

Müller, Felix Claus; Ibert, Oliver

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(Re-)Sources of Innovation: Understanding and Comparing Innovation Dynamics through the Lens of Communities of Practice

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Felix C. Müller, Oliver Ibert

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Abstract

Communities of practice play an important role in innovation processes. It is however still unclear what their particular function is. One problem is that the concept seems to be too wide and too narrow at the same time to address this question adequately. The notion is too narrow as long as it remains focused on its original understanding of craft-based practices of knowing. The notion however is too wide to encompass the whole multiplicity of knowledge practices that meanwhile have evolved in knowledge societies. In this paper we develop further a typology that has been proposed by Amin and Roberts some years ago. We complement their inductive approach with deductive elements. Concretely, we introduce the systematic dimensions domains of knowing (scientific vs. socio-cultural knowing) and modes of reflexivity (push vs. pull) to establish a matrix to locate different types of communities of practice. This matrix provides a useful template to study the influences of communities of practice on innovation processes in a comparative way. These types of communities can be regarded as distinct sources of innovation, as a locus in which novel ideas emerge and subsequently take particular trajectories. Moreover, these types of communities provide distinctive resources for innovation that can be used at different phases of an innovation process to complete decisive steps.

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1 Introduction

‘Community of practice’ as a concept is highly productive and yet not utilized to its full potential in understanding the workings of innovation. The abundant literature in this field has become influential in explaining the innovative performance of firms (Wenger *et al.*, 2002; AMIN and COHENDET, 2004). Some even argue that in a knowledge-based economy, communities should be treated as a mode of economic governance on its own right beside hierarchy, market and network (MAYNTZ, 2010; IBERT and STEIN, 2012).

“Communities of practice are groups of people who share a concern, a set of problems, or passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis” (WENGER *et al.*, 2002, p. 4). Mutual engagement of members and close interaction between knowledgeable practitioners and their working environments are constitutive features (WENGER, 1998).

In economic geography, communities of practice have often been described as transcending the boundaries between organizations. At the same time the mutual engagement of practitioners seems to be strongly place-bound and thus mainly afford a local circulation of knowledge (BROWN and DUGUID, 2000b). As such this strand of research has complemented and enriched related discourses on knowledge-based theories of spatial clustering (MALMBERG and MASKELL, 2002), localized learning, regional knowledge spillovers or innovative milieus. However, most recently, communities are increasingly recognized not only as closely knit, locally situated groupings of interacting practitioners (COOK and YANOW, 1993), but also in a more general sense as mediators of economic interactions and carriers of social identity more broadly (DJELIC and QUACK, 2010). These ideas open up new avenues to study communities of practice beyond regionally embedded forms of mutual learning towards practices of knowledge sharing and recombination across physical distance (FAULCONBRIDGE, 2006, 2008, 2010; BATHELT and TURI, 2011; GRABHER and IBERT, 2014). Moreover, it becomes not only possible to widen the scope of knowledge-based theories on spatial clustering but also to establish a new spatial perspective on the process of knowledge generation itself (IBERT, 2007).

The aim of this paper is to specify promising ways in which the communities of practice concept can be harnessed for such a geography of innovation and knowledge generation. At first glance the notion of communities of practice seems to be the philosopher’s stone for innovation research. It associates positive features like inclusion, belonging and egalitarian collaboration with creativity and innovation. These combinations are wonderfully compelling as they seem to promise not only the possibility of making “your passion your profession” (HAGEL *et al.*, 2012, p. 21) but even the democratization of innovation itself (VON HIPPEL, 2005). A second glance, however, reveals that things are more complicated unfortunately.

Communities of practice, as any other communitarian association, are rife with ambiguities. For instance, as communities of practice are highly focused on particular domains of knowing (REN *et al.*, 2007) they are not only inclusive to those who are interested to contribute, at the same time they almost automatically exclude anybody else. Further, communities of practice are often related to organizational structures of

firms. In some situations communities can transcend hierarchical differences within organizations (HILDRETH *et al.*, 2000) or boundaries between firms or firm divisions (BROWN and DUGUID, 2000b). This, however, does not mean that communities are flat and egalitarian social phenomena in general. On the contrary, their thematic boundaries often reflect hierarchical differences (e.g. professional communities of “desk clerks” and “line-managers”). Additionally they establish their own internal hierarchies, in which central actors dominate over more peripheral ones. Authority is not absent in communities, but it does not depend on formal status but is derived from prior achievements and the reputation of members among their fellow peers. Finally, communities often impose rather strict and also formalized procedural rules. In contrast to rules within formal organizations, however, members voluntarily decide to adhere to these rules when becoming increasingly engaged with a community of practice.

