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INCENTIVIZING PRACTICE

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Intro

Social capital has proved an increasingly useful and--as this workshop itself testifies--influential perspective for understanding learning, work, and innovation in a knowledge society. The social capital [SC] approach shares a great deal with community of practice analysis--the perspective this paper will attempt to lay out. In particular, in discussions susceptible to individualistic and economistic thinking, both stress the social underpinnings of knowledge work.

As this workshop is focused on the notion of SC, and most contributions will explore SC's particular strengths, it seems less useful to go over the common ground between the two perspectives, extensive though that is, than to discusses differences between the two, and by extension what community of practice [CoP] theory can add to our understanding. So I will focus here on what is distinctive about the CoP approach and in the process offer a critique--but I hope a constructive critique--of SC theory and its assumptions.[1]

SC theory draws attention to the networks of individuals which help to embed economic interactions in social relations (Polanyi, 1944; Granovetter, 1985). Through social exchanges, people build webs of trust (Fukuyama, 1995; Putnam, 1993, 2000), obligation, reputation, expectations, and norms (Coleman, 1988). In these webs and through these relations, SC theory suggests, people are willing and able to share knowledge.

The CoP perspective goes along with these claims until it pauses at the word "able." That is, CoP analysis accepts the importance of social capital networks to understanding why people will and will not share. But the CoP perspective makes a distinction between people's willingness to share and their ability to share. It suggests that people have to engage in similar or shared practices to be able to share new and

[1] There have been several recent critiques of social capital from other perspectives. A special issue of *Journal of Economic Issues* on "Social Capital, Karl Polanyi, and American Social and Institutional Economics" (Summer, 2003) in particular noted that it was being used as a way for governments to avoid their responsibilities. See Carrol & Stanfield (2003), Dolfsma & Dannreuther (2003), and van Staveren (2003); see also Portes & Landolt (1996).

innovative knowledge about those practices.[2] Thus, where SC theory points to the unseen links that unite people, CoP theory points equally to unseen boundaries--boundaries shaped by practice--that divide knowledge networks from one another, despite all the obligations of good will and social capital that may connect them.

The two theories differ, then, over their assumptions of the way knowledge circulates. Such assumptions are critical to any discussion of innovation and the right social incentives for promoting it. Currently, discussions concerning new ICT related incentives--digital rights management or software patents, for example--are becoming increasingly contentious.[3] It is 50 years since Penrose (1952) claimed that "If national patent laws did not exist, it would be difficult to make a conclusive case for introducing them." To many eyes, in the intervening period, the intellectual property incentive system has graduated from being merely inadequate to being counterproductive. Mowery, Nelson, Sampat & Ziedonis (2001) believe patenting is now inhibiting U.S. scientific communication. Foray (1997) and others are concerned about a general tendency of the system to "tip" away from openness. David (2003) and Kogut & Metiu (2001) are among several who believe we should worry less about the tragedy of the commons (Hardin, 1968), which has been freely invoked to justify rigorous intellectual property, than about the tragedy of the anticommons" (Heller & Eisenberg, 1998). Built to promote innovation, the intellectual property system may rather be strangling it.[4] Thus the two different perspectives on the flow of knowledge contested here, however abstruse, have practical--and timely--policy implications.

In offering the distinct perspective of CoP theory, this paper holds that, while emphasizing *social* in the research lexicon, SC has nonetheless remained fairly close to its roots in economics (residual in that word *capital*).[5] This has a couple of implications. First, SC theorists' focus on "rational actors" (Coleman, 1988) portrays social groups as little more than "combinations" of individuals (Nahapiet & Ghoshal,

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[2] The emphasis here is on "new and innovative"; as I note later in the paper, society has built numerous workarounds to deal with established, settled knowledge.

[3] Some will find it hard to think of digital rights management as an incentive scheme, but that is how it is presented in Stefik's (1996) seminal paper on the topic.

[4] Lawyers seem to have been more aggressive than economists in pointing to the flaws of the IP system. See Boyle, 1996; Lessig, 1999, 2001; Litman, 2001 and *Law and Contemporary Problems*, special issue 2003 66 (1&2).

[5] Coleman is quite explicit about this. His aim is "to import the economist's principle of rational action for use in the analysis of social systems proper ... [t]the concept of social capital is a tool to aid in this" (1988, p. 97).

1996). The CoP perspective, by contrast, sees knowledge-sharing networks as more complex than the aggregate choice of individual rational actors. So, while SC analysis ranges indifferently over a broad array of social groups, including such things as firms, bowling leagues, housing organizations, and families, the CoP perspective, by contrast, limits itself to communities and networks that are distinguished by the particular practices members share and in which membership can only be achieved by entering into the practice.

Second, while some SC theorists, again like economists, tend to view the sharing of knowledge as little more than the exchange of "information that facilitates action" (Coleman, 1988, p. 104) between individuals, CoP theory suggests that isolation of individuals and information underestimates the challenge of sharing knowledge and fails to predict where knowledge "sticks" (von Hippel, 1994; Cowan, David, & Foray, 1999) or "leaks" (Szulanski, 1996)--critical questions for a knowledge society.

This paper thus begins by challenging economistic views of knowledge sharing, noting in particular the effort of some economists to dismiss the notion of *tacit* knowledge from debates about innovation. Tacit knowledge, important to CoP theory, is problematic for economists because it is hard to explain in terms of information exchanged between individuals.

The paper then explores the links between the tacit dimension of knowledge and social practice. It looks "beyond information" and "beyond individuals" to argue that practice forms two interconnected knowledge groupings, the community of practice and the network of practice. It is these that help predict the flow--or lack of flow--of new knowledge in society. The paper goes on to argue that social practice has two dimensions, the epistemic and the ethical. These explain not only why people will and will not share knowledge (the focus of SC theory), but also where, despite good will, knowledge can and cannot flow. The epistemic dimension determines where knowledge sticks, the ethical helps explain why it leaks.

Having followed a principally theoretical path, the paper then pauses to analyze "Open Source" software in the terms it has laid out. This discussion helps link the issues raised so far to ICTs. Moreover, Open Source is an area of particular interest because it has challenged conventional ideas about incentives for and the organization of innovative in a knowledge society. Open Source networks are

celebrated for leaking knowledge (hence the *open* in *open source*), but we also need to understand where and why Open Source knowledge sticks. The paper suggests that such an understanding helps illuminate in terms of practice the different roles of networks and organizations.

In conclusion, the paper questions both the assumption that ICTs circulate knowledge and the assumption that stronger intellectual property provides better incentives for innovation. It argues that if we seek to promote innovation and communications, we should attend neither to information nor to knowledge, *per se*, but to practice and its social, organizational, epistemological, and ethical entailments. In closing, it suggests that the system of copyright, patents, and trademarks should be altered to keep knowledge "open."

Tacit Knowledge & Skeptical Economists

Stigler (1961) opens a seminal essay on the economics of information with a rapid but not atypical transition between information and knowledge: "One should hardly have to tell academicians that information is a valuable resource: knowledge *is* power" (p. 213). More generally the economics of information and of knowledge seem indistinguishable or interchangeable (Arrow, 1969). Consequently, many discussions of incentives for a knowledge society focus primarily on the circulation of information and the extent to which it can be carried by ICTs and encouraged by legal protection of intellectual property, or sheltered by organizations (Schumpeter, 1947; Chandler, 1962; Nelson & Winter, 1982). Tacit knowledge makes problems. How do we share something that is tacit? How to we put it in ICTs? Hence, while economists and economic historians increasingly embrace the contribution of knowledge to economic progress (Nelson & Winter, 1982; Mokyr, 1990; North, 1980, 1992) and the "knowledge economy" (Mokyr, 2002), they treat tacit knowledge with a certain suspicion and move quickly, like Stigler, to information.

Atypically, Cowan, David and Foray (1999) make their move explicit. They describe their approach as "the skeptical economist's guide to 'tacit knowledge.'" These skeptical economists (SE) motivate their argument from a paradox they detect in appeals for government-subsidized incentives for innovation. On the one hand, the SE note, these appeals justify government funding by arguing that markets deal poorly with nonrivalrous, nonexcludable public goods like knowledge. Yet, when it is claimed that national subsidies are inefficient because some nations will free ride

on the economic subvention of others, the same people, according to the SE, argue that tacitness will make the new knowledge "sticky" and so prevent free riding.[6] The two claims, the SE argue, are incompatible. Knowledge can't be both so "leaky" that markets fail, and yet so "sticky" that free riding fails. The source of this incoherence, the SE claim, lies in this quasi-mystical notion of tacitness that they seek to dismiss.[7]

Champions of the tacit are guilty, the SE argue, of concluding that what they can't see must inherently invisible. While it may be true that a groups of experienced colleagues, in Polanyi's famous phrase, "know more than [they] can say," it does not follow what is left unsaid is fundamentally unsayable. Rather, the SE claim, the relevant knowledge is merely "latent" in such groups, whose members do not need to codify and thus lack incentives to overcome the "substantial marginal cost" of codification.[8] There is, from this point of view, no logical barrier between tacit and explicit, only an economic one.

There are many reasons to take the SE argument seriously. David, in particular, has helped show economists the problems of market failure and the limits of neoclassical approaches to knowledge, he is dubious about the benefits of the current intellectual property system, and he is committed to "openness" in science. Above all, he and his colleagues take the problem of the tacit seriously: "the nature of knowledge, its codification or tacitness, lurks only just beneath the surface of important ideas about economic growth" (p. 12).[9]

Yet their dismissal is not as conclusive as they would like it to be. In the first place, they actually avoid the heart of the question they raise, setting aside the category of "unarticulated and unarticulable knowledge" as "not very interesting" (p. 14). Their conclusions thus arise from analysis of knowledge that they have agreed in advance is either "articulated (and thus codified)" or unarticulated but codifiable.

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[6] The SE paper doesn't actually provide examples of either argument but simply talks of "the standard argument" put forward by "proponents" who are identified as Harry Collins (1974), Michel Callon (1995), and Bruno Latour (who is indicted but not cited); a group that ideologically does not sit happily together.

[7] The paradox of knowledge appearing both sticky and leaky is addressed in Brown & Duguid (2001), on which much of the discussion here is based.

[8] For economic ideas of coding, see Arrow (1964).

[9] Others tend to skirt the issue. Mokyr (2002), for instance, notes the tacit and claims it is uncodifiable, but doesn't go on to weigh what the implications of that claim are. See also Nelson & Winter (1982), pp 76-82, whose conclusion on p. 82, the SE seem to be following.

Further, in its analysis of codification (the process of transforming tacit knowledge into explicit knowledge), the SE's argument seems to have a logical flaw. Codification, they argue, merely requires a suitable codebook. With the right codebook, any piece knowledge becomes economically tractable. There are economic costs to producing such a codebook, but not, in the SE argument, epistemological barriers. They fail to show, however, how we come to understand any particular codebook in order to decode the knowledge to which it applies. A codebook must either explain itself or require another codebook to explain it. The argument is thus trapped between circularity (with codebooks explaining themselves) and an infinite regress (with codebooks explaining codebooks).

Of course there is another alternative. There could be another kind of knowledge to get us started.[10] This would seem to be what serious proponents of the tacit are trying to argue. In a tradition that stretches back less to the sociologists of science that the SE name than to Socrates and the *Meno*, a chain of arguments suggests that codified knowledge rests on an uncodifiable substrate. It is this that Polanyi (1966) calls not tacit knowledge, but importantly the "tacit dimension."

Beyond Information

Ryle (1949) makes a similar argument with his famous distinction between *know how* and *know what*. These two are not alternative kinds of knowledge. They are interdependent dimensions of knowledge. Consequently, *know how* doesn't reduce to *know what*--a book of codified knowledge. Rather *know how* allows us to interpret *know what* and make it actionable. Avoiding a regress, this tacit dimension or *know how* is logically distinct and separately acquired from the explicit or *know what*, but it makes the latter actionable. Usable knowledge is always two-dimensional. (Even theorizing, Ryle argues, requires a particular *know how*--the *know how* of theorizing.) Thus, while the SE argue that codification and explication are the essence of learning, Ryle suggests that no amount of explicit *know what* can produce tacit *know how*. We learn *how*, he argues, in practice.

This two-dimensional character of knowledge helps explain the contradictory character of knowledge from which the SE launch their argument. Those who have

[10] The SE in part concede this point, noting that "Successfully reading the code ... may involve prior acquisition of considerable knowledge (quite possibly including knowledge not written down anywhere)" (p. 9). They give no explanation of how this is acquired.

acquired *know how* through practice can make use of and understand related *know what*.[11] Consequently, for them, codified *know what* related to that practice would be an inherently leaky, nonrivalrous, public good, able to spread readily and usefully among other practitioners. Scientific disciplines, professional societies, and other networks of practitioners (what Strauss (1978) calls "social worlds") share *know what* in documents, phone calls, faxes, email messages, etc. with relative ease. For those who lack the practice, the same *know what* is inherently sticky, communicating little or nothing actionable. Academics speaking outside their discipline, judges instructing juries in the law, economists talking to humanists all meet points at which the significance of what they are saying, transparent to the speaker and his or her "world," becomes opaque to the audience.

It would appear, then, that the standard elision between information and knowledge can be problematic. *Know what* is pretty much what economists mean when they talk of *information* and is inherently "leaky."[12] It is the sort of stuff we pass around or store in ICTs. But to be useful, requires the requisite *know how.* While we can store or transfer information/*know what* in IT systems, while we can balance information asymmetries, while we can explore the transaction costs of information exchanges, the outcome of this effort is futile if the second dimension, the requisite *know how* is not in place. And *know how*, by contrast, is "sticky." It doesn't fill codebooks, cannot be stored or transmitted in IT systems, is indifferent to information symmetries, and can make transaction costs exorbitant.

Focus on information alone may not merely be ineffectual but also counterproductive. Incentives for codification, for example, may actually impede the development of *know how*, the ability, in SE terms, to decode. For example, educational and training systems tend to assume that the ideal place to transfer *know what* are technologies of learning (from the classroom to the computer terminal) that withdraw learners from the messiness of everyday life. They thereby hide from learners the very social-material conditions of practice from which we acquire *know*

[11] It doesn't necessarily explain self-serving arguments for subsidy.

[12] This argument that we produce information through elaborate processes (Duguid, 1996), echoes Tuomi's (2001) argument that. T. S. Eliot's often-quoted progression from data to knowledge is upside down.

how. Consequently, some learning technologies can paradoxically increase the difficulty of learning.[13]

Beyond Individuals

Ryle's argument that we gain *know how* not through receiving *know what*, but through practice--through our engagement in the material and social world--puts him (perhaps surprisingly) in the tradition of practice theorists, a tradition that stretches back to Aristotle and has been recently revitalized by, among others, Oakeshott (1991) and Bourdieu (1977) and underpins Lave's notion of communities of practice. In this tradition, knowledge is less a thing than an aspect of the relation between a person and the world. Thus the knowledge of the high-energy physicists that Knorr-Cetina (1999) studied is "object centered," that is, the physicists' knowledge is structured around objects through which and on which they work. Similarly, the knowledge possessed by the technicians in Orr's (1996) classic study of the Xerox service representatives (or "reps") rose out of, was expressed in relation to, and is inseparable from the machines that they worked on. The knowledge of the navigators Hutchins (1991) studied or the physicists Collins (1974) studied again reflect the tools with which they work and world these tools make visible. In each case, the particular person-world relation of participants develops a particular kind of *know how* that makes related *know what* intelligible and actionable.

One corollary of this relational view is that knowledge is socially situated: the "world" in the person-world relation includes the social world--colleagues, competitors, clients, etc.--was well as the material world. Thus learning, in Lave & Wenger's (1991) view is not the acquisition of information, but the development of a social identity. In learning physics successfully, you learn to be a physicist--to act as and be recognized as a physicist. A second corollary is that people who share a particular practice and thus share similar person-world relations come to share *know how* that allows them to communicate *know what*. The knowledge of the microbiologists Knorr-Cetina also studied is also object centered, like that of the physicists. But the objects involved are significantly different. Consequently, as Knorr-Cetina argues, the two fields construct their knowledge/identities differently

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[13] Of course, for learners that already possess the requisite *know how*, these technologies may work well.

and develop into distinct "epistemic cultures." As the notion of a "culture" suggests, the groups that form around practice are not merely combinations of individuals, as SC theory would suggest. Shared practice creates social groups with distinct properties. In them, *know what* relevant to the common practice circulates efficiently and effectively (Kreiner, 2001) supported by the shared substrate of *know how*. Of course, we share a great deal of practice by virtue of being human. But participation in specialized and esoteric practices inevitably reduces the number of people with whom we can communicate effectively about that practice--though we may be in the same bowling league.

Aside from humanity at large, two related kinds of social group that develop around practice seem of particular significance when trying to understand innovation. The first is the community of practice (CoP), whose members not only have a practice in common but coordinate that practice with one another. The second is the network of practice (NoP), whose members share but do not directly and systematically coordinate practice.

The Community of Practice

Developed in a theory of learning proposed by Lave and Wenger (1991), the CoP comprises a group of people who share, coordinate, and over time help to reproduce their practice.[14] The CoP is the social locus through which aspects of a person's identity related to that practice are developed and in which that identity is performed.[15] A CoP's members are interdependent, their person-world relations significantly similar, their practice often collaborative, so the knowledge related to that practice is distributed across the collective rather than held by individuals (Hutchins, 1995).[16] These knowledge collectives do not fit easily with some conventional economic views of knowledge. Simon (1991), for example, argues that all learning takes place inside individual human heads (p. 12), while Mokyr (2002)

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[14] It seems right to start from a theory of learning, given Edquist's (1997) mandate of "learning to the center" (p. 16).

[15] Everyone has multiple sites in which they acquire and perform identities. For many, their work identity is among the most significant (the answer to the question "what do you do?"). Given that any CoP member will have an idiosyncratic set of identity sites, CoP members, though they may have much in common, are nonetheless diverse.

[16] Some people, and perhaps even Lave & Wenger, do not restrict the CoP to an interdependent group. It was with the purpose of distinguishing interdependent groups from groups of people that share practice but do not coordinate one another's practice that Brown & Duguid (2001) introduced the notion of the network of practice (see below).

argues that knowledge resides in people's minds (or storage devices) (p. 4). Social relations, collaborative work, and distributed identities do not figure into these models. The CoP perspective does not deny the integrity of the individual--given their distinct life trajectories, each individual's person-world relation, however similar to others', will be distinct. But the CoP perspective situates individuality in social relations, making separating individual from collective knowledge difficult and often pointless.[17]

Many organization theorists have found the CoP to be inherently attractive notion. But it needs to be noted that the process of identity formation is more or less indifferent to the identity formed. The concept would seem applicable the formation of drug using collectives (Bourgeois, 1998), Mafia families (Lewis, 1964), or the inner circle of megalomaniac dictators (Sebag Montefiore, 2003). Moreover, even more socially acceptable groups are not necessarily collegial or compliant. Invested in the reproduction of a practice over time, the CoP is rife with internal tensions around "continuity and displacement" (Lave & Wenger, 1991). Shared practice may provide grounds for a fight as much as grounds for agreement. Collective defence of shared identity also creates external tensions between a CoP and those who would change its practice from outside.[18] The CoP may then be both less comfortable than an SC network.[19] But, as a site where knowledge is developed and shared, the CoP is critical to understanding innovation.

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[17] Knorr-Cetina (1999) talks of a new epistemic subject, a procurer of knowledge that is collective and dispersed (p. 178).

[18] The argument in Brown & Duguid (1991) has recently been condemned as "structuralist functionalist" (Contu & Willmott, 2003) for arguing that the CoP of reps furthered the aims of the company. The reps proved an interesting example because by ignoring the company's instructions they saved their company from its own inept instructions. The paper did not claim, as Contu & Willmott suggest, that all CoPs have this property. Indeed, a cursory reading would suggest that the CoPs that designed the documentation for the reps and the CoPs of engineers that denigrated the reps' knowledge, while following managerial instructions were a detriment to strategic goals. Whatever the functionalist appearance of the reps, they highlighted the significance of local, communal knowledge. Probably antedating Taylor and certainly since Roy's classic studies (1952, 1953, 1954), the literature has been well-stocked with examples of disruptive workers and small group "goldbricking." Consequently, organizations and academics have felt free to deprecate local knowledge and disrupt small group cohesion. A central goal of Brown & Duguid (1991) was to give an alternative vision of local knowledge. It was not to deny that small group actions may undermine corporate interests. Vaast (2003), in her Ph.D. thesis explores "the dark side" of CoPs, showing that they may not act even in their own interests, let alone a corporation's.

[19] It is often forgotten that Coleman (1988) insisted that SC accounted for such things as cartels and could reduced innovativeness.

My schema reserves the term *CoP* for interdependent practitioners who share and coordinate practice and have implicit responsibility for the reproduction of their community. But most practices are shared by more than local practitioners. The NoP designates the collective of all practitioners of a particular practice, of which the CoP is then a subset. Thus Knorr-Cetina's (1999) epistemic culture of high-energy physicists constitutes a global NoP, in which particular labs form local CoPs. Equally, the local CoP of Xerox technicians that Orr (1996) studied is a subset of a worldwide NoP of some 20,000 reps doing similar jobs.

It needs to be acknowledged that *network* is on its own a vague term (Zucharman, 2003)--as indeed is *group* (Merton, 1968) and *community* (Williams, 1976). There are economic networks (some of which replace market relations, and some of which include market relations) and there are social networks (in some of which the people know each other and in others they don't). There are networks where the intriguing feature is the nodes, and networks where it is the link. There are networks with heterogeneous nodes or links, and networks with homogeneous nodes or links. There are formal networks, and there are informal networks. In truth, almost any aggregate can be called a network. Some discrimination is useful.

The NoP is a primarily social non-market network, with homogenous nodes (practitioners), whose members are united by the similarity of their practice and, by extension, the person-world relations they engage in.[20] (The SC network is similar, but its members are connected by social ties rather than ties of practice.) Within these NoPs, common practices allow the members to exchange *know that* and common person-world relations allow this to be "reembedded" (Giddens, 1990) in a local context in a relatively effective, coherent way.[21] In such networks, then, as Ryle argues, practice precedes theory, providing the substrate on which theoretical knowledge circulates. In attempting to move between NoPs--even along paths built by SC--where by definition practice is not continuous, knowledge is likely to sticks.

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[20] This last is an important distinction. Distinct person-world relations make the network of nurses distinct from the network of doctors (Leonard & Sensiper, 1998); the network of accountants distinct from networks of forecasters (Arrow, 1984); or networks of conmen distinct from the genuine practitioners they imitate.

[21] The work-related NoP is thus similar to Barley's (1988) occupational communities, but NoPs are not only work related.

The CoP and the NoP are ideal types that like most sociological categories suffer "boundary specification problems." Relations among members are most dense in the CoP and fade gradually towards oblivion at the outer reaches of the NoP as the amount of practice in common diminishes and the variation in person-world relations grows. Boundaries between CoP and NoP or between NoP and other practices and practitioners are not necessarily well defined. The major distinction between the CoP and the NoP turns on the control and coordination of the reproduction of a group and its practice. Within a CoP--whether it is a department of economists in a university, a group of coders in an IT department, or a criminal "family" in a New Jersey suburb--members influence on who joins and under what terms and so directly affect the evolution of local practice.[22] NoPs, by contrast, are more extensive and less coordinated.

NoPs offer a powerful example of the kind of networks along which information, supported by shared practices, moves with extraordinary efficiency--and where it can be easily supported by ICTs. Powell, Koput, Smith-Doerr (1996) reveal networks stretching through diverse institutions--universities, research labs, small firms, large corporations--distributing knowledge across organizational boundaries, even in the competitive world of biotechnology. The "locus of learning," these authors argue, is the network rather than the individual firm. Their study focuses for the most part on formal networks. Kreiner & Schultz (1993) discuss similar but informal and often unauthorized links that sidestep formal restrictions but allow practitioners in one organization to draw on knowledge generated elsewhere and circulating through NoPs.[23] Such leakage along NoPs does not only involve science or high-tech NoPs. Every profession has its workshops, conferences, and annual meetings for knowledge sharing, and most practitioners at one time or another reach out across competitive boundaries to draw on connections in other companies. As Offer (1994) argues, the market economy has always been porous. NoPs do not necessarily show us something new, but they do help us to see where the leaks have and have not been occurring.

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[22] Continuity is important here. Transient groups of people--work teams--that do not reproduce themselves over time are not, in this analysis, CoPs. Of course, workplace CoPs don't usually get to choose their members, but as Lave & Wenger (1991) point out, such groups have their own powers of exclusion which can give them a certain amount of control over their reproduction.

[23] For recent work on networks, for example, the Tedis group in Venice (Charvesio et al., 2003) and Teigland's (2003) Ph.D. thesis at the Stockholm School of Economics.

They also help us understand the value of leakiness. The density of such NoPs, the distribution of practitioners, and the extent of leaking help explain the vitality of industrial districts (Marshall, 1916; Almeida & Kogut, 1999; Brown & Duguid, 2001) and their "regional advantage" (Saxenian, 1994). Networks running across districts like Silicon Valley help overcome "innovators' dilemmas" (Christensen, 1997) by pushing knowledge from where it is developed but stuck to where it is more likely to be used. In so doing, NoPs may help spur aggregate growth, but at the expense of the initial innovator--an outcome that questions the advisability of tight intellectual property rights and hermetic "regimes of appropriation" which separate the rights individual economic actors from the interests of larger collectives.

Innovation and Communication

We have so far looked from the perspective of practice at, for the most part, the circulation of knowledge. Any theory of innovation has also to explain its production. At base, invention requires having new ideas, which, from a practice perspective, entails a change in person-world relations. As neither the world nor an individual's identity is static, this relation is always changing.[24] New practice remains like a private language if kept at the level of the individual. When it becomes social practice, it has taken an initial step on the Schumpeterian journey from invention to innovation, which, as Tuomi (2002) argues, "happens when social practice changes" (p. 10).[25] This definition helps map the terrain on which innovation can occur, from changes in local practice within a community, to changes propagated along a network of practice, to--the most challenging of all--changes spread beyond the network to affect other practices. In this way, the social context is both a determinant and a register of innovation.

Within CoPs, novelty can propagate almost invisibly through coordinated practice. It may not always do so, however. As a site of identity formation, CoPs

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[24] Knowledge is a dynamic phenomenon, though paradoxically, a great deal of unnoticed effort seems to go into both keeping routine stable in a changing world and keeping the effort involved in stabilizing routine invisible. Dynamic in the cause of stability, we conceal from ourselves, as Suchman (1989) has shown, a great deal of the spontaneous change to which we are involved.

[25] Edquist's (1997) notion of introducing new knowledge or new combinations of knowledge into the economy, Mokyr's (2002) idea of new useful knowledge, or Nelson & Winters' (1982) idea of "changes in routine" are all congruent with Tuomi's (2002) definition, but tend to focus on knowledge and to heighten the tendency to think of knowledge as a self-sufficient entity with inherent properties. The importance of Tuomi's definition is that it changes focus to practice.

represent major personal investment by members. Change, whether driven from within or without affects those identities and can meet with strong resistance. The battle between continuity and change can be fierce.[26] Beyond the CoP, new ideas can also spread among practitioners, though as noted the varying social and material circumstances in which it must be reembedded will cause mutations. As NoPs are less tightly coordinated, resistance to change is less likely to be as fiercely contested. New ideas can simply be ignored until demand for network coherence becomes unavoidable. Even scientific communities seem able to manage in practice a fair amount of loose coupling and incoherence, though they are, as Ziman (1968) notes, more committed than the humanities or social sciences to seeking consensus.

Once the practitioners are separated, however, the challenge of communication among them grows. Academic NoPs, while useful illustrations (given the likely audience of this paper), can conceal the challenge of communication because, unlike many NoPs, communication is very much a part of their practice. Sociologists of science seemed shocked to discover that writing is central to scientific practice and documents are critical scientific instruments (Latour & Woolgar, 1986), but reflective scientists have long recognized this (Ziman, 1968). Scientific publishing does not merely record scientific practice; it is, as Ziman noted, scientific practice. Yet even here where the process of disembedding and reembedding, of annunciation and interpretation, are part of practice, communication cannot be taken for granted. But the disciplines have highly formal processes to help promote communication in the network (which are undoubtedly backed up by many informal ones). In networks where the practice does not involve communication and formal systems are not in place, disembedding *know what* from practice can be far more demanding.and the task of formalizing and of disembedding alien to practitioners and resented.ERP and other systems that demand increasing formal reporting can be seen by people them not as an extension of their practice but a burden upon it (Micheelson

[26] Contu & Willmott (2003) insist on the importance of setting CoP relations in the context capitalist relations. Many CoPs are inevitably the product of capitalist organizations, though the CoP as a social structure would certainly antedate capitalism. Moreover, CoPs may develop in a semi-autonomous fashion and their reproduction may exist in tension with changes dictated by the firm. The tensions between research labs and corporations or between academic departments and universities offer conventional examples, but the same clash of interests may occur between any CoP and the organization on which it depends. This clash of interests may also occur within the CoP,between those whose loyalty to an overarching organization is stronger than their loyalty to the CoP and those who are more loyal to the CoP and related NoPs. Ziman (1968) discusses the effects of divided loyalty on scientists working within corporations, but this division can be generalized.

& Damkjar, 2002). The failure of "knowledge management" systems, often designed by people to whom the demands of academic communication have become relatively invisible, may arise from this extra and complex demand (Hansen, 2000; Bansler & Havn, 2002). [27] In sll, hough they may appear to offer an easy solution to spreading "best practice," building ICT connections between practitioners may raise as many problems as it solves.

While inevitably the challenge of changing practice locally and spreading knowledge along a network is more demanding than this schematic sketch can show, it is clear that incentives for innovation and communication face different forms of stickiness, from individual resistance to changing identity, to collective resistance to demands of embedding and reembedding, to unexpected differences between embedding conditions. In this regard, no one should expect ICTs to offer a simple solution.

I have laid out the CoP and the NoP so extensively because I think they help draw distinctions between SC and CoP theory while offering insight into the way knowledge flows and fails to flow. Thus they help explore, on the one hand, incentives to help knowledge flow in a knowledge workshop, and on the other, the contribution ICTs can and cannot make--central themes in a knowledge society and themes to which I now turn.

Epistemic and Ethical Dimensions of Practice

Economic studies of the contribution of innovation to growth imply that society develops by promoting the codification of knowledge (Cowans et al., 1999), providing access to information (Mokyr, 2002), reducing the transaction costs (Williamson, 1981) and protecting private interests (North, 1982). Social capital theory reflects most of these views, implying that the accrual of social capital, by increasing trust in particular, reduces transaction costs and so increases economic efficiency (Coleman, 1988; Nahapiet & Ghoshal, 1996).[28] A practice perspective modifies these notions of codification, access, and costs as the critical elements for

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[27] The "skeptical economists" (Cowan, David, & Foray, 1999) are thus right to point to the substantial overhead of encoding, though wrong to assume that, once that is done, remebedding is relatively costless.

[28] Some differ over whether social capital has tangible economic benefits. Nahapiet & Sumantra (1996) seem fairly confident that it has, whereas Cohen & Prusak (2001) despite their title, are more agnostic.

innovation along two distinct dimensions, which for brevity we might distinguish as can/can't versus will/won't. On the one hand, even with access, there are difficulties around what people can share. On the other, there are also difficulties concerning what people will share. These challenges, it should now be clear, are not simply economic. Local communities and even disaggregated networks of practice may simply not want to share what they know (Constant, 1989); or (and this lies on the same dimension), they may not want to hide what they know, despite the existence of regimes of appropriation. To clarify these dimensions, we need to understand a bit more about the epistemic and ethical consequences of practice.[29]

Epistemic entailments: can/can't

Modern society organizes itself around a division of labour, which might as easily be called a division of practice. As practice gives rise to knowledge, these division have epistemic implications. The division of labour/practice, as the argument presented so far would suggest, produces a division of knowledge. Knorr-Cetina (1999) helps clarify this process in talking of an "epistemic culture" (which she likens to a Durkheimian collective conscious). Cultures are determinants of meaning, so, as most people accept, within cultures, knowledge can travel with relative ease; between, it usually cannot flow without difficulty.[30] The same is true of NoPs--which are epistemic cultures resulting from common practice. Promoting flow within a NoP, as suggested, is relatively easy. Promoting it across the epistemic gulfs between practices is much more challenging--even when the different practices lie together within an organization (Bechky, 2003; Carlile, 2002; Osterlund, 1996)--but critical to promoting innovation and in dealing with such things as "complementary assets" (Teece, Rumelt, Dosi, & Winter, 1986) (Richardson (1972) more judiciously called be called "complementary activities," which at least opens the door to the significance of practice).

This problem of "stickiness" is well recognized, though it is not always considered in terms of practice and is instead often addressed as a problem of information, to be addressed by ICT. Simply pushing information across an epistemic

[29] While Foss (2003) argues that organizational analysis does not consider interactions of "cognition" and "motivation," this paper attempts to connect the two along these epistemic and ethical dimensions (see below), though probably not in a form that Foss would approve.

[30] Mokyr (2002), for example, acknowledges the difficulty of getting knowledge from Europe to Asia and vice versa.

gulf is not a great deal of help. Alternative strategies for bringing two different communities into alignment, include using standards, routines (Nelson & Winter, 1982), boundary objects (Star, 1989), or boundary spanners. Most of these, however, tend to be fairly static, establishing a fixed relationship between two communities but offering little scope for dealing with the dynamics of a changing relationship.

The challenge faced here may help clarify the advantages of the famous "lean" Japanese manufacturing over the conventional U.S. system (Womack, Jones, & Roos, 1990). The U.S. system, in the tradition of Taylor and Ford, works a with an entrenched mental/manual division of labour.[31] Cars are built by workers on the production line, who report to foremen who do not work on the line but oversee those that do. Through the foreman, who stands at one remove from the practice of the line, lies the path to the rest of the system, the mangers, the engineers, the designers, and so forth. Communication, in this system, has to bridge all these divisions cross the gulfs of practice/knowledge that separate them. One way to deal with this challenge is to formalize reporting, but formalization has ultimately to assume in advance the character of the problem, so if formalization is rigorously followed nothing fundamentally new can be reported. Consequently, the U.S. system, though encumbered with ICTs has a great deal of difficulty dealing with novel problems. Here, information may flow, but unexpected knowledge (the critical knowledge to repairing breakdowns) sticks.

The lean system also works around about a division of labour, but not only are there many fewer divisions, there is also a great deal in the structure that helps avoid or bridge them. For instance, less hindered by mental/manual divisions, the workers on the lean lines have responsibility for many of the issues that arise there (Womack et al., 1991). Work groups can address the challenge of understanding the issue itself, without having to deal with the extra challenge of how to communicate it to someone both outside the team and outside the practice--who, if and when the problem is understood, must face the mirror-image problem of communicating what is to be done back to the workers on the line. Where such divisions cannot be avoided, efforts are

[31] Along with an entrenched mental/manual division of labour (which is evident in its highly managerial sports), the U.S. also has a profound faith in the power of explication. Toulmin (2001) argues that this faith may be misplaced. He notes intriguingly that people may agree in practice but, when they produce reasons for this practice, find they disagree in principle. Eckert (2001) gives a nice example of a group of girls who use an image to represent their unity, but when they are asked to explain what the image means produce quite different explanations.

made to blurr the boundaries of practice. Japanese engineers, for example, spend their first three months with the company on the production line. This makes them participants--if only novices--in the practice of manufacturing. Similarly, when production on the line slows, line workers are sent out to work with the sales force, where they get to understand the challenge of selling what they build. As a result, through common practice, epistemic barriers become usefully susceptible to leakage.

Ethical commitments: will/won't

Lean car production illustrates, from a practice perspective, how knowledge sticks or flows at the boundaries between practice and a couple of examples of ways to get around the problem in the context of formal organization. But even where knowledge can be shared more easily than this, we also need to understand why and when people will and will not share what they know. Regimes of appropriation assume that those who have competitive knowledge will not share it with those outside the regime. Conversely, knowledge management systems tend to assume that people will share the useful knowledge they have. Incentives are offered in both cases. Despite these, however, people will sometimes share what is meant to be protected, and conversely will not share, despite encouragements, when they are expected to. People may resist incentives from the market economy aimed at individual self-interest on behalf of collective interests and what Thompson (1971) famously called the "moral economy" (Bollier, 2002). Knowledge, that is, may stick or flow for ethical rather than epistemic reasons.[32]

In creating social allegiances, the division of labour produces ethical as well as epistemic commitments. As Marx and Engels (1978) argued, those among whom labour is divided develop a "communal interest" (p. 53). Durkheim (1960) expands this notion when he argues that "The division of labour becomes a predominant source of social solidarity at the same time it becomes the foundation of the moral order" (p. 333). More recently, the ethical philosopher Alasdair MacIntyre (1981) argued that "the self has to find its moral identity in and through its membership of communities" (p. 205).[33] Thompson, following Marx, suggests that such social

[32] These are more collective than the individualist motives discussed by Foss (2003).

[33] As both are cited in this paper, it should be noted that Toulmin and Giddens both strongly reject MacIntyre's view of moral order.

groups will resist, in the name of their moral interests, changes in the economic and social order that they deem unreasonable.

Thompson's draws his example from the late eighteenth century. Across the century, people resisted the shifting power that came with the rise of capitalism and was felt in, among other things, the denial of customary rights and the appropriation of common land (which, *pace* Harding, had been developed and protected through collective action (Moor, Shaw-Taylor, and Warde, 2002)) or of collective produce by individual interests. People responded particularly aggressively when they found factors taking or simply pricing corn produced locally out of local markets in order to sell it elsewhere, resulting in some cases in local starvation. To prevent this, people from where the corn had been produced seized shipments, organized impromptu markets, and sold the corn at prices the local market would bear (delivering the income to the owner). These collective actions, Thompson argues, reflect the struggle of the moral economy with the market economy.

I will elaborate on implications of this moral economy and its tension with the market in the following discussion of "open source" software [OSS]. For the moment, it is worth emphasizing how practice, through creating epistemic commitments, can create significant tensions between identities of allegiance, such as membership in an organization and identities of practice, such as participation in a profession. Arrow (1974, 1984) highlights the way that scientists in corporations, torn between their professional obligation to openness and freedom and organizational mandates for secrecy and authority, exemplify this problem.

Open Source Practice

The success of OSS--whereby remarkably robust software has been created by loosely connected, independent programmers (von Hippel & Krogh, 2003)--has challenged notions of the firm as a critical site for innovation (Schumpeter, 1947; Chandler, 1962; Nelson & Winter, 1982),while turning attention instead to the loose, informal networks which produce OSS. Some see these networks as foreshadowing the economic structure of the future (Castells, 2001, Lamoreaux, Raff & Temin, 2002; Piore & Sabel, 1984; Sturgeon, 2003). OSS has also questioned the idea that well-defined and well-protected individual property rights are the price society should pay

for the efficient production of socially beneficial intellectual goods.[34] Consequently, it seems a useful site to address issues raised in this workshop and this paper. This section, then, situates ideas discussed already--of CoPs and NoPs, of incentives, innovation and communication, and of epistemic and ethical commitments--in the context of OSS, while addressing central themes of the organization of a knowledge society and the incentivization of innovation.

CoPs, NoPs, and formal organization

OSS coders present interesting examples of CoPs and NoPs. Though some researchers (Kogut & Metiu, 2000) have labeled the collective of Linux contributors a CoP, this collective is too large and amorphous to fall under the present use of the term. It would, however, qualify as a NoP: the membership do share a common practice (coding) and very similar person-world relations. On the other hand, within distinct groups working on a particular project--a driver, port, or most critically the kernel--members fairly directly coordinate how tasks will be divided or shared, who can and cannot "commit" to that particular project, and so how the group evolves over time. Consequently, coordinating practice and helping determine its reproduction, these smaller projects qualify as CoPs, by the definition offered aboce. Critically, membership in these both NoPs and Cops is not by affiliation or association, it is through practice. OSS communities involve a fairly strict meritocracy. You perform your membership by contributing. If you cannot hack, you can't belong. There is no other qualification. In that way, OSS coders might be thought of rather pure CoPs and NoPs, where the centrality of practice is not obscured by institutional or organizational factors.

On the other hand, OSS communities are distinct from most other CoPs because they do not seem to require the face-to-face interaction. Before embracing ideas of the death of distance and the end face-to-face interaction, we should note the peculiarities of this particular practice. Not only does practice here almost always engage seamlessly with global communications technology, but also that technology and the projects involved, though highly sophisticated, constrain practice tightly within quite distinct limits. Consequently, face-to-face communication may become less important. Outside those limits, when, for example, trying to develop complex

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[34] OSSS has cleverly (if a little quixotically) used IP law to defend itself (O'Mahony, 2003)

new features (such as the implementation of SMP in FreeBSD (Jorgensen, 2001) or to plan the future of the Linux kernel, coordination does indeed seem to require face-to-face interaction. Moreover, OSS practice is surrounded by robust face-to-face institutions that support it almost invisibly. Not only do firms and universities support most people who work in OSS (Lakhani, Wolf, & Bates, 2002), but such organizations introduce OSS coders into the practice--as, indeed, such institutions, often unknowingly, launched central features of OSS including Unix (at AT&T), GNU (at MIT), BSD and BIND (at Berkeley), Linux (at Helsinki University), and Apache (at NCSA). Indeed, rather than the alternative to conventional forms of business and education that some theorists envisage, OSS networks appear to be complementary to them, feeding off and feeding into formal organizations. Instead of seeing the history of organizational forms as one of replacement, with networks replacing firms, it may be better to see them in terms of increasing differentiation and complementarity: networks and firms, not networks or firms.

Barriers to communication: epistemic commitments

In their success, OSS networks illustrate how knowledge can spread within a NoP, pushed both by practitioners' will and ability to share and constrained by the common material world they work with. Unfortunately. OSS networks also help illustrate how difficult it can be to move knowledge across divisions of practice--even in a relatively static form--particularly across the division between producer and consumer. OSS coders, unexpectedly successful in providing software along their networks, have had a great deal of difficulty addressing directly the practices of "ordinary" computer users outside these networks. (OSS coders, for the most part being anything but ordinary.) In ICTs, the conventional way this is done is through user interfaces. These form a boundary object (Star & Greisemer, 1989) coordinating the two different practices (of expert and ordinary user) without demanding that practitioners on either side understand each other. The boundary object and its designer mediate between both practices--this, indeed, is the critical challenge and importance of good design.

Within its networks, OSS has developed around a system of progressively transparent, modularized black boxes that, when necessary, can be opened and inspected, but otherwise can be taken for granted (Tuomi, 2001). Programmers can take them on trust or inspect them at will. This strategy does not work so well with

unsophisticated computer users, for whom the closed box is as opaque as the open one is a quagmire. What they need is less like transparency and more like a mirror: users need to see not into the programmer's strange world (which OSS wonderfully provides), but a reflection of their own, familiar world.[35] For the distance between the two sides to be bridged, it first has to be understood as one not of information shortage--to which the conventional response merely burdens the user even further (Brown & Duguid, 1996b)--but of distinct practices. OSS has struggled to reflect ordinary practice in its interfaces--even with the Windows-like GNU/Linux graphical user interfaces KDE and GNOME.[36] Here we may perhaps be confronting one of the limits of these creative networks such as OSS. Weakened by their own strong ties (Granovetter, 1973) though very good at reinforcing the knowledge within the network, they face difficulties in developing the necessary "negative capability" to understand those outside the network and to look on their own practice from an outsider's perspective. That task--particularly as it is represented in the ordinary-user interface--may not be decomposable, may not, in Raymond's (1999) terms, be made shallow by multiple eyeballs (Jorgensen, 2001) and for that reason may require complex organization and perhaps complex organizations.

In the struggle to overcome epistemic barriers, we may start to understand, in terms of practice, the complementarity between the firm and NoPs such as the OSS projects. As already noted, there has been a tendency to think of the relationship as one of replacement, with the network replacing the firm. Benkler (2002), using an argument developed around human and social capital, suggests that IT has reduced the transaction costs that, according to Coase hold the firm together. By decomposing tasks into small, modular granules, IT makes it possible for human capital to assign itself to tasks that previously required the hierarchy of the firm. He gives examples of Slashdot, OSS projects, Project Gutenberg, Napster, Google and Amazon rankings, NASA "clickworkers". All of these draw on distributed contributions of individuals, and each is remarkable in its own right. But reading from left to right, each requires larger and larger organizations either to decompose the task for modularization or to

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[35] When Apple redesigned the Xerox user interface, it wisely reduced choices and simplified options that would have overwhelmed its customers. The vilified single-button mouse is a legacy of this process.

[36] KDE, which is designed for the user to have greatest control over the configuration of the interface, is particularly difficult for people who may not understand either the implementation or the implications of the choices they are offered.

reaggregate the results.[37] None of this argument either invalidates or deprecates OSS (or ICTs). It does suggest, however, that as with technologies (Duguid, 1996), so with organizational forms, replacement may be less common than augmentation and complementarity. The core competencies of successful organizations may lie in their ability to coordinate practices that, without external prompting, would be increasingly inward looking (Adler & Borys, 1996; Adler, 2003). It the realm of user interfaces, the relationship between Apple and the freeBSD OSS project may exemplify this complementarity. OSS may, then be telling us where NoPs can replace formal organization and, by the same process, where they cannot.

Barriers to barriers: ethical commitments and moral economies

As well as exemplary CoPs and NoPs, OSS coders provide an interesting example of ethical commitment and a moral economy at work.[38] Clearly, code is not corn and starvation has not been a significant problem for OSS coders as it was for the labourers Thompson studied. The parallel lies in the resistance to the appropriation of local labour and the denial of access for workers to what they helped produce. In OSS, the primal case is the deal between MIT & Symbolics, which in the name of intellectual property denied programmers at MIT access to their own code (Levy, 1984; Moody, 2001). Similarly, copyright agreements between the University of California, Berkeley, and AT&T and then Novell attempted to deprive university coders access to Unix code, even though they had developed a significant amount of it. In both cases, the coders responded by releasing or creating code in such a way to guarantee continued local access. As the projects developed and contributors spread, the underlying commitment to resist closure was woven into the practice of coding. (Though there are many other reasons for contributing to OSS, a recent survey found more coders contributing because code "should be open" than for any other reason (Lakhani et al., 2002).) OSS and closed code offer two distinct approaches to the incentivization of innovation. OSS involves NoPs where people, because they share practice, can circulate the knowledge they have developed. Economic incentives and legal restrictions try to arrange things so that they will not. The moral economy,

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[37] Napster, of course, relies on the recording industry and Gutenberg on the publishing industry--as did the OED, another favourite example of open source at work *avant la lettre* (Lessig, 2001).

[38] Shared practice may also produce shared aesthetic commitments. Moody (2001) notes that shared aesthetics are one way in OSS practice limits a tendency to "fork". See also Tuomi (2002) p. 175.

however, insists that many do. Hence, although there may be complementarity between OSS networks and formal organizations, there is also a good deal of tension.[39]

In this OSS networks are not entirely new.. Like scholarly communities, they are part of a broader historic tradition in which ethical implications of social ownership and customary rights are closely associated with the epistemic implications of the practice. Mauss (1990) analysed this tradition in his study of the "gift," which as Douglas noted is part of a French social tradition in reaction to Anglo-Saxon individualism. For Tocqueville and Durkheim as for Mauss the individual was also a social being who through drawing on the common stock incurred social obligations to contribute to and maintain a common stock. Neither the gift economy nor the moral economy is separate from the market economy. All are entwined, as markets are "embedded" in the social world (Granovetter, 1984). Creating markets and market incentives, then, becomes a remarkably tricky endeavour.

Many of these ethical commitments also emerge in SC networks. But I suggest the resistance is fiercer in NoPs than in other, heterogeneous networks, because by rewarding individual ownership and building barriers around intellectual property, the incentive system attempts to separate individuals from the newtork in which they shaped their identity and out of which their product came. Intellectual property rights make private what was built on public resources and exclude from practitioners products to which their collective practice has contributed. As networks of practice are less divisible than other social networks, so the reaction when they are artificially divided may be fiercer and the ability to disrupt division more effective.[40] Indeed, OSS may only be the latest (and most successful) of in a tradition of resisting such appropriation.[41] In a similar vein, Thomas Rogers, one of the great early railroad designers, provided specifications of his improvements to the Patent Office, but did not request a patent (Kahn & Sokoloff, 1993). Eli Whitney was also generous in providing details of his gin to other innovators, and was forced into court primarily to

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[39] Undoubtedly, all members of OSS networks do not share equally in the moral conviction--see, for example, the difference between the "free" and "open" software movements--but the practice creates strong pressure to observe certain ethical norms and to resist the commodification of collective products.

[40] For another fight over the transformation of public goods into private ones, see the fight over the human genome involving Craig Venter, Celera, and the publicly funded Human Genome Project.

[41] Thompson (1975) also writes about the way laws are "turned" in this way.

keep his inventions open by prosecuting those who tried to patent and profit from what Whitney had shared for free (Scotchmer, 1991). OSS, which uses copyright to promote rather than restrict the right to copy inherits this tradition of using the intellectual property regime against itself and of putting the moral economy ahead of the economic economy. The particular moral economy of OSS has been sufficiently productive that it suggests we may need to reassess the relationship between networks of practice and formal organization, the moral and the market economy.

Conclusion: IT & IP--Open or Closed?

The paper has attempted to lay out a set of relationships between social practice, social entities (the CoP and the NoP), and social commitments (ethical and epistemic). In so doing, it has tried to highlight what distinguishes CoP theory from SC theory, looking beyond information and beyond individuals, to understand the complex social contexts in which knowledge is created, acquired, and circulated. In so doing, it has tried to suggest that ICT cannot, on its own, bridge epistemic and ethical divisions created by practice. Similarly, it has suggested that our intellectual property system [IP] may be introducing and reinforcing divisions which it would be better to try to overcome.

In conclusion, I shall try to sketch some implications of these claims for ICT and IP respectively.

ICT

Focussing primarily on information and individuals, economists presume that communication involves the circulation of information and that new information technologies simply reduce communication costs--see, in particular, Mokyr's (2002) interpretation of Eisenstein (1983)--and thereby help promote the spread of knowledge. As I have argued, ICTs deal primarily with the explicit dimension. Thus they can promote leakiness of information, without being able to overcome stickiness of knowledge--the paradox that the skeptical economists found puzzling. That is, ICTs are powerful disseminators of disembedded information but not of the tacit dimension. They require the practice needed to receive, interpret, and reembed that information to be in place already to guarantee successful communication. ICTs need to be designed, then, with practice in mind.

Eureka (Bobrow & Whalen, 2002), a well-known knowledge-sharing system implemented by researchers from Xerox to help circulate practice-based tips among the network of technicians, is an example of a elegant and successful ICT implementation that implicitly relies on the extensively shared tacit knowledge of a large body of technicians and honoured their moral economy. (At the request of the reps, for instance, in its initial instantiation a major motivation was an ethic of sharing rather than the incentive of financial rewards.) While acknowledging its success, it is important to understand its limits. It worked well within the NoP of Xerox reps worldwide--people who shared a similar practice, working in a similar way on similar machines. It has proved difficult to move knowledge out of this network to the networks of designers and engineers to whom these tips might provide useful insight into the failures of the machines they build. From the perspective of practice this is not surprising. The reps' understanding of the machines is not the same as the engineers'.

The model has proved relatively hard to replicate, but this may be because alternative implementations have tried to use similar platforms to move information across boundaries of practice--in essence attempting to transform a peer-to-peer service into a hierarchical one.[42] The argument presented here suggests that this will not succeed, both for epistemic and for ethical reasons. Intriguingly, Orlikowski (2001) describes system designed to cross boundaries (between academics and students) which became successful transformed itself in practice into a peer-to-peer system among students alone. The successes and failures of Eureka-like implementations intimate that developing IT to spread innovation and understanding the successes and failures of such developments requires taking account of not just of social capital (though that may be important) but also of social practice and the epistemic and ethical commitments it gives rise to.

IP

While, in the right circumstances and within the confines of shared practice, ICT can be designed to further the spread of information and encourage openness not only of software, but also of science more generally, we cannot jump to the conclusion that the technology inherently favours openness or access or that it reduces transaction

[42] See also the Berkeley Central Valley Project (Feldman et al., 2003).

costs. The degree of openness is a function of design and use. ICTs actually makes very good black boxes. They can, for example, hide code in binaries, a transformation which drove the early "free software" proponents to resistance. It can also make secure or "trusted" systems for "digital rights management" (Stefik, 1996) and other forms of restricted communication and exchange (Bar, 2001). Even for experienced programmers, understanding the implications of code can be very difficult. When combined with the belief that innovation is best promoted through IP, these ICT capabilities contribute to a more general and more worrying trend towards closedness. Technology is being designed to offer more tightly defined and finely divided control over property rights on the assumption that, because IP has made a significant contribution to economic development, ever-stronger IP will make an ever-stronger contribution. But in the process, the balance between private control and public disclosure that IP previously maintained (Jaszi, 1996) (though not without difficulty, Litman, 2001) is being lost. David (2000) notes the increase in patents that reveal little and in new forms of copyright than can reveal nothing (particularly binaries), while Kelty (2001) describes a move from Ziman's "public knowledge," theoretically accessible to all, to "publicly visible, privately owned" knowledge, where access may be denied. (The use of peer-to-peer networks to share copyrighted music files would seem to be a reaction to this trend of restrictions and privatization.)

This trend seems to move to some degree away from IP--which traded publication for legal protection towards trade secrets and the "code of code" (Lessig, 2000), where nothing is revealed. In many ways, this is a move back in time (Moser, 2003). Two hundred years ago, entrepreneurs hired idiots and customs officers searched suitcases in the effort to stop knowledge flowing ("Josiah Wedgwood", 1867; Shaw, 1864). Now we do it more efficiently with ICTs. But this movement is not entirely away from IP--only from those aspects of IP that demand publication, copyright and patenting. As Arrow (1984) has argued, purchasers rely on institutional endorsement to warrant what they cannot inspect for themselves. When you download an Open Source package, you can inspect the code. When you buy a proprietary, shrink-wrapped, licensed package, you rely heavily on the accompanying trademark. Trade secrets and trademarks, the often underappreciated facet of IP, play together, allowing firms to resist openness. Successful brands are a remarkably powerful form of IP, tipping the rents in complementary assets from the ideal shared

state that Teece (1986) suggests towards the strongest brand in the chain, which then squeezes all others (Duguid, 2003).

Even OSS does not escape the power of trademarks. While it has subverted copyright (in "copyleft") and resisted patents, it has embraced brands (O'Manhony, 2003). Linux is a trademark, one whose power, moreover, may help account for the software's ascendancy over the various flavours of BSD. While Linux, wary of the centralization of copyrights in the Apache OSS model, keep copyright distributed among those who write the code, its brand is privately owned and increases in value every day. Red Hat's remarkable market value after its IPO shows the power of such brands. And given the paucity of business models under the GPL, it is not wholly surprising, then, to see another OSS distributor, Mandrake, trying to monetize its brand. Brands in other sectors change hands every day. It would not be surprising to see them change hands here. The Unix brand, after all, has been alienated from the Unix code. Unless it is recognized that OSS is not independent of the market but integrally part of it, the IP constraints that the moral economy has pushed out through one port may be brought in through another by the market economy.[43] More broadly, until we understand that innovation is an aspect of social practice and is hedged in by both epistemic and ethical constraints and boundaries, our chances of devising an ICT system that does not stumble over epistemic boundaries and an IP that does not affront the ethical commitments of people contributing to the knowledge economy will be severely limited.

Finally, to narrow these broad conclusions down to some more specific recommendations from the perspective of practice. In general I suggest that we need to move even further away from the assumptions of rational *homo economicus* working in a world of information and individual property than social capital theory has managed to get. In the process, we need to try to reestablish a balance between the market economy and the moral economy. From the development of the Stationers' register and King James's Statute of Monopolies to the Digital Millennium Copyright Act, Anglo-Saxon society has developed and modified incentives for the

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[43] Furthermore, if brands increasingly threaten to close off innovation, it may be important to try to return to their origins, when they were not alienable property so much as a way to hold manufacturers responsible for the quality of their goods. Trademarks might become a source for openness if they became an implied warrant, over which trademark holders could be held responsible for the inadequacies of their branded goods.

dissemination of innovation in response to changes in the means of communication (Jaszi, 1991; Rose, 1993, Litman, 2001).[44] ICTs--with their ability to enclose--have disturbed this balance once again. Increasing the strength of IP, piling rewards on individuals while extracting ever greater monopoly rents from the network, the current trend, will only exacerbate the problem. Indeed, in acknowledgement of the joint history of ICT and IP, it is worth considering ICT and the means of circulation get ever further from their roots, it may be time to return IP and the incentives for production closer to theirs. Copyright for 14 or 28 years after the death of the author would seem adequate to garner all justifiable rewards in "Internet time." Similarly, patents only for conventional technologies, not for business processes or software, would help acknowledge the distance between the old system and the new capabilities. Software, as a form of expression, would remain with copyright. Business processes could look after themselves as they always have. But perhaps most of all, in an age of trade secrets, trademarks, and et increasing problems arising from the trademarked products, it would be particularly useful to reassert the notion of trademarks as implied guarantees that carry with them, in cases where the trademarked goods are trade secrets, responsibility for quality and performance on the part of the trademark holder, who can only escape that responsibility by placing the trade secrets in the public domain. That way, the incentive to hide and sequester would be balanced by important rewards for openness.

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[44] Space does not allow consideration of more than the Anglo-Saxon tradition. I do not assume that this was the dominant tradition. Indeed, during the 19th century, at least, the French dominated (may even be said to have created) the collective system of IP; across that century, other countries, including Britain and the US, changed their legislation to accommodate the French.

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