

Knowing in action: Beyond communities of practice

Ash Amin^{a,*}, Joanne Roberts^{b,**}

^a *Department of Geography and Institute of Advanced Study, Durham University, Science Laboratories, South Road, Durham DH1 3LE, UK*

^b *Newcastle University Business School, Newcastle University, Room 20, 2nd Floor, Armstrong Building, Newcastle upon Tyne NE1 7RU, UK*

Received 18 February 2007; received in revised form 5 November 2007; accepted 21 November 2007

Available online 18 January 2008

Abstract

This paper engages with the recent turn in the social sciences towards communities of practice as a driver of learning and knowledge generation across a variety of different working environments. While agreeing with the broad reinstatement of situated social practice in thinking on the dynamics of knowledge capitalism, the paper takes issue with the increasingly homogeneous and instrumentalist use of the term communities of practice to encapsulate 'knowing in action'. On the basis of an extensive review of the available literature, the paper argues for the importance of differentiating between different varieties of knowing in action. The paper notes the differences – in organisation, spatial dynamics, innovation outcomes, and knowledge processes – between four modes: craft or task-based knowing; epistemic or high creativity knowing; professional knowing; and virtual knowing. The proposed typology is used to illustrate the insight gained from such analytical precision, through a discussion of the spatial configuration of knowing in action, long assumed to require spatial proximity. It is shown that spatial and relational proximity – which can be struck at a distance – should not be treated as one and the same.

© 2007 Elsevier B.V. All rights reserved.

Keywords: Communities of practice; Knowledge economy; Situated learning; Geographies of knowledge; Organisational innovation

1. Introduction

Communities of practice (CoPs) have attracted much attention from scholars and practitioners interested in the role of situated practice in the process of learning and knowledge generation. Originating in research into group-based learning in workplaces such as insurance claims processing, photocopy machine repair, and corporate research (Lave and Wenger, 1991; Wenger, 1998;

Orr, 1996; Brown and Duguid, 1991), the language of CoPs is currently being used to explain learning and knowledge generation across a variety of work, organisational, and spatial settings. What started out as a critique of orthodoxy explaining economic creativity and innovation as the alchemy of different knowledge inputs (from skills and competences to patents, technology and R&D capability), risks becoming a new orthodoxy of baseline or standardised forms of social practice fit for most learning and knowledge contexts. As CoPs thinking proliferates, the original emphasis on context, process, social interaction, material practices, ambiguity, disagreement – in short the frequently idiosyncratic and always performative nature of learning – is being lost to formulaic distillations of the workings of CoPs and

* Corresponding author. Tel.: +44 191 334 1850; fax: +44 191 334 1801.

** Corresponding author. Tel.: +44 191 222 6232.

E-mail addresses: ash.amin@durham.ac.uk (A. Amin), joanne.roberts@ncl.ac.uk (J. Roberts).

instrumentalist applications seeking to maximise learning and knowing through CoPs (as increasingly lamented by some of the pioneers—see Duguid, 2008; Lave, 2008). As the race for survival in the knowledge economy intensifies, so too seems the desire to exploit the potential for creativity and innovation offered by CoPs, ever wishful of articulating and harnessing the intangible, the tacit, and the practiced (Amin and Roberts, 2008).

This paper questions the value of such an approach to situated practice, one rooted in turning the innocence of general interest in CoPs into generic formulation. It does this on the basis of an extensive review of academic and management literature that uses the terminology of communities of practice to describe situated social practice, learning, and knowing. Our reading of the literature, in fact, reveals many different kinds of situated practice with quite varied processes and outcomes, gathered around distinct forms of social interaction. Our argument is that there are different socialities of knowing in action, each requiring a specific terminology, if the varieties of situated learning and knowing are to be appreciated, and if the distinctive insights of original CoPs thinking are not to be blurred. We offer a typology of knowing in action based on observations of differences in organisation, social engagement, spatial dynamic, and mode of innovation or knowledge formation in different clusters of working environment. Our aim is to build on the CoPs approach to provide a fuller account of knowing in action.

We begin by briefly exploring early conceptualisations of CoPs, before going on to consider the properties of different communicative settings of situated knowing. We give particular attention to four types of collaborative working: craft or task-based work, professional practice, epistemic or high-creativity collaboration, and virtual collaboration (a hybrid that overlaps with the latter in terms of learning and knowledge outcomes, but is a distinctive space of situated practice). These are offered as an illustrative typology of varieties of knowing in action, as a heuristic of variegated possibility. They are not intended to be exhaustive, mutually exclusive, or pure in form and function. The final section considers the insight gained by recognising the varieties of knowing in action, through a discussion of the spatial structures of situated practice. The turn towards communities of practice is leading to an understanding of ‘being there’ as being in close spatial proximity with others so that facial and social familiarity woven into the routines of shared work can trigger social learning and tacit knowing. Normatively, it is a turn returning hope to the small community, the isolated

region, and the disempowered collective in the new knowledge economy. We argue that such a conclusion may be premature on the grounds that varieties of situated knowing come in different spatial forms showing that relational proximity is not reducible to co-location.

1.1. From communities of practice to knowing in action

In their pioneering contribution on craft-based learning, Lave and Wenger (1991, p. 98) defined a community of practice as ‘a system of relationships between people, activities, and the world; developing with time, and in relation to other tangential and overlapping communities of practice’. They saw these relationships as essential for learning. Further work in the 1990s on small groups united by common skills or tasks went on to claim that such situated practice was also a rich source of knowledge-formation (Brown and Duguid, 1991, 1998; Wenger, 1998; Barley and Orr, 1997; Gherardi et al., 1998; Carlile, 2002). Wenger (1998, 2000) traced the link between situated practice and learning/knowing to three dimensions of ‘community’ – mutual engagement, sense of joint enterprise, and a shared repertoire of communal resources – which he proposed as sources of learning and knowing based on individuals doing things together, developing a sense of place, purpose and common identity, and resolving their differences. Wenger was keen to stress that not all forms of joint work could be labelled as communities of practice, but required particular charac-

Table 1

Key characteristics of a community of practice

-
- Sustained mutual relationships—harmonious or conflictual
 - Shared ways of engaging in doing things together
 - The rapid flow of information and propagation of innovation
 - Absence of introductory preambles, as if conversations and interactions were merely the continuation of an ongoing process
 - Very quick setup of a problem to be discussed
 - Substantial overlap in participants’ descriptions of who belongs
 - Knowing what others know, what they can do, and how they can contribute to an enterprise
 - Mutually defining identities
 - The ability to assess the appropriateness of actions and products
 - Specific tools, representations, and other artefacts
 - Local lore, shared stories, inside jokes, knowing laughter
 - Jargon and shortcuts to communication as well as the ease of producing new ones
 - Certain styles recognised as displaying membership
 - A shared discourse reflecting a certain perspective on the world
-

Source: Compiled from Wenger (1998, pp. 125–126).

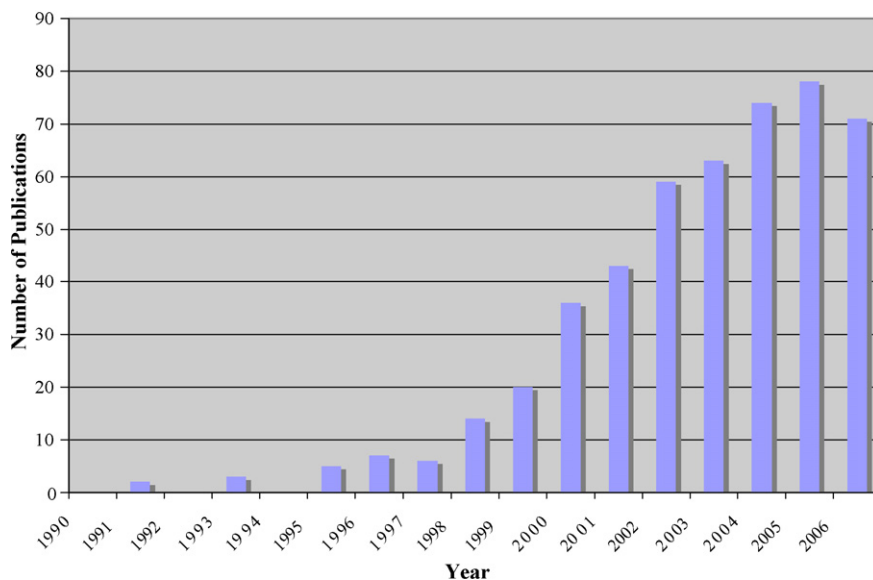


Fig. 1. The Expanding Literature on Communities of Practice. *Source:* derived from EBSCO data, August 2007.

teristics in order to be considered to be dynamic learning environments (see Table 1).

Since the publication of Lave and Wenger's book there has been an explosion of research on CoPs. For example, a search for the term 'communities of practice' in the *EBSCO Business Source Premier* database¹ in August 2007 identified 543 publications including academic papers, trade publications, magazine articles and books and monographs. As illustrated in Fig. 1 the interest in CoPs has risen exponentially during this decade. No more than two-thirds of these publications can be classified as academic contributions, indicating that the interest is being taken up as a means to both analyse and manage knowledge practices in diverse settings, with the term CoPs acting as the proxy for a more general recognition of the powers of learning and knowing in action through situated practice.

Our reading of much of this literature, however, shows that the use of the term has become imprecise, having strayed far from the original definition of CoPs as relatively stable communities of face-to-face interaction between members working in close proximity to one another, in which identity formation through participation and the negotiation of meaning are central to learning and knowledge generation. The status of the term as a keyword of new thinking on the sources of

learning and knowledge generation seems to rest upon a certain loss of the original awareness of context and habitus (Mutch, 2003), careless use of the word community (Lindkvist, 2005; Roberts, 2006), and speculation on the link between situated practice and learning or innovation outcomes (Handley et al., 2006). Thus, social practices of all kinds in all sorts of collaborative setting and all manner of learning and knowledge outcomes are becoming folded together into one undifferentiated form.

Our argument in this paper is that this homogenisation is unhelpful, for it not only glosses over significant varieties of situated practice with very different creative outcomes, but it also blunts policy action in an approach to knowledge management that demands attention to situated detail. Our thesis is that if an umbrella term is to be retained, it should capture the generic form of learning/knowing in action or practice, but then stimulate effort to name its various forms with clarity and precision. Put differently, it might be asked whether CoPs support a specific mode of learning and knowing. At the level of general terms, Gherardi (2006, p. 110), for example, has proposed the term community of practitioners rather than CoPs, in order to place the emphasis on 'practice' rather than 'community', in turn also redefining community as 'an effect, a performance, realised through the discursive practices of its members'. At the level of capturing variety, Lindkvist (2005) has used the term collectivities of practice, to refer to temporary groups or project teams concerned with knowledge creation and exchange, while Brown and Duguid (1991) have referred

¹ *EBSCO Business Source Premier* provides full text for nearly 7600 scholarly business journals and other sources, including full text for more than 1125 peer-reviewed business publications. This database offers information in nearly every area of business.

to ‘networks of practice’ to describe relations among group members which are significantly looser than those in a community of practice. In turn, Knorr Cetina (1999), Gittelman (2007) and Haas (1992) have described communities of specialised knowledge workers as epistemic communities, while Fischer (2001) has described groups of stakeholders from different CoPs brought together to resolve a specific problem as communities of interest.

In what follows, we join this group of scholars interested in – and valuing – different forms of situated practice and their learning/knowing outcomes, in an attempt to construct a systematic typology that includes CoPs and other forms of knowing in action. Our focus falls on the dynamics of innovation and knowledge creation, rather than on learning, largely because the subliminal focus of this paper is the nature of the social and spatial moorings of knowledge capitalism.

2. Varieties of knowing in action

The typology proposed in this section is the result of similarities and differences relating to knowledge dynamics that emerged in the course of reviewing over 300 publications on CoPs and related practice-based approaches.² The typology we have developed – summarised in Table 2 – remains more or less faithful to the descriptors of interacting communities in the literature examined (craft workers, task specialists, public sector professionals, online communities, creative artists, scientists and technicians). We wanted to stay with this mode of differentiation as it most closely mirrored self-defining group identities and affiliations and precisely because of our desire to delve into groupings defined as such in the literature to show their varied character. Looking across the many groupings, however, we came to the conclusion that four clear sets with distinctive properties could be identified, as groupings with specific modes of knowing in action—task/craft-based, professional, epis-

temic/highly creative, and virtual. The four – discussed in turn below – differed markedly along four dimensions relating to the dynamic and character of knowledge production: firstly, and most obviously, the knowledge used and produced, secondly the nature of social interaction, thirdly, the kind of innovation undertaken and fourthly, the organisational dynamic of interaction, as summarised in Table 2.

To briefly consider each of these dimensions in turn, firstly it cannot be assumed that knowledge dynamics in situated practice are homogeneous. The practices of knowing central to many craft and task-based communities require the development of kinaesthetic and aesthetic senses through the repeated practice of certain tasks under close supervision from core members of the community. The knowledge of professional communities, in contrast, is often acquired through lengthy periods of training designed to absorb, largely through the application of intellectual capacities, a given canon of knowledge and associated practice. Secondly, the nature of social interaction that sustains innovation and learning varies markedly (precisely why the temptation to reduce it to practices of community must be avoided). For instance, craft and task-based work requires close proximity and face-to-face interaction, a factor that will shape the nature of social interaction, usually in the direction of close communitarian ties. In contrast, ties within epistemic communities, as we shall see below, tend to be structured more closely around common projects and problem-driven cooperation (common also among certain high-energy online communities), while professionals such as teachers and health-workers tend to rely on long training histories and institutional affiliations to gather common purpose.

Thirdly, the groupings considered in this paper vary markedly in terms of the nature and centrality of innovation. For example, epistemic communities, which bring experts together explicitly to develop new knowledge, display a high propensity to innovate. Communities of physicists and molecular biologists gathered around particular projects are there to break the mould, while craft/task-based communities such as flute makers and insurance claims administrators, are more concerned with the preservation of skills and with incremental innovation, rather than with radical innovation. Fourthly, as the discussion below reveals, situated knowledge comes in varying forms of organisation, which in turn, affect the nature of innovation and creativity. These differences relate to whether a community is managed in a decentred or hierarchical manner, and whether it is open or closed to the flow of knowledge from other communities and to change in general. For example, whether knowledge is

² The results from the original EBSCO database search were supplemented by a number of other electronic database searches including the *Web of Knowledge* and *Infotrac*. Internet-based publications were identified through *Google scholar* search. The body of literature identified from our search included theoretical and review papers together with critiques and papers reporting the findings of empirical studies. Our review focused primarily on original empirical contributions on situated knowing in varied working and professional settings, including public services such as education and healthcare, private business organizations, other commercial and non-commercial environments including financial services, creative and innovative networks, craft-based learning environments, online communities, and a range of miscellaneous contexts.

Table 2
Varieties of knowing in action

Activity	Type of knowledge	Social interaction			Innovation	Organisational dynamic
		Proximity/nature of communication	Temporal aspects	Nature of social ties		
Craft/task-based	Aesthetic, kinaesthetic and embodied knowledge	Knowledge transfer requires co-location—face-to-face communication, importance of demonstration	Long-lived and apprenticeship-based Developing socio-cultural institutional structures	Interpersonal trust—mutuality through the performance of shared tasks	Customised, incremental	Hierarchically managed Open to new members
Professional	Specialised expert knowledge acquired through prolonged periods of education and training Declarative knowledge Mind-matter and technologically embodied (aesthetic and kinaesthetic dimensions)	Co-location required in the development of professional status for communication through demonstration. Not as important thereafter	Long-lived and slow to change. Developing formal regulatory institutions	Institutional trust based on professional standards of conduct	Incremental or radical but strongly bound by institutional/professional rules Radical innovation stimulated by contact with other communities	Large hierarchical managed organisations or small peer managed organisations Institutional restrictions on the entry of new members
Epistemic/creative	Specialised and expert knowledge, including standards and codes, (including meta-codes) Exist to extend knowledge base Temporary creative coalitions; knowledge changing rapidly	Spatial and/or relational proximity. Communication facilitated through a combination of face-to-face and distanced contact	Short-lived drawing on institutional resources from a variety of epistemic/creative fields	Trust based on reputation and expertise, weak social ties	High energy, radical innovation	Group/project managed Open to those with a reputation in the field Management through intermediaries and boundary objects
Virtual	Codified and tacit from codified Exploratory and exploitative	Social interaction mediated through technology—face-to-screen. Distanced communication Rich web-based anthropology	Long and short lived Developing through fast and asynchronous interaction	Weak social ties; reputational trust; object orientation	Incremental and radical	Carefully managed by community moderators or technological sequences Open, but self regulating

held in silos or able to move easily around an organisation will influence the level of innovation arising from the cross-fertilisation of ideas.

The four groups discussed in this section are not intended to be exhaustive, and by no means mutually exclusive. There may well be other groupings and sub-groupings that could be identified. Our aim is not to offer a complete typology. Instead, it is to reveal how variety matters, and in ways that exceed the term communities of practice. That said, we would be the first to admit that the boundaries between the groupings are porous. For example, some professional communities such as medical practitioners rely on kinaesthetic and embodied knowledge in much the way that craft communities do, and epistemic/creative collaborations can draw on incremental learning in the way that other groupings do, even to make the break-through innovations that they come together for. The typology is a heuristic, not a comprehensive and clearly delineated classification.

2.1. *Craft/task knowing*

What, then, are the distinctive properties of craft/task knowing? We begin with a summary of some classic studies before going on to tease out the properties. Early contributions to the literature on CoPs focused on craft or task communities. For instance, in their study of situated learning *Lave and Wenger (1991)* examine the activities of Yucatec midwives, Vai and Gola tailors, naval quartermasters, meat cutters, and non-drinking alcoholics, arguing that ‘learners inevitably participate in communities of practitioners and that the mastery of knowledge and skills requires newcomers to move toward full participation in the sociocultural practices of a community.’ (p. 29). Thus, mastery and knowledge reside in the organisation of community so that apprentices learn to replicate a certain set of tasks within a particular sociocultural and technological setting using skills acquired through practice-based learning and mastery of both skills and the conventions of a working community.

In *Wenger’s (1998)* later study of insurance claims processors, learning is explained as a combination of putting codified knowledge into practice and participating in a community. Newcomers absorbed knowledge from a variety of sources including formal training and from working in a social context with more experienced co-workers. While much of the activity is standardised some claims are idiosyncratic, necessitating specialist knowledge. Part of achieving full participation in this community is gaining knowledge of who knows what in order to be able to access knowledge to process idiosyncratic claims that require specialist treatment.

Another classic contribution is *Orr’s (1996)* study of Xerox technicians involved in replicating and refining a certain kind of craft-knowledge through shared practice. Orr shows that, in the process of learning how to repair photocopy machines, the technicians are often involved in the co-production, with colleagues and clients, of knowledge pertaining to specific machines. Technicians learn to improvise: each machine has its own peculiarities. In this way they draw on a range of knowledge; from that codified in manuals to the aesthetic knowledge embedded in their mental and physical senses. New methods of repair are developed through knowledge in action and shared in the community of technicians through the recounting of stories from the field during informal meetings over breakfast and lunch.

Cook and Yanow’s (1993) study of learning in the manufacture of flutes provides a good example of a ‘pure’ craft environment. The author describes a work culture in small workshops where flutes are constructed by artisans in close proximity, each focusing on a particular task. As the flute is passed from one person to another, the recipient assesses the work of the previous person, returning it for further work if it ‘does not feel right’. Organisational learning occurs through the handing back and forth, and the evaluation, of the flute sections. This process involves a kinaesthetic and aesthetic dimension in as much as flute makers, both individually and collectively, make judgements of hand and eye (*Yanow, 2000*). Novice and experienced flute makers must compare the feel of the artefact that they are producing; knowledge and learning develops from a collective shared tacit understanding of what constitutes the distinctive feel of the company’s flute. The significance of the (kin)aesthetic dimension in craft knowledge is also evident in *Strati’s (1999)* study of construction workers describing how workmen on a roof learn to feel the roof through their feet. The workmen have a kinaesthetic understanding of how to work safely, an understanding in which feeling and knowing intermesh to underpin routine activity as well as new inventions (*Gherardi, 2006, p. 81*).

Several characteristics of knowledge in action in craft/task-based communities emerge from this short review. Firstly, even though elements of knowledge may be codified most knowledge is embedded within individuals and the sociocultural context. Experience, tacit knowing, embodied know-how, continuous learning, and (kin)aesthetic awareness are some of the factors responsible for a form of unique knowledge that requires special cultivation.

Secondly, in craft/task-based activities the social dynamic sustaining knowledge is characterised by

work colleagues sharing a community-specific language (including physical cues), relating stories, building strong ties of reciprocity, trust, and dependence, drawing on facial, tactile, and emotional contact; all of which lead to a high degree of mutuality born out of shared work. While knowledge can be, and is, codified to facilitate its transfer, as in the case of Xerox manuals, the preferred mode of knowledge transfer is through verbal and physical communication. For instance, the quality of a flute results from the fine degrees of dimension and tolerance in how the components fit and function as a whole. Yet such dimensions and tolerance are not known explicitly by the flute makers, who prefer hand-eye judgements to those available through the use of measuring instruments such as callipers and feeler gauges. Knowledge of how to become a midwife, tailor, or flute maker is acquired through a period of apprenticeship involving the practice of engagement in a relatively close-knit community which, in the course of time, produces forms of affiliation that knit together objects, people, and ways of doing things. The result is strong community ties structured around particular ways of doing things, resulting in cultures of work and professional identity that can frequently clash with standards elsewhere, even in the same organization.³

Thirdly, craft/task-based activities are primarily concerned with replicating and preserving existing knowledge rather than engaging in radical innovation. However, over a relatively stable period, the knowledge developed through everyday interaction among people involved in the same tasks, or between masters and apprentices, is far from mundane or unchanging. It evolves constantly in response to the changing environment, customer requirements, and evolving community practices, and is also capable of quite significant innovations, which, however, stop short of path-breaking leaps. The innovations are of an incremental nature, but always geared towards the production of a customised product marked by artistic signature and craft awareness of some form. Thus, while craft/task-based activities may be concerned with preserving existing knowledge, this does not in any way mean that they are open to substitution or replication by new actors.

Finally, knowing in action within craft/task-based activity occurs within a community organisational dynamic characterised by hierarchy. Yet these commu-

nities are open to newcomers as long as they are willing to engage in a period of apprenticeship through which they learn to master the community's knowledge-base.

2.2. Professional knowing

This section focuses on professional practice in the healthcare sector, where increasingly ideas of practice-based innovation and learning are thought to hold potential for quality improvement and the reform of delivery systems (Bate and Robert, 2002). The literature reveals a number of characteristics that are common to professional communities more broadly.⁴ The first of these relates to the type of knowledge acquired, generated, and disseminated by professionals, which requires the mastery of both tacit and codified knowledge. While much of the codified knowledge can be absorbed through individual academic study, tacit knowledge must be gained through learning by doing. The significance of access to tacit knowledge is highlighted by Gabbay and Le May (2004) in their ethnographic study of how primary care clinicians working in informal CoPs internalise collectively reinforced tacit guidelines, or 'mindlines', which they use to inform their practice.

But how is such knowledge gained, held, and communicated? In a study of pre-operative anaesthetic work, Hindmarsh and Pilnick (2002) find that the organising practices and skills associated with *in situ* team-working reveal the critical importance of embodied conduct. Rather like in craft communities, practice includes implicit relations, tacit conventions, subtle cues, untold rules of thumb, recognisable intuitions, embodied understandings and shared world views. Such practice-based knowledge is acquired through social interaction involving verbal communication through CoP-specific language, the use of artefacts, and, perhaps to a lesser extent, the acquisition of (kin)aesthetic understanding through the observation and imitation of the actions of experts. For instance, a surgeon must learn to feel the correct pressure with which to use a scalpel in order to make an incision of the required depth in the same way that a flute maker must learn the correct feel of an appropriately calibrated flute. However, competence is also about convincingly projecting declarative knowledge. In professional activities such 'performance' knowledge may be used in a reflexive or non-reflexive manner.

The nature of social interaction provides a second common characteristic of professional communities.

³ Examples include Xerox technicians privileging community knowledge over that provided in organisational manuals (Orr, 1996), or construction workers seeking employment only in those building businesses that have safety standards that are congruent with those acquired in their safety practice communities (Gherardi, 2006).

⁴ Professional communities in education were also examined in the course of this study, but not considered here due to space constraints.

Rather like in task-based or craft communities, the apprenticeship-style learning necessary for the development of professional competences involves the co-location of a newcomer with experienced members of a community. Newcomers move from legitimate peripheral participation towards full participation, shaping knowledge, developing their professional identities and participating in incremental innovative activity as they learn (Goodwin et al., 2005; Bleakley, 2002). However, in contrast to task-based or craft communities, once individuals have mastered a body of professional knowledge, they seem to benefit from knowledge exchanges facilitated by virtual communications with geographically dispersed members of their profession.

The authenticity of knowledge circulating in such networks is ensured by the presence of professional standards. Knowledge exchange in an informal evidence-based healthcare email network of 2800 UK healthcare practitioners investigated by Russell et al. (2004) helped to bridge the gap between research and practice by serving as a rich source of information, providing access to members' experiences, suggestions, and ideas, facilitating cross boundary collaboration, and enabling participation in networking at a variety of levels. This study illuminates not only the value of virtual communication, but also the importance of informal social processes and weak social ties for building, sustaining and disseminating knowledge practices (Donaldson et al., 2005).

The third common characteristic of professional communities is the nature of innovation, which tends to be incremental rather than radical, and reliant upon cross-community links. Bridging the boundaries between different groups within the healthcare system is essential for the efficient exchange of information and for the dissemination of innovation because, as a qualitative study tracing 8 innovations in the UK healthcare sector revealed, the uni-disciplinary CoPs of different professions may retard the spread of innovations (Ferlie et al., 2005). The available research indicates that efforts to innovate involving interactions between CoPs give rise to greater diversity and, therefore, a wider range of possible outcomes than innovation within a single CoP. Interaction with other professional or non-professional groups is widespread in the healthcare sector which is made up of a diverse range of professional groups, including accountants, managers, doctors, nurses, radiologists, dieticians, pharmacists, and therapists of various sorts. Additionally, many agencies and groups interact with healthcare professionals and their organisations, including social services, health visitors, voluntary organisations, pharmaceutical companies and

medical instrument suppliers, as well as patients and their families. Not surprisingly, then, many CoP studies in healthcare explore the boundaries and interactions between these various groups, with their often distinctive cultures (Freed, 1999; Ferlie et al., 2005; Lathlean and Le May, 2002; Gabbay et al., 2003).

A fourth distinctive feature of professional communities is that the protectionist role of professional associations can act as a barrier to radical change. This is illustrated by Bullough et al. (2004), who use the CoPs framework to show how clinical and university-based educators sharing a set of assumptions about their respective roles, engaged in a form of "collusion" to undermine the agreed conventions of partnerships, preventing the sharing of knowledge across professional boundaries (Bates, 2000; Currie and Suhomlinova, 2006). Such protectionist responses to radical change seem to characterise professional communities. Yet, as Faulconbridge's (2007) study of collective learning in advertising and law reveals, professional associations can promote the dissemination of new incremental knowledge across the sector. However, where the hierarchies are less pronounced, the research seems to suggest that experiments with CoPs (loosely interpreted by practitioners) have helped to ameliorate dissonances between professions and organisations. For example, Adams and Blandford's (2005) investigation of the introduction of new privacy and security policies in two hospitals finds CoPs to be a valuable mechanism for overcoming the difficulties arising from the implementation of policies developed by the formal organisational structure without adequate regard to their impact on the everyday practices of those delivering healthcare service. Similarly, Swan et al. (2002) show in a study of the adoption of a radical innovation in the treatment of prostate cancer, how the use of CoPs as a rhetorical device can counter resistance from powerful professional groups in order to legitimise changes in the work practices.

Four concluding observations can be made about professional communities. The first of these relates to the type of knowledge, including codified, tacit and embodied, which is acquired and disseminated through various forms of interaction. Secondly, social interaction is facilitated through specific uses of language, the use of artefacts, and the demonstration and imitation of embodied conduct involving (kin)aesthetic dimensions. But once individuals have mastered a body of professional practice-based knowledge, they can benefit from knowledge exchanges through virtual communications with geographically dispersed members of their profession. Thirdly, innovation and creativity

appear to be stronger where professional communities intersect with related professions. Fourthly, the development of professional knowledge is constrained by the regulatory activities of professional associations.

2.3. *Epistemic/creative knowing*

In this section we examine the dynamics of collaboration among experts brought together explicitly to experiment with new knowledge of a path-breaking nature. These are commonly described as epistemic communities, purposefully organised to unleash creative energy around specific exploratory projects and typically involving coalitions of scientists, product developers, academics, visual and performing artists, advertisers, software developers, consultants, media professionals, or designers. Such coalitions can arise within organisations (e.g. product-development teams within corporations), they can be offsite (e.g. scientific, artistic or academic collaborations formed around specific projects), or they can exist as an inter-organisational network (e.g. business or advertising consultants working closely with clients in different firms). In all cases, however, it seems that the high level of independence of individual participants, together with their distributed contact networks, yield collaborative practices that spill over organisational boundaries.

Creativity in such collaborations thrives on the juxtaposition of variety. Novelty comes from fusing elements not connected before, drawing on heteronymous interactions and a degree of willingness to venture into uncharted territory (Lindkvist, 2005). A key feature that contrasts sharply with the other forms of knowing in action discussed above is the mobilisation of difference in conditions of uncertainty as a means of generating new interactive knowledge. Creplet et al. (2001) summarise the difference as that between experts who apply acquired knowledge to new situations and those who ‘create new knowledge that was not existing before’ (p. 1521) based on the mobilisation of variety, ambiguity, and uncertainty. The latter seems to be a consistent finding of research; examining knowing in action among traders on a New York financial derivatives trading room (Beunza and Stark, 2004), scientists attracted to renowned laboratories (Knorr Cetina, 1999; Collins, 2001), corporate innovation units deliberately organised for multidisciplinary and blue-sky scenario-building, global advertising projects thriving on cognitive distance, improvisation, frequent personnel changes, and diverse clients (Grabher, 2004), and experimental col-

laborations in the visual and performing arts organised for ‘structured chaos’ (Yanow, 2001).

Crucially, however, how variety and ambiguity are reconciled has a central bearing on whether the fruits of creative engagement can be harnessed in epistemic communities. These are collaborations involving experts with substantial egos, high expectations, frequent turnover, rudimentary rules and procedures, tight deadlines, and considerable ambiguity and uncertainty. Given the immense scope for fragmentation, misunderstanding and disunity, success is far from guaranteed. Four factors appear to be significant in channelling the ambiguities of heterogeneity towards productive creative openings. The first has to do with the link between personality and peer recognition. Playing on Michael Polanyi’s celebrated summation of tacit knowledge as knowing more than we can tell, Lindkvist (2005, p. 1203) has suggested that the collaborations ‘tell more than we can know’. In contrast to task/craft communities, in which the individual learns through group enculturation and participation, experts in epistemic communities come with considerable autonomy and worth linked to their individual skills, experience and reputation. This self-assuredness is held to combine with an interest in joint venture motivated by traits such as inquisitiveness, professional commitment, peer recognition, corporate or ethical responsibility, and career progression. According to Creplet et al. (2001), who have studied business consultants, these traits coincide with certain personality traits such as charisma, authority, empathy, and logical capability, without which the trust placed on experts to address complex tasks in collaborative networks would waver.

Secondly, it is commonly argued by researchers working on high creativity collaborations that they are not communitarian in nature (dependent upon strong interpersonal ties) but marked by strong loyalties to a shared problem. This is an important distinction, one that differentiates such collaborations from even other forms of expert knowing. For example, Grabher (2004) finds that in some areas of software development, collaboration involves recombining existing know-how and is dependent upon intense social ties, common work histories, and high levels of trust—much in the way of classic communities of practice. In contrast, he notes that high-creativity advertising projects are marked by cognitive friction and weak ties held in place by the force of professional ethic, peer recognition, calculated loyalty, and project-orientation. What prevails is ‘learning by switching’ between teams, agencies, supplier and clients, ‘driven by the canonical compulsion of freshness, mobility, and flexibility’ (Grabher and Ibert, 2006, p. 261).

A third factor of productive ambiguity is organised slack. High creativity collaborations are influenced by the scope for free thinking, imaginative play, visualisation of problems, and serendipity. This is illustrated by Thompson's (2005) ethnography of a high-energy web design team, which uncovers a conversational culture of impromptu meetings, many interruptions, repudiated formal agendas, and quick-fire analysis of problems. Importantly, however, he describes this as 'consciously cultivated informality' (p. 156), formed around pool tables, informal meeting areas, and a surfeit of toys, taken as necessary to unlock collective imagination. The nature of organised slack varies between project teams and working environments, but what seems clear is that factors such as informality, iterative purposefulness, and productive idleness are common to most high creativity groups, from teams of scientists working to a strict deadline to artistic directors who have come together to put together a new performance. They are the spark for improvisation, offering space for embodied expertise and material engagement to combine in open and experimental ways (Grabher, 2004; Hatch, 1999; Yanow, 2001; Gibson, 2006). Organising for slack has an important spatial dimension. Commentators on the creative industries frequently remark on the role of central business districts in providing contact networks (Leadbeater, 1999), opportunities to test markets (Maskell, 2004), and cultural buzz (Storper and Venables, 2002; Florida, 2002; Amin with Thrift, 2007). As Grabher (2004) notes, advertising collaborations stretching across long distances frequently rely on local buzz—the bolt-holes, meeting places and social networks in places like Soho in London or central Munich, where new possibilities are often hatched.

Managing dissonance requires considerable alignment in order to bridge the gap between creativity and tangible innovation, the fourth factor which we believe distinguishes epistemic communities from other forms of knowing in action. Although collective commitment to a joint venture is clearly an important integrating device, it is not a sufficient one. Other modes of alignment are also required. One of these is codification. Nonaka and Takeuchi (1995), and more recently others working on epistemic communities (e.g. Creplet et al., 2001), have argued that the codification of tacit knowledge is crucial for circulating know-how in the creative process. Making idiosyncratic or pre-cognitive knowledge explicit is not only essential for capturing and circulating know-how, as Nonaka has stressed, but is part of the process by which collective sense-making occurs. It allows different actors – proximate and distant – to communicate with each other. Most importantly, in

project-based work with pressing deadlines, one important achievement of scribbles, drawings, formulae, data, briefings, and reports is to herd collaborators towards a common direction, as they come to internalise and share the objects. For example, Fischer (2001) shows how an urban-planning experiment managed to bridge different interests with the help of an interactive electronic table that allowed people to jointly design an urban layout. Similarly, Carlile (2002) stresses the role of shared artefacts and technologies in helping a heterogeneously composed design engineering team to produce a working prototype.

'Meta-coding' is another mode of alignment. High creativity collaborations consist of highly autonomous agents, yet their discipline is not reducible to self-organisation and mutual respect. New work is emerging on bridging devices that hold together diverse or distributed groups of experts. For example, Hernández-Martí (2005) argues that the establishment of meta-teams led by 'visionaries' from diverse backgrounds helped to foster creative exchanges between different expert communities in a major oilfield services corporation. In turn, Kogut and Macpherson (2004) show how Chicago School ideas on privatisation have spread as a global standard through the circulation of graduates, citations, keywords, and the like, functioning as a meta-code of measure and worth among otherwise fiercely independent economic policy communities. The significance of meta-codes becomes apparent when cognitive distances between knowledge domains cannot be bridged, as shown in a study by Rist et al. (2004) of unsuccessful communication between indigenous epistemic communities and mainstream scientists wedded to canonical beliefs and established methodologies, and for this, unable to overcome their suspicion of the world views and practices of indigenous peoples.

Our discussion of highly creative epistemic communities has focused on the challenge of alignment because a distinctive feature of such communities is the absence of an obvious social dynamic of cohesion and mutuality. Projects are short-lived, individuals are often self-centred, tasks are not shared, professional identities are not shaped through joint work, and there is an absence of strong loyalties to members of the group. Instead, autonomy, improvisation, individual expertise, and object-orientation are prevalent. The tools of collaboration have to be made, but once in place, they offer immense potential for creativity based on dynamics of situated practice that draw on professional integrity, reputation, weak ties, and deliberate arrangement of the architecture of collaboration.

2.4. *Virtual knowing*

The final type of situated knowing we wish to consider is virtual knowing.⁵ Until recently it has been assumed that virtual space cannot be considered as a site of situated practice, generative of knowledge on its own terms. Although, virtual interaction has been seen to enable information exchange, learning, and possibly situated knowing at the interface between face and screen, it has not been considered as an ecology of social knowing in its own right. As it becomes easier to communicate with distant others in real time and in increasingly rich ways due to the availability of sophisticated software and visual technologies, interest is growing in how the new environments support knowledge generation. The proliferation of online communities has spurred this interest, with research increasingly inquiring into how their knowledge dynamics differ from those of communities that depend on social familiarity and direct engagement (Ellis and Vasconelos, 2004; Johnson, 2001; Preece et al., 2003).

Online communities are far from homogenous. At one end of the spectrum lie large, loosely structured chatrooms, and at the other end lie small, purposeful, and managed groups. In between can be found newsrooms that allow material to be read and posted but involve little interaction, online databases and repositories that permit some degree of manipulation, clubs and game sites that involve intense interaction and emotional attachment, and online projects designed explicitly to broker knowledge exchange and learning. Not only are there huge differences in technical, social, and institutional specification, but also in participation norms, genres of communication, activities (speak, post, read, role-play), conventions of interaction, and protocols of organisation and management (Kling and Courtright, 2003).

This variety has an important bearing on the role of online interaction in knowledge generation. In the majority of cases, conversations circulate rapidly among many participants who barely know each other and who come and go at high frequency, propped up by fairly rudimentary design and data-processing facilities, and minimal attempts to control, channel, and structure the conversations. It would be hard to argue that interactions are generative of knowledge, and learning outcomes, if any, tend to be the outcome of individual

foraging rather than mutual engagement. Notwithstanding the emerging literature on social capital formation in online communities (Kavanaugh et al., 2005; Huysman and Wulf, 2005), sometimes prone to interpret evidence of shared expertise, trust, or mutual engagement as a stimulant of collective knowledge formation (Davenport, 2001; Trentin, 2002), most open and unstructured online groups are not in the business of generating new knowledge through virtual interaction.

However, there are two types of online interaction that merit closer attention as spaces of situated knowing. These are, firstly, innovation-seeking projects that can involve a large number of participants, and secondly, relatively closed interest groups facing specific problems and consciously organised as knowledge communities. Open source software development, involving participants interacting with each other on a purely virtual basis, is a good example of the first type of community. Typically, it involves short-lived projects that make source code freely available to technical experts who are motivated by the challenge of solving a difficult programming problem, but are also keen on peer recognition. The successful projects appear to be those guided by shared notions of validity between participants, contributions from a core group, and the presence of a maintainer – often the originator of the project – who actively directs the flow of discussion and achievement.

Edwards (2001) has argued that the creative dynamics of successful open source software projects such as Unix and Linux can be compared to those of epistemic communities. While we agree that both share certain characteristics such as the presence of highly motivated experts, problem-orientation, and coming together for the explicit purpose of generating new knowledge, we would argue that the ethnography of interaction in online communities is very different. Ironically, it is underpinned by a sociality similar to that in communities of practice, despite the absence of strong inter-personal ties. For example, Wasko and Faraj's (2000) study of three Usenet technical communities, shows that people collaborate not only in the expectation of tangible returns (e.g. getting an answer to a technical problem), but also for intangible reasons such as the desire to meet similar minds, learn from others, help others in a common community, maintain a certain 'craft' standard. These factors explain why even in more instrumental online communities motivated by personal enhancement and free riding, there is a readiness to share valuable knowledge as well as cooperate with other enthusiasts (e.g. as Hall and Graham, 2004, show in their study of enthusiasts who joined an e-group offering a prize of £10,000 to the first person to break the 10 code CipherChal-

⁵ In this section, for reasons of space, we focus specifically on online communities, leaving out knowledge dynamics supported by extensive online interaction within distributed corporations, organisations, and workplaces (but see Amin and Roberts, 2007).

lenge presented at the end of a Simon Singh's *The Code Book*).

That such social proximity can be achieved among complete strangers and in a virtual environment is something quite different from the dynamics of social familiarity in non-virtual environments of situated knowing. More research is needed on how software inventions and screen interfaces of the sort discussed in the preceding section might contribute to virtual sociality. Sociality might be enhanced when the technology is able to offer clear negotiation pathways, activate stored data, operate in different time spans, and encourage reflexivity. What is interesting is that a new generation of software is becoming available, allowing large sets of information to serve virtual communities of practice. For example, hypermedia, interactive digital libraries, and other technologies are enabling electronic memories to support 'emergent, dynamic, exploratory interpretation' (Marshall et al., 1995, p. 5) along with providing symbols that allow people to see an information structure as it becomes apparent to them.

Hall and Graham (2004) argue that new knowledge generation is rare in open access communities, but more common in smaller and more closed groups, the second type of virtual practice we wish to discuss. Recent years have seen a rapid rise in online initiatives established explicitly by professionals, experts, or lay people, to advance knowledge. Typically, they involve groups of teachers or health professionals interested in developing and exchanging best practice in the classroom or in medical practice, or patients and carers wishing to learn about, and influence, health policy in specific areas of illness. The research we have reviewed reveals the significance of participant commitment towards the endeavour, the clarity of purpose and rules of engagement, and the qualities of leadership and intermediation, in explaining success in generating new knowledge (again a mix of factors common to but also different from epistemic and professional communities of knowing).

The peculiarities of alignment and coordination in small purposeful online communities are illustrated by Kling and Courtright's (2003) study of an elaborate website in Indiana established to support inquiry-based teaching creativity among science and maths teachers. It finds that while project developers expected a 'community of practice' to emerge once the technology for virtual communication was perfected, success in reality was the product of sub-groups emerging, sustained by clarity of purpose and iterative exchange between the teachers. The authors argue that three factors in particular underpinned success: active support from cre-

ative and knowledgeable e-forum managers; the use of the question and answer modes of engagement, along with prompts to encourage reflection and thinking-aloud on screen; and the possibility of offline meetings that helped to build familiarity and trust. These factors, notably face-to-face meetings, shared background, and problem-orientation are also noted in other studies of online knowing (e.g. Cox and Morris's, 2003, study of web developers, Johnson's, 2001, survey of 16 different online collaborations, Tracey, Fowler and Penn's, 1999, study of an online educational experiment involving parents, children, and teachers, and Patrick and Abdullah's, 2003, study of a managed online experiment involving 20 librarians).

In all these studies it is the screen and software-mediated ethnography of purposeful and managed interaction that emerges as the significant factor in facilitating situated practice. This is not a form of interaction that can be reduced to the qualities of trust and social capital. In virtual networks there are clear spatial and relational limits to the texture of the latter, but the few examples we have summarised show clearly that this limitation need not hamper the formation of other types of sociality conducive to new knowledge formation. This is illustrated by Josefsson's (2005) study of online patient groups in Sweden, which have become important forums of learning and new therapeutic knowledge, especially in the domain of poorly understood illnesses. These groups, allowing dispersed patients, carers, and professionals to communicate freely and frequently with each other, have managed to influence medical policy and practice through their situated knowledge of symptoms, life circumstances, and curative support. Josefsson notes the ability of the discussions, when mediated by an experienced and sensitive manager and when characterised by a 'netiquette' of sensitive use of language, to develop a culture of engagement replete with humour, empathy, kindness, tact, and support. This communicative culture both facilitates often painful and highly personal issues to be revealed, and lubricates learning and new knowledge formation.

In summary, virtual knowing seems to work best when technological and human intermediaries are available to help cultivate a 'net' sociality building on purposefulness, social interaction, and affective commitment. The successful examples reveal that online communities can replicate a rich texture of social interaction normally associated with communities of practice marked by high levels of inter-personal trust and reciprocity or collaborations built around strong professional and/or project ties. But, it is a very different kind of sociality, building on affect a commitment at a distance.

3. Conclusion: making space

There are clearly many overlapping dynamics between different varieties of situated knowing. On the other hand, we have tried to show that the differences also stack up. In the four settings of collaborative work considered, the contrasts in organisational, technical, and spatial structure, together with those relating to the nature and intensity of social interaction, are significant enough to affect the nature of economic creativity generated. Accordingly, we have argued that the use of the term community of practice as a proxy for all forms of situated knowing is unhelpful. The dynamics of the task or craft-based communities studied by the originators of the term seem to be barely replicated in settings of high creativity, epistemic, professional, or virtual learning and knowledge formation.

It is time that a more heterogeneous lexicon for different types of situated practice was developed. This will help to reiterate that knowing in action always defies easy codification and standardisation in being a situated, embodied, practiced, experimental, and always-provisional activity, but it will also allow the process of naming the many shapes and sizes of knowing in action to begin. We close this paper by considering the merits of such awareness, by focusing on the reading of space that emerges from a heterogeneous interpretation of knowing in action (other implications, such as those relating to knowledge management in firms and organisations are discussed elsewhere—see Amin and Roberts, 2007). We focus on the geographies of situated practice because an important consequence of the growing recognition of CoPs as a driver of learning and knowledge formation has been an increase in awareness of the necessity to reinforce local ties (within and between organisations and localities). Building work-place sociality and local networks of trust and collaboration is being seen as vital not only for corporate survival but also for local economic renewal, based on the assumption that the spark to new learning and innovation will involve considerable local spillover. We have seen, however, that knowing in action involves many geographies of organisation and social interaction, which would suggest that it may be premature to assume that attending to the potential of situated practice can be solely a matter of building local ties.

As we have seen, virtual knowing relies on elaborate networks that support distanced connectivity, while knowing in action within professional or high creativity collaborations draws upon a mixture of virtual interaction, temporary local coalitions, institutional and professional ties that are not reducible to local space,

and varied forms and intensities of mobility. If proximity is a keyword of knowing in action, the preceding discussion reveals that it comes in many forms, enabling ‘being there’ to draw on institutional, cultural, social, technological, cognitive, organizational, and geographical proximity (Knoben and Oerlemans, 2006). All of these dimensions are of course instantiated through situated practice, and consequently operate as a tangled assemblage, but what is clear is that situated knowing can be reduced neither to geographical proximity nor to a prevailing spatial form. These heterogeneities of proximity should be grasped as an opportunity to rethink the nature and dynamic of space in situated knowing.

Amongst economic geographers there has been a vigorous debate in recent years on the spatial form of tacit or community-based knowledge generation, with some commentators emphasising the centrality of spatial proximity and others emphasising the strength of relational ties in trans-local networks (see Amin and Cohendet, 2004, for a summary). Initially, this debate was polarised around a ‘local versus global’ dualism, with one side stressing the powers of local know-how, inter-personal ties, and local institutional or cultural synergies, and the other side focusing on the possibilities of relational proximity offered by travel, technology, and supply-chain, corporate or inter-organisational links. More recently, both sides have started to acknowledge that local and global ties contribute to knowledge generation (Gertler and Levitte, 2005; Lorenzen, 2005; Boschma, 2005; Bathelt et al., 2004).

The spatial variegations highlighted in this paper, however, force reflection on the very meaning of basic spatial categories such as ‘local’, ‘global’, ‘proximate’, ‘distant’, ‘location’ and ‘territory’ in mapping the geography of knowing in action. This is not a new problem, and indeed, work on the sociology of science, has long argued that a knowledge network should be conceptualised as a continuous but contoured space in which location, proximity, and distance are relationally, rather than geographically, determined (Callon and Law, 2004), where all relational networks, regardless of their spatial reach, require active work by a range of intermediaries to hold them in place (Latour, 2004), and where flow, face, text, technology, and virtual space blend into one hybrid knowledge domain. This is an approach that takes space and spatial boundaries to be traced by the geometries of situated practice rather than expecting such practice to conform to pre-given spatial formations – offices, regions, corporate structures, virtual architectures – imbued with distinctive properties. Accordingly, we might conclude that what determines the texture

of ties or trust is not spatial proximity, but the nature of contact, intermediation, and communicative complexity involving groups of actors and entities. This interplay may trace a geography of local ties, nourished by wider market transactions, supply chains, telephony and software, databases and documents, and virtual communication systems (Belussi, 2005), but it may also trace other geographies of organisation and interaction involving global circulation of bodies and matter, displaced projects and temporary meetings, strong relational ties struck at a distance, and corporate, institutional or professional affiliations that recognise few territorial boundaries.

To recognise a spatial ontology freed from thinking of space in purely territorial terms – bounded and scalar – is not to disregard the significance of urban, regional, and national space. Networks of knowledge formation reliant on transnational connections, satellite communications, routine flows between places, always involve rich nodal practices, site specific relationalities that are never reducible to shunting grip and gain along the filaments of the network. We have learnt this amply from the literature on learning regions, which has revealed the significance of local associational ties in the production of knowledge, and for local advantage, involving elaborate links between firms, institutions, specialised labour markets, and communities. Similarly, we have seen that in all the varieties of knowing in action discussed above, situated practice involves some form of local engagement, more or less temporary, more or less inter-personal, more or less mediated by the sociology of interaction between face and screen, more or less dependent upon local externalities.

If the interest lies in grasping the implications of knowing in action for local returns, the question that needs to be asked is not whether relational space substitutes territorial space, but whether the quality, intensity, and duration of nodal practices promises potential for repetition, accumulation, and local spill-over. This requires attending to the interplay between network space, territorial space, and corporate space in a given location and explanation of why the interplay produces outcomes of varying local returns. Might it therefore be the case that in regions such as Silicon Valley brimful of civic and professional associations as well as venture capitalists (known to be notoriously regionally oriented in terms of contact networks and investment decisions—see Benner, 2003; Zook, 2004), the growth of knowledge and commercial networks that are largely international in orientation (Saxenian and Hsu, 2001) has served to harness local and trans-local geographies of knowledge for local advantage? Could it be that the

question of local returns and the strength of local ties has less to do with the character of situated practice in local nodes of global knowledge networks, than with character of the surrounding supply base, the nature of local institutions, labour markets, infrastructures, capital markets, research environments?

Our point is that the intersections between network space, corporate space and regional space define the geography of knowledge, with each spatial axis (office, building, region, internet connectivity, space of mobility and flow, virtual space, and network architecture) contributing something specific to the knowledge process, but not with sufficient autonomous force to claim a distinctive knowledge practice (e.g. face-to-face equating to trust-based interaction, urban buzz equating to high creativity, or virtual contact equating to relational thinness). We can also say this of specific knowledge sites, which are always hybrid in composition and always linked into multiple circuits of association.

We close this paper by focusing on the geographies of knowledge in financial trading, to illustrate how the varied ecologies of situated practice that we have discussed intersect. Financial trading is an activity that involves intense social interaction in spaces such as trading floors and stock exchanges, as well as in virtual spaces supported by software intelligence, email exchange, sophisticated computer graphics and programming capacity, a face-to-screen visual culture, and endless telephone conversations. It is a high volume, high speed, and fast moving activity that demands making sense of an extraordinarily high volume of information laden with hidden messages, at the flick of an eyelid, and rapid-fire decisions that can make or lose vast profits on the basis of a gesture or an utterance. It is the passing moment that activates a complex knowledge ecology formed through education, training and experience, tacit know-how and instinct (Winroth, 2003), keeping alert and abreast, and familiar with the styles and tools of the trade (Zaloom, 2004).

There is a tangled geography of daily engagement that defies spatial reduction. For example, the ethnography of electronic trading in the foreign-exchange spot market by Knorr Cetina and Bruegger (2002) shows how traders sitting at their computer screens around the world should not be read as passive agents to whom a pre-formed market is *presented*, but as active agents of market formation in a ‘face-to-screen world’, to whom the market is *appresented*, for interpretation and intervention. Knorr Cetina and Bruegger see the screen itself as a site of situated practice, interactively connecting traders with distant others, information sets, formulae that help interpretation, and software tools that facilitate

visualisation and judgement. The screen dances into play as a site of calculative practice, negotiation, and action, linking trader know-how, evaluative and sensory skills, and software-sorted information. Thus, for example, its visual properties and the calculative capacity and speed of hidden software allow vast quantities of information to be quickly analysed and evaluated, while equally quick-fire teletype messages with brokers and traders located around the world, and imbued with various communicative protocols (including trust—MacKenzie, 2004), allow judgement and decision.

This example reveals the complex web of relational ties and the multiple agencies at work in even the most innocuous of sites. Every situated space (screen, office, trading floor, virtual community) comes with multiple connections. This is the case even when intensely localised interactions seem to be prevalent, as revealed by Beunza and Stark's (2004) ethnography of arbitrage in a Wall Street trading room. The authors show, on the one hand, that the traders surrounded by an array of technologies and data located beyond the trading room, rely centrally on 'situated awareness . . . drawing on the multiple sensors (both human and instrumental) present in the room' (p. 381). For example, Beunza and Stark show how office lay out matters, arguing that the large and open plan room, with its parallel clusters of arbitrage specialists on the vertical axis, its sales desks on the horizontal axis, its floor manager at the intersection of the two axes, its whiteboard placed so that all can see the scribbled equations and options, is part of the local fabric of innovation, steering interaction within and between specialist teams (based on talk, movement, visibility, display, bodily gesture, exchange of objects). On the other hand, however, Beunza and Stark are quick to dispel the idea that the situated knowledge of the trading room is bounded by its four walls. Folded into the interpretative possibilities offered by the trading floor are large Bloomberg screens, customised by traders for rapid response, with individual know-how woven into calculative capacity 'distributed across socio-technical networks of tangible tools that include computer programs, screens, dials, robots, telephones, mirrors, cable connections, etc.' (p. 389).

All these examples challenge the view that face-to-face or localised interactions are fundamentally different from those struck at a distance. This is a view that has allowed some who are keen to celebrate the local potential of CoPs to argue that local ethnographies of knowledge production are superior, or stickier, on the grounds of claiming that trans-local networks are socially thin and technology driven, while the latter are bristling with human possibility, familiarity and

understanding.⁶ The clear implication of the counter-evidence is that other relational proximities capable of generating situated knowledge in different spaces of engagement are also capable of stickiness. It is evidence that invites us to judge the geography and sociology of knowing in action without prejudice, by viewing craft, creative, epistemic, professional, and virtual practices of knowing as equally textured and equally productive of space.

References

- Adams, A., Blandford, A., 2005. Bridging the gap between organizational and user perspectives of security in the clinical domain. *International Journal of Human-Computer Studies* 63, 175–202.
- Amin, A., Cohendet, P., 2004. *Architectures of Knowledge: Firms, Capabilities and Communities*. Oxford University Press, Oxford.
- Amin, A., Roberts, J., 2007. *Communities of Practice? Varieties of Situated Learning, A Dynamics of Institutions and Markets in Europe* Background Paper, available from: <http://cops.dimeu.org/files/active/0/Amin.Roberts.pdf>.
- Amin, A., Roberts, J., 2008. *Community, Economic Creativity, and Organisation*. Oxford University Press, Oxford.
- Amin, A., Thrift, N., 2007. Cultural economy and cities. *Progress in Human Geography* 31 (2), 143–161.
- Barley, S., Orr, J. (Eds.), 1997. *Between Craft and Science: Technical Work in the United States*. Cornell University Press, Ithaca, NY.
- Bate, S.P., Robert, G., 2002. Knowledge management and communities of practice in the private sector: lessons for modernizing the National Health Service in England and Wales. *Public Administration* 80 (4), 643–663.
- Bates, P., 2000. Changing the culture of a hospital: from hierarchy to networked community. *Public Administration* 78 (3), 485–512.
- Bathelt, H., Malmberg, A., Maskell, P., 2004. Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography* 28 (1), 54–79.
- Belussi, F., 2005. Are industrial districts formed by networks without technologies? The diffusion of internet applications in three Italian clusters. *European Urban and Regional Studies* 12 (3), 247–268.
- Benner, C., 2003. Learning communities in a learning region: the soft infrastructure of cross-firm learning in networks in Silicon Valley. *Environment and Planning A* 35, 1809–1830.
- Beunza, D., Stark, D., 2004. Tools of the trade: the socio-technology of Arbitrage in a Wall Street trading room. *Industrial and Corporate Change* 13 (2), 369–400.
- Bleakley, A., 2002. Pre-registration house officers and ward-based learning: a 'new apprenticeship' model. *Medical Education* 36 (1), 9–15.
- Boschma, R.A., 2005. Proximity and innovation: a critical assessment. *Regional Studies* 39 (1), 61–74.

⁶ For example, Malmberg and Maskell (2005) argue that local ties draw on shared values and identities, underpinned by strong relations of trust, and are more spontaneously creative than global ties, which, in requiring greater maintenance and organisation, are better transmitters than generators of knowledge. The discussion of varieties of situated knowing in this paper, however, suggests that this distinction may not necessarily hold.

- Brown, J.S., Duguid, P., 1991. Organizational learning and communities of practice: towards a unified view of working, learning and innovation. *Organization Science* 2, 40–57.
- Brown, J.S., Duguid, P., 1998. Organizing knowledge. *California Management Review* 40 (3), 90–111.
- Bullough, R.B., Draper Jr., R.J., Smith, L., Birrell, J.R., 2004. Moving beyond collusion: clinical faculty and university/public school partnership. *Teaching and Teacher Education* 20 (5), 505–521.
- Callon, M., Law, J., 2004. Absence–presence, circulation, and encountering in complex space. *Environment and Planning D: Society and Space* 22 (1), 3–11.
- Carlile, P.R., 2002. A pragmatic view of knowledge and boundaries: boundary objects in new product development. *Organization Science* 13 (4), 442–455.
- Collins, H., 2001. Tacit knowledge, trust and the Q of sapphire. *Social Studies of Science* 31 (1), 71–85.
- Cook, S., Yanow, D., 1993. Culture and Organizational Learning. *Journal of Management Inquiry* 2 (4), 373–390.
- Cox, A., Morris, A., 2003. Creating professional communities of practice for librarians. *Electronic Library* 21 (2), 94–98.
- Cox, A., Patrick, K., Abdullah, R., 2003. Seeding a community of interest: the experience of the knowledge library project. In: *Aslib Proceedings*, vol. 55, No. 4, pp. 243–252.
- Creplet, F., Dupouet, O., Kern, F., Mehmanpazir, B., Munier, F., 2001. Consultants and experts in management consulting firms. *Research Policy* 30, 1517–1535.
- Currie, G., Suhomlinova, O., 2006. The impact of institutional forces upon knowledge sharing in the UK NHS: the triumph of professional power and the inconsistency of policy. *Public Administration* 84 (1), 1–30.
- Davenport, E., 2001. Knowledge management issues for online organisations: ‘Communities of practice’ as an exploratory framework. *Journal of Documentation* 57 (1), 61–75.
- Donaldson, A., Lank, E., Jane, M., 2005. Connecting through communities: how a voluntary organization is influencing healthcare policy and practice. *Journal of Change Management* 5 (1), 71–86.
- Duguid, P., 2008. Community of Practice then and now. In: Amin, A., Roberts, J. (Eds.), *Community, Economic Creativity, and Organization*. Oxford University Press, Oxford.
- Edwards, K., 2001. Epistemic communities, situated learning and open source software development. Working Paper. Technical University of Denmark.
- Ellis, O., Vasconelos, 2004. Community and Virtual Community. *Annual Review of Information Sciences and Technology* 38, 146–186.
- Faulconbridge, J.R., 2007. Exploring the role of professional associations in collective learning in London and New York’s advertising and law professional service firm clusters. *Environment and Planning A* 39, 965–984.
- Ferlie, E., Fitzgerald, L., Wood, M., Hawkins, C., 2005. The nonspread of innovations: the mediating role of professionals. *Academy of Management Journal* 48 (1), 117–134.
- Fischer, G., 2001. Communities of interest: learning through the interaction of multiple knowledge systems. In: Bjornestad, S., Moe, R., Morch, A., Opdahl, A. (Eds.), *Proceedings of the 24th IRIS Conference*, Ulvik. Department of Information Science, Bergen, Norway, pp. 1–14.
- Florida, R.L., 2002. *The Rise of the Creative Class*. Basic Books, New York.
- Freed, A.F., 1999. Communities of practice and pregnant women: is there a connection? *Language in Society* 28, 257–271.
- Gabbay, J., Le May, A., 2004. Evidence based guidelines or collectively constructed “mindlines?” Ethnographic study of knowledge management in primary care. *British Medical Journal (BMJ)* 329 (October), <http://www.bmj.com/>.
- Gabbay, J., et al., 2003. A case study of knowledge management in multi-agency consumer-informed ‘communities of practice’: implications for evidence-based policy development in health and social services. *Health* 7 (3), 283–310.
- Gertler, M.S., Levitte, Y.M., 2005. Local nodes in global networks: the geography of knowledge flows in biotechnology innovation. *Industry and Innovation* 12 (4), 487–507.
- Gherardi, S., 2006. *Organizational Knowledge: The Texture of Workplace Learning*. Blackwell Publishing, Oxford.
- Gherardi, S., Nicolini, D., Odella, F., 1998. Towards a social understanding of how people learn in organizations. *Management Learning* 29 (3), 273–298.
- Gibson, W., 2006. Material culture and embodied action: sociological notes on the examination of musical instruments in jazz improvisation. *The Sociological Review* 54 (1), 171–187.
- Gittelman, M., 2007. Does geography matter for science-based firms? Epistemic communities and the geography of research and patenting in biotechnology. *Organization Science* 18, 724–741.
- Goodwin, D., Pope, C., Mort, M., Smith, A., 2005. Access, boundaries and their effects: legitimate participation in anaesthesia. *Sociology of Health and Illness* 27 (6), 855–871.
- Grabher, G., 2004. Temporary architectures of learning: knowledge governance in project ecologies. *Organization Studies* 25 (9), 1491–1514.
- Grabher, G., Ibert, O., 2006. Bad company? The ambiguity of personal knowledge networks. *Journal of Economic Geography* 6, 251–271.
- Haas, P., 1992. Introduction: epistemic communities and international policy coordination. *International Organization* 46 (1), 1–37.
- Hall, H., Graham, D., 2004. Creation and recreation: motivating collaboration to generate knowledge capital in online communities. *International Journal of Information Management* vol. 24, 235–246.
- Handley, K., Sturdy, A., Fincham, R., Clark, T., 2006. Within and beyond communities of practice: making sense of learning through participation, identity and practice. *Journal of Management Studies* 43 (3), 641–653.
- Hatch, M.J., 1999. Exploring the empty spaces of organizing: how improvisational jazz helps redescribe organizational. *Organization Studies* 20 (1), 75–100.
- Hernández-Martí, R., 2005. Forming a visionary core at Schlumberger: evolving support technology through communities of practice. *Knowledge Management Review* 7 (6), 16–19.
- Hindmarsh, J., Pilnick, A., 2002. The tacit order of teamwork: collaboration and embodied conduct in anaesthesia. *Sociological Quarterly* 43 (2), 139–164.
- Huysman, M., Wulf, V., 2005. ‘Introduction: the role of information technology in building and sustaining the relational base of communities’. *The Information Society* 21, 81–89.
- Johnson, C.M., 2001. A survey of current research on online communities of practice. *Internet and Higher Education* 4, 45–60.
- Josefsson, U., 2005. Coping with illness online: the case of patients online communities. *The Information Society* 21, 143–153.
- Kavanaugh, A.L., Reese, D.D., Carroll, J.M., Rosson, M.B., 2005. Weak ties in networked communities. *The Information Society* 21, 119–131.
- Kling, R., Courtright, C., 2003. Group behavior and learning in electronic forums: a sociotechnical approach. *Information Society* 19, 221–235.

- Knoben, J., Oerlemans, L.A.G., 2006. Proximity and inter-organizational collaboration: a literature review. *International Journal of Management Reviews* 6 (2), 71–89.
- Knorr Cetina, K., 1999. *Epistemic Cultures: How the Sciences Make Sense*. Chicago University Press, Chicago.
- Knorr Cetina, K., Bruegger, U., 2002. Inhabiting technology: the global lifeworld of financial markets. *Current Sociology* 50, 389–405.
- Kogut, B., Macpherson, J.M., 2004. The decision to privatize as an economic policy idea: epistemic communities, palace wars, and diffusion, mimeo. ISEAD, Paris.
- Lathlean, J., Le May, A., 2002. Communities of practice: an opportunity for interagency working. *Journal of Clinical Nursing* 11, 394–398.
- Latour, B., 2004. *Reassembling the Social*. Oxford University Press.
- Lave, J., 2008. Situated learning and changing practice. In: Amin, A., Roberts, J. (Eds.), *Community, Economic Creativity, and Organisation*. Oxford University Press, Oxford.
- Lave, J., Wenger, E., 1991. *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, Cambridge.
- Leadbeater, C., 1999. *Living on Thin Air*. Viking, London.
- Lindkvist, L., 2005. Knowledge communities and knowledge collectivities: a typology of knowledge work in groups. *Journal of Management Studies* 42 (6), 1189–1210.
- Lorenzen, M., 2005. Introduction: knowledge and geography. *Industry and Innovation* 12 (4), 399–407.
- MacKenzie, D., 2004. Social connectivities in global financial markets. *Environment and Planning D: Society and Space* 22 (1), 83–101.
- Malmberg, A., Maskell, P., 2005. Localized learning revisited. DRUID Working Paper No. 05-19. Danish Research Unit for Industrial Dynamics, Copenhagen Business School.
- Marshall, C.C., Shipman III, F.M., McCall, R.J., 1995. Making large-scale information resources serve communities of practice. *Journal of Management Information Systems* 11 (4), 65–86 (Available at. Accessed 16/02/07) <http://www.csd.tamu.edu/~marshall/jmis/jmis.html>.
- Maskell, P., 2004. A knowledge-based theory of the geographical cluster. In: Breschi, S., Malerba, F. (Eds.), *Clusters, Networks, Innovation*. Oxford University Press, Oxford.
- Mutch, A., 2003. Communities of practice and habitus: a critique. *Organization Studies* 24 (3), 383–401.
- Nonaka, I., Takeuchi, H., 1995. *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press, New York/Oxford.
- Orr, J.E., 1996. *Talking About Machines: An Ethnography of a Modern Job*. IRL Press an imprint of Cornell University Press, Ithaca, NY/London.
- Preece, J., Maloney-Krichmar, A., 2003. History and emergence of online communities. In: Wellman, B. (Ed.), *Encyclopaedia of Community*. Sage, Thousand Oaks, CA.
- Rist, S., Zimmermann, A., Wiesmann, U., 2004. From epistemic monoculture to cooperation between epistemic communities—lessons learnt from development research. In: Paper presented at the International Conference “Bridging Epistemologies. Millennium Assessment, 17–20 March 2004, Alexandria, Egypt.
- Roberts, J., 2006. Limits to communities of practice. *Journal of Management Studies* 43 (3), 623–639.
- Russell, J., Greenhalgh, T., Boynton, P., Rigby, M., 2004. Soft networks for bridging the gap between research and practice: illuminative evaluation of CHAIN. *British Medical Journal (BMJ)* 328 (May), 1174 (Available at. Accessed 16/2/2007) <http://www.bmj.com/cgi/content/abridged/328/7449/1174>.
- Saxenian, A., Hsu, J.-Y., 2001. The Silicon Valley-Hsinchu connection: technical communities and industrial upgrading. *Industrial and Corporate Change* 10 (4), 893–920.
- Storper, M., Venables, A., 2002. Buzz: the economic force of the city, paper presented at the DRUID Summer Conference on Industrial Dynamics of the Old and New Economy. Elsinore, Copenhagen, pp. 6–8.
- Strati, A., 1999. *Organization and Aesthetics*. Sage, London.
- Swan, J., Scarbrough, H., Robertson, M., 2002. The construction of “Communities of Practice” in the management of innovation. *Management Learning* 33 (4), 477–496.
- Thompson, M., 2005. Structural and epistemic parameters in Communities of Practice. *Organization Science* 16 (2), 151–164.
- Tracey, K., Fowler, C.J.H., Penn, C., 1999. Developing an infrastructure to support communities of learning. *BT Technology Journal* 17 (1), 98–110.
- Trentin, G., 2002. From Distance Learning to Communities of Practice: The wide range of possibilities for using the Internet in continuous education and training. *International Journal of E-Learning*, 55–66.
- Wasko, M.M., Faraj, S., 2000. It is what one does: why people participate and help others in electronic communities of practice. *Journal of Strategic Information Systems* 9, 155–173.
- Wenger, E., 1998. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge University Press, Cambridge.
- Wenger, E., 2000. Communities of practice and social learning systems. *Organization* 7 (2), 225–246.
- Winroth, K., 2003. Professionals in Investment Banks—Sharing an Epistemic Practice or an Occupational Community? GRI Report. vol. 1, School of Economics and Commercial Law, Gothenburg Research Institute.
- Yanow, D., 2000. Seeing organizational learning: a ‘cultural’ view. *Organization* 7 (2), 247–268.
- Yanow, D., 2001. Learning in and from improvising: lessons from theater for organizational learning. *Reflections* 2 (4), 58–65.
- Zaloom, C., 2004. The productive life of risk. *Cultural Anthropology* 19 (3), 365–391.
- Zook, M.A., 2004. The knowledge brokers: venture capitalists, tacit knowledge and regional development. *International Journal of Urban and Regional Research* 28 (3), 621–641.