The ambiguity of communities of practice becomes particularly pertinent when it comes to innovation. On the one hand, contributors reiterate that practices rely on repetition and refinement of routines and cultivation of traditions. Also the stepwise enculturation of neophytes has been an important topic in the communities of practice debate from the very beginning (LAVE and WENGER, 1991). The related learning dynamics seem to be mainly preservative and narrowly focused but hardly creatively destructive. From this point of view it appears questionable at all that communities of practice are more innovative than other collectives. However, more recently the community debate increasingly highlights reflective capabilities of communities of practice. AMIN and ROBERTS (2008) suggested that different types of knowing might also be associated with different degrees of innovativeness. In particular creative and epistemic communities provide procedural routines that systematically push learning processes towards reflexive outcomes. Moreover, communities can become reflective when practices overlap with practices from other communities at their periphery (WENGER, 1998; BROWN and DUGUID, 2001) and elements of formerly unrelated practices are recombined. Finally, HAGEL, BROWN and DAVISON (2012) identified “pull” as a new mode of mobilizing resources for innovation processes which can mainly be harnessed in and through communities.

In the present debates it is thus increasingly less disputed that at least some types of communities of practices play some role in innovation processes. However, it is not yet well understood what particular functions these social entities play, how their impact on innovation can be grasped conceptually and whether or not there are systematic differences between types of communities and their impacts on innovation.

The notion of community of practice was thus found to be too coarse and at the same time too much focused on traditional craft-based communities to account for the diversity of knowledge creation and innovation as well as the related spatial practices of knowledge sharing and recombination today. One first conceptual improvement was suggested by AMIN and ROBERTS (2008), who on the basis of an extensive literature review identify four types of ‘knowing in practice’. On the basis of a critical reflection of this pioneering work, in this paper we develop a slightly modified typology that affords a comparative analysis of innovation processes across several forms of communities. Mainly we complement the inductively generated typology by Amin and Roberts by

introducing elements of deductive systematization. More concretely our typology allows a differentiation along different spheres of knowing – *scientific* and *socio-cultural* knowing – and along different prevailing modes of reflexivity – *push* and *pull* modes (HAGEL *et al.*, 2012).

In the subsequent section we discuss the diverse nature in which communities have been conceptualized in economic geography and beyond, especially with regard to knowledge creation. In part three we differentiate the community concept according to the different forms of knowing in practice, which can be found empirically and can be deduced conceptually. We then sketch the relational and spatial dynamics, which occur, when these communities initiate innovation and briefly illustrate how this typology might direct empirical inquiries. The proposed typology can be used to guide comparative studies of innovation that treat different forms of communities as sources and/or resources of innovation.

2 Economic geography and knowledge production by communities

Economic geography has a particular potential for an integrated approach to knowledge creation in and by communities of practice. This potential lies in the open and diverse nature in which aspects of community and knowledge creation are reflected in economic geography literature. First, economic geographers have been interested in two different epistemologies of knowledge creation, which bear relevance for innovation and its social contextualization (IBERT, 2007): *Knowledge as an object*, an understanding which is common in the economic literature, and *knowing in practice*, an understanding both found in the ‘communities of practice’ literature and in theories of scientific practices (e.g. LATOUR, 1987; KNORR CETINA, 1999). Second, a differentiation between communities as closely knit, localized groupings (LAVE and WENGER, 1991) and larger societal entities which involve elements of social construction and ‘imagined’ communality (DJELIC and QUACK, 2010) can be recognized (FAULCONBRIDGE, 2010). Both ends of this continuum are relevant for economic geographers. This double bridging position of economic geography is explored in the subsequent sections for its utility in studying the functions of the communities-concept in studying innovation.

2.1 Knowledge and knowing

A controversy surrounds knowledge creation in and by communities. Two strands of theory can be distinguished (AMIN and COHENDET, 2004; IBERT 2007): one which treats knowledge as an object or good, adhering to a ‘cartesian’ ‘epistemology of possession’, and one which treats knowing as a part of practice and takes on a ‘pragmatist’ (DEWEY, 1933) ‘epistemology of practice’ (COOK and BROWN, 1999). Both regional economists and economic geographers for most of the time have treated knowledge as an object, whose existence is viewed as absolute yet immaterial, and which displays characteristics of an economic good. In the most common interpretation of Polanyi’s distinction between tacit

and explicit knowing, knowledge is either seen as codified and generally available (a public good) or as tacit, embodied and only accessible through personal experience (thus a non-public good with certain properties of a club good). Tacit knowledge was found to be less mobile in space and more prominent in early stages of innovation processes (MASKELL and MALMBERG, 1999). In dealing with spatial patterns of knowledge creation, the concept of knowledge spillovers was introduced to account for the 'surplus' knowledge dynamics in places with higher concentrations of knowledge intensive activity. The utility of such conceptualizations very clearly lies in their ability to fit something as elusive as knowledge into the rationales of neoclassical economic modeling. The nature and material foundation of knowledge remained obscure however. Little is known or understood about how knowledge is made sticky or mobile.

The community concept, by contrast, is much closer to a pragmatist epistemology. The pioneering works are generally understood as a critique of the then hegemonial understanding of knowledge and learning as storage and processing of information, taking place inside individuals or organizations. The practice perspective places emphasis on learning as an inherently social, embodied and situated process, which takes place regardless of the intensity of information processing or formal qualification involved. Accordingly the early studies of communities of practice focus on professions otherwise not associated with knowledge creation, such as midwives (LAVE and WENGER, 1991), flute makers (COOK and YANOW, 1993) and repair technicians (ORR, 1996).

Essential findings are that rather than applying pre-existent knowledge to given problems, practitioners create knowledge in direct and often physical interaction with each other, with artifacts or clients, and cultivate this knowledge via storytelling. Furthermore, acquiring competence is a process of learning how to behave appropriately as a practitioner, i.e. adopting the identity constructions and cultures of a trade, rather than it being a process of absorbing objective information. Although there are substantial theoretical differences, the context-specificity of knowledge, which is highlighted in this approach, provides a link to recent discussions on the situatedness and materiality of knowledge creation in scientific work (LAW and MOL, 2001). Such accounts from Actor Network Theory and the Science and Technology Studies show that, rather than being objective or universal, knowledge has a time, place and social context in which it exerts validity as an element of practice. Context-specificity of knowledge and knowing in practice thus is a conceptual frame linking a variety of approaches. It allows geographers to adopt a new, i.e. a topological view on space when they account for the spatiality of knowledge creation (IBERT, 2007): Instead of striving to determine the spatial reach of knowledge and knowledge networks (a typical approach under the 'knowledge as an object' paradigm or 'epistemology of possession'), the situated perspective calls for an account of the material contexts and places of knowing in practice, as well as the places of permanent or temporary co-presence which occur in processes of knowledge creation.

However the situated perspective has been subject to critical scrutiny. Shortcomings are seen in its reductionist view on the knowing individual and its disregard for the mobility of knowledge beyond communities. YAKHLEF (2010) argues that, if the quality of knowing were to reside only in an individual's enculturation in a community, individual ingenuity

would be outside the scope of study. Instead, knowing should be understood as a process of abstracting situated experiences and applying new perspectives to situated contexts. In this perspective an individual's ability to transcend and move between environments is highlighted. Likewise LORENZ (2001) rejects a purely situated perspective on knowledge in favor of a 'cultural historic' view, which places the institutional regulation of skills, careers, knowledge and practice center stage (COLE and ENGSTRÖM, 1993). The critique of the situated approach thus raises the question of what is to be seen as the social context of contexts, as it were, and what makes knowledge carrying individuals and objects mobile within it.

An integrative perspective is offered by COOK and BROWN (1999). According to their notion of "bridging of epistemologies", knowledge is an ability to act, a potential which remains existent even when it is not currently performed. It can be explicit or tacit, and both forms can be possessed by individuals or groups such as communities of practice. Individual explicit knowledge takes the form of 'concepts' while individual tacit knowledge is embodied as 'skills'. Group explicit knowledge is stored and conveyed as 'stories'. Group tacit knowledge, probably the most elusive concept, manifests itself as 'genres': group specific, shared understandings regarding the meaning of types of practices and forms of interaction. Apart from individuals or groups, knowledge can be manifest in objects: It can be codified in documents or inscribed in artifacts. Such reifications (WENGER, 1998) of knowing are revealed when practitioners actively interact with objects, e.g. when engineers disassemble an older machine to experience 'how it feels' or when scientists read and interpret academic articles.

Knowledge emerges from interaction among people or between people and objects. In this process, existing knowledge is used to create new knowledge. The dynamic action or interaction necessary to achieve this goal entails knowing in practice or 'epistemic work'. The term conveys the dialectic relationship of work and knowing: Knowledgeability is a prerequisite to perform work, and work (or practice) is the medium through which knowledge is generated. It can be a routinized kind of practice, which allows an individual to acquire the skills of a trade bit by bit, thus generating individual tacit and explicit knowledge. Or it can be work which expands the realm of what is known in a particular group. Epistemic work thus is dynamic. Typical elements are 'productive inquiry' (the targeted search for a yet unknown way to do things), material interaction and, as a product of it, 'dynamic affordance'. The term refers to the emergence of learning opportunities ('facilities and frustrations') when material interaction takes place dynamically over time, e.g. when dynamic physical interaction between a bicycle and an inexperienced cyclist affords opportunities to experience which movements help to maintain balance and which don't.

Epistemic work aims at the creation of fundamentally new knowledge. It is oriented towards epistemic objects (KNORR CETINA, 2001): objects which in interaction not only afford the opportunity to learn about their functionality, but are continuously altered and afford new interpretations of potential functionality (RHEINBERGER, 1997; MIETTINEN and VIRKKUNEN, 2005). The concept affords a view on knowledge as being dynamically generated and contextualized in knowledge practice, but also being objectivized and thus

made mobile in the form of artifacts, stories or personal experiences. Knowledge can transcend the community context. In accordance with an ANT perspective however, its existence cannot be taken for granted in an immaterial, objectivist sense. Rather it is literally embodied in artificial or natural bodies (LAW, 1986). Patent documