6 and Case 7). In cases involving members from different organisations, this also involves a deeper concern about sharing expertise with people from other companies. Overall, these behaviours are indicative of a lack of trust within the virtual teams. A change in the mindset of the virtual team members is necessary for the full potential of the virtual teams to be achieved.

Even when team members are prepared to share information and knowledge with each other, the sheer time and effort required to manage the logistics of communication can also be a serious problem. Perhaps because of this, developing trust, a shared team culture and agreed procedures for effective communication - the essential 'common ground' (Clark & Brennan 1991) of a successful virtual team - remains elusive.

In the following sections, we will argue that some of these barriers can be overcome through the Communities of Practice (CoPs), which may provide a mechanism for strengthening and enhancing the effectiveness of virtual teams.

COMMUNITIES OF PRACTICE

The concept of a Community of Practice (CoP) was first introduced by Lave and Wenger in 1991. Although often seen as a simple apprenticeship model where knowledge is transferred through the situated learning that takes place between a master and apprentice, the central concept of CoPs, Legitimate Peripheral Participation, is not restricted to apprenticeships alone.

Lave and Wenger (1991) described a CoP as "… a set of relations among persons, activity and the world, over time and in relation with other tangential and overlapping communities of practice". In these communities newcomers learn from old-timers by being allowed to participate in certain limited tasks relating to the practice of the community. Over time newcomers move from being peripheral to the community, to full participation.

Lave and Wenger (1991) saw a CoP as "an intrinsic condition for the existence of knowledge". They saw the learning that takes place not as narrow situated learning, where instances of practice are simply replicated, but "learning as Legitimate Peripheral Participation". LPP is not merely learning situated in practice, but learning as an *integral* part of practice: "generative social practice in the lived in world".

For Lave and Wenger (1991), participation provides the key to understanding CoPs. CoPs do not necessarily imply co-presence, a well-defined or identifiable group, or socially visible boundaries. However, CoPs do imply participation in an activity about which all participants have a common understanding about what it is, and what it means for their lives and community. The community, and the degree of participation in it, are inseparable from the practice.

Partly as a response to the changes in the business environment outlined earlier in this paper, the notion of a CoP has been expanded to encompass a far wider range of definitions (e.g. Seely Brown 1991; Manville and Foote 1996; Stewart 1996; Seely Brown 1996; Wenger 1998; Wenger and Synder 2000) that were not part of Lave and Wenger's original idea. Manville and Foote (1996) offer the following definition of a Community of Practice

> *'… a group of professionals informally bound to one another through exposure to a common class of problems common pursuit of solutions and thereby themselves embodying a store of knowledge'*

Seely Brown and Solomon Grey take this further:

> *At the simplest level, they are a small group of people ¼ who have worked together over a period of time. Not a team not a task force not necessarily an authorised or identified group … They are peers in the execution of "real work". What holds them together is a common sense of purposes and a real need to know what each other knows'*

As a result of this proliferation of definitions, the term Communities of Practice is now applied, perhaps erroneously, to a range of groups, from project teams (Lindstaedt 1996) to functional departments (Sandusky 1997). There have been several attempts to define CoP in a way that is relevant to commercial organisations and even attempts by some consultancies, such as Andersen Consulting, to formalise them (Simonson 1996).

As we have seen, many commercial organisations now operate in a geographically and temporally distributed environment. Hence in order for such communities to function they will have to operate (at least in part) in the virtual world. Lave and Wenger's (1991) and Seely Brown and Duguid's (1991) examples of CoPs are co-located. However, the increasing internationalisation of business raises the question can a CoP be virtual? Some aspects of a CoP should translate from the co-located to the virtual world easily, for example finding a common purpose or at least a shared interest. If the members are doing similar jobs, then there will already be a shared domain language and knowledge. However, other aspects of CoPs, such as LPP, may prove more difficult.

There has been much discussion of virtual communities where the members never meet (Castells 1996; Fernback 1997; Poltrock. 1997). Conkar, Noyes and Kimble (1999), when discussing Multi-User Dungeons (MUDs), referred to their members as a Community of Practice. Although MUDs may appear to be an example of wholly virtual CoPs, in fact they are more similar to Lave and Wenger's (1991) CoPs as, in a MUD, the MUD itself is the practice. The MUD is not simply the medium by which the community communicates but it is also the raison d'être of the community.

STUDY TWO: 'COMMUNITY OF PRACTICE' IN PRACTICE

The second study consists of two case studies (Hildreth, Kimble and Wright 1998; Hildreth, Kimble and Wright 2000) of virtual CoPs in commercial settings. It examines the applicability of CoPs to virtual teams and highlights their potential benefits. The first was a case study undertaken at an international actuarial organisation. It identified a number of groups that could be characterised as CoPs, some of which had a distributed aspect to them, although none were

wholly distributed. Typical behaviour in these groups involved regular contact between colleagues, the sharing of projects, solving problems together, the informal swapping experiences and learning from discussions.

The most important finding concerned the way in which the different CoPs related to each other. Figure 2 illustrates the links that may exist between a co-located CoP and other individuals who may not be co-located. It also shows that members can be members of other Communities of Practice and that links may develop between Communities of Practice. To some extent, this mirrors the networks of organisations that develop in the new networked economy described by Castells (1996).

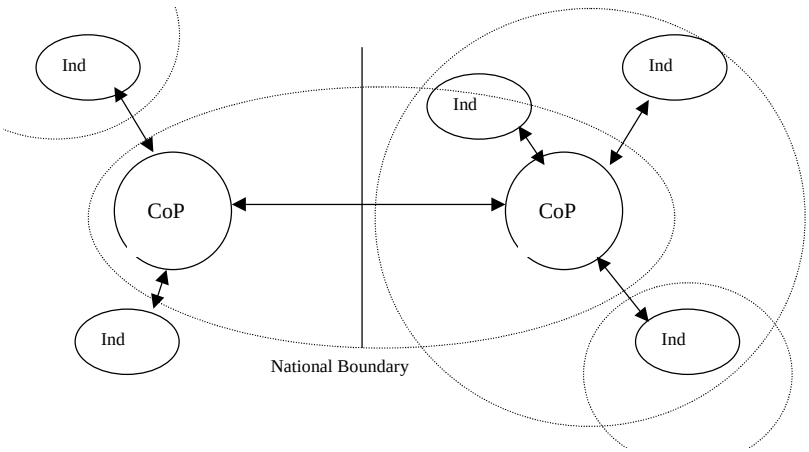

Figure 2: The model of CoPs found in the first case study.

Although LPP was central to the teams of Lave and Wenger (1991) it did not seem to be an essential aspect of the distributed CoPs in this case study. Where LPP was observed, it was in the physically co-located part. This need for a co-located element is supported by findings from elsewhere (Lipnack 1997; Seely Brown 1996; Castells 1996).

The next case study describes three days in the functioning of a virtual team and was undertaken in the research arm of a major international company. The group being investigated was the management team of IT support. Again, the group had a virtual and a co-located aspect. There was a group of four members co-located in the UK, a group of five members in the USA and one member in Japan.

The members of the group were generally very specific in their choice of media for certain tasks. Given that a face-to-face element was considered important by them, it was perhaps surprising that video conferencing was not the medium of choice for this group. Video is often claimed to be the medium with the highest bandwidth after face-to-face. However, the members' feeling was that the technology did not add enough over a simple telephone link to justify its use. Of far greater importance to the group was ease of use and the speed of interaction. Consequently, telephone conferencing was widely used, usually in conjunction with Microsoft NetMeeting as a means of sharing documents.

The sharing and creation of documents was the central activity during the period of this case study. In particular, the majority of the activities focussed on a planning document that was being developed by the UK core of the group. This document was of particular interest because, whilst it was being created for one purpose, it was also used for many others. The document was based on a template that had already been developed in the US, which meant that all members of the CoP were familiar with the layout and contents. It was evident from an interview that the UK core had designed this document with the aim of crossing national and organisational boundaries. Because they had already developed strong working relationship with their peers in the US, and felt that they knew them very well, the UK core could develop the document knowing their peers in the US would have confidence in the process. In addition,

the participation by the UK and US core in this common activity, bonded the group even more. A simple planning document became a catalyst for virtual collaboration.

The relationships between the cores had developed over time and, in most cases, were based on people having met each other in the physical world. A lot of the community's work was undertaken separately within the UK and US cores, but members meet regularly on a six-monthly basis. In between these meetings, they maintained communication via e-mail, voice mail, telephone conferences and Microsoft NetMeeting. They felt that during the periods of electronic communication the momentum of the group gradually slowed, until a physical meeting picked it up again.

There are some important implications of this face to face element for distributed team working. The members felt that meetings in the physical world allowed them to get to know each other far better than electronic meetings. The importance of having a good personal relationship with the other members was regarded as essential by all of the members, as this carried the community through the periods of electronic communication. The members gained a greater feeling of identity and common purpose through knowing each other. As one respondent described it '… you need that personal relationship if you are to go the extra half mile for someone': the community's members felt that they *knew* who they were dealing with - even if it was via e-mail.

The findings of the case study show the continued importance of the physical space- it sustains relationships through subsequent electronic communication. Although these relationships need re-charging at intervals, this re-charging in turn contributes to the further growth and evolution of the team. As the member's confidence and trust in each other increases, they gain legitimacy in each other's eyes and further participation develops.

CONCLUSIONS: OVERCOMING BARRIERS TO VIRTUAL TEAMS THROUGH COMMUNITY OF PRACTICE

Using empirical evidence gathered from ten virtual teams, this paper has highlighted the main technical and non-technical barriers to virtual teams. Key technological barriers include the underdevelopment of a telecommunications infrastructure; the high cost of using such services; the demands on expert time in upgrading the systems and the rapidly growing expectations of users. In addition, many existing ICTs have been developed for using in conventional office environment and may not be suitable for use in a distributed team environment. A radical re-orientation in the design of ICTs equipment and systems may therefore be necessary in order to support virtual teams effectively.

Working in virtual teams poses problems not usually encountered when groups of people work in the same building. Examples include the constraints (and advantages) of time zones; lack of non-verbal cues; cultural differences between team members and problems of trust and identity. Virtual team members often need to share work-in-progress with others which may require team members to adopt new attitudes and new mindsets towards work. Developing a team culture and common communication procedures are essential for the development of credibility and trust among team members in a virtual environment. To be effective virtual teams have to develop new ways of sharing knowledge and understanding in the electronic space.

Many of these problems appear to be addressed by the CoP. In the second study the members accepted and used the co-existence of the electronic and physical space. On one hand, the CoP yielded geographical flexibility and exploited the opportunities of electronic space. Members worked across national borders, had regular communication patterns and were able to share documents. Yet, the CoP still managed to deal with the physical aspects that can affect the operation and development of organisations. Frictions of distance derived from differences in local culture were overcome through regular face to face meetings and participation in shared activities. Trust and identity were built up through face to face communication in the physical

environment, and carried over into the electronic space. The CoP enabled the physical and electronic space to be successfully integrated.

The implications of the 'two spaces' for virtual teams are profound, and many lessons can be learnt from new theories on the geography of information economy. Instead of living in the physical space and place, and overcoming distance by transportation, organisations and individuals now have to deal with different combinations of physical and electronic spaces and places. These spaces and places can co-exist with one another and can be integrated flexibly. The geographical and organisational flexibility derived from these combinations implies that organisations have to adapt the way they manage internal activities and external relations. Although decisions regarding 'who and what locate where' remain critical to many organisations, the number of options and choices open to organisations and individuals has increased significantly. How to exploit the two spaces and manage the enormous complexity associated with this will be one of the most significant challenges to management in the next decade; virtual teams need to be understood in this broad context.

Today only a small proportion of virtual teams reach a level of performance that goes beyond what the individuals concerned could achieve independently (Benson-Armer and Hsieh 1997). New research is clearly needed to understand the problems faced by virtual teams if they are to achieve their full potential. The CoP is one vehicle for more effective virtual team working. It makes some inroads in tackling the complexities and challenges in the new business environment and it can be integrated with both the physical and the electronic environment.

The face to face element of the CoP in the last case study overcame many of the cultural and distance barriers derived from the new information economy. This enabled relationships to develop quicker and go further. If a strong relationship is developed in the physical environment, members of the community are more likely to 'go the extra half-mile' for each other. The feelings of identity and trust developed in this way provide a sound basis for subsequent electronic collaboration. This study also demonstrated how different boundaries (group, organisation, cultural and national) could be crossed by building trust and understanding so that the CoP became a way to share and leverage organisational knowledge.

Finally, many of the barriers identified in this paper derive from a lack of understanding of the new geography of the information economy. Contrary to the myth, created by Utopian authors and promoted by the popular media, that geography will cease to matter this paper argues that geography has never been more complex or more important to organisations and individuals. The emergent electronic space significantly increases the complexity of the business environment and the geographical flexibility of organisations and individuals. Rather than accepting the notion that 'geography no longer matters', continued efforts must be made to understand the relationship between the physical world and the electronic world of virtual team working. A CoP is only one method for addressing organisational and cultural barriers and overcoming frictions of distance. Theoretical frameworks are needed to understand the different aspects of virtual team working and to guide their development in real organisational settings. Virtual teams must be seen in the broader context of the new organisations and the new business environment of the information economy.

REFERENCES

Ahuja M K and K M Carley (1998) 'Network structure in virtual organisations' Journal of Computer-Mediated Communications 3(4): 1-29 Http://jcmc.huji.ac.il/vol3/issue4/ahuja.html

Benson-Armer R and T Hsieh (1997) Teamwork across time and space McKinsey Quarterly 1997 4: 19-27

Castells M (1985) High technology economic restructuring and the urban-regional process in the United States Castells M (ed.) High Technology Space and Society Sage London

Chesbrough H. W. and Teece D. J. (1996) When Virtual is Virtuous? Organising for Innovation Harvard Business Review January-February: 65-73

Clark H and Brennan S E (1991). Grounding in Communication. In Resnick L B, Levine J and Teasley (eds), Socially Shared Cognition. American Psychology Association

Davidow W and Malone M (1992) The virtual corporation Harper New York

Friedman K (1997) Cities in the information age: A Scandinavian perspective in Igbaria M and M Tan (eds.) The Virtual Workplace Idea Group Publishing Virginia

Goddard J (1992) New technology and the geography of the UK information economy Robins K (ed.) Understanding information business technology and geography Belhaven London

Godfrey D (1979) 'All information in all places at all times' in Godfrey D and Parkhill D (eds.) Gutenberg Two Porcepic Press Toranto

Grabowski Martha and Karlene H. Roberts (1998) Risk Mitigation in Virtual Organisations in Journal of Computer-Mediated Communications 3(4): http://jcmc.huji.ac.il/vol3/issue4/grabowski.html

Grimshaw D J and Kwok F T S (1997) The business benefits of the Virtual Organisation in Igbaria M and M Tan (eds.) The Virtual Workplace Idea Group Publishing Virginia

Harvey D (1989) The condition of postmodernity Basil Blackwell Oxford

Hepworth M (1989) Geography of the information economy Belhaven London

Hightower R T Sayeed L Warkentin M E and McHaney R (1997) Information exchange in virtual work groups in Igbaria M and M Tan (eds.) The Virtual Workplace Idea Group Publishing Virginia

Hildreth P, Kimble C and Wright P. (1998) Computer Mediated Communications and Communities of Practice. Proceedings of Ethicomp'98, Erasmus University, The Netherlands, pp 275 - 286

Hildreth P, Kimble C and Wright P. (2000) Communities of Practice in the Distributed International Environment, Journal of Knowledge Management. MCB University Press, 4(1), March, pp 27 - 37.

Igbaria M and M Tan (1997 eds.) The Virtual Workplace Idea Group Publishing Virginia

Jarvenpaa S L and D E. Leidner (1998) Communication and Trust in Global Virtual Teams in Journal of Computer-Mediated Communications 3(4): http://jcmc.huji.ac.il/vol3/issue4/jarvenpaa.html

Knoll K and Jarvenpaa S L (1997) Working together in global virtual teams in Igbaria M and M Tan (eds.) The Virtual Workplace Idea Group Publishing Virginia

Li Feng and Andy Gillespie (1994) 'Team Telework: An Emergent Form of Work Organisation' in Baskerville R et al. (Des) Transforming Organisations with Information Technology North Holland/IFIP WG8.2 Amsterdam 1994 397-418.

Li Feng (1995) The Geography of Business Information John Wiley and Son Chichester

Li Feng and H Williams (1998) Living in 'Two Spaces': Multinational organisations in the information economy in Roche Edward Kalle Kangas and Reima Suomi (Des) MIS Shaped or Mis-Shaped: Emerging IS Issues in the New Global Arena International Federation for Information Processing IFIP WG8.7 series. TUCS General Publications Turku Finland

Lipnack J and J Stamps (1997) Virtual Teams: Researching across Space Time and Organisations with Technology John Wiley and Son New York

Mandeville T (1983) The spatial effect of information technology Future February 1983

Naisbitt J (1984) Megatrends. Warner Books New York

O'Brien R (1992) Global Financial Integration: The End of Geography The Royal Institute of International Affairs/Pinter Publishers London

O'Hara-Devereaux M and Johansen R (1994) GlobalWork: Bridging distance culture and time Jossey-Bass San Francisco

Seely Brown J and Duguid P (1991). Organisational Learning and Communities of Practice. Organization Science, Vol. 2 No. 1

Seely Brown J and Duguid P (1996) Universities in the Digital Age. Change, July/August 1996 pp 11-19

Simonson, N. A (1996), Cultural Implications of Knowledge Management within the Change Management Community of Practice, Change Management Forum, Andersen Consulting, Private Communication.

Townsend A A M DeMarie and A R Hendrickson (1998) Virtual teams: Technology and the workplace of the future Academy of Management Executive 12(3): 17-29

Wenger E. 1998. Communities of practice. Learning meaning and identity. CUP

Wenger E and Snyder W (2000), Communities of Practice: The Organisational Frontier, Harvard Business Review, Jan-Feb, pp 139 - 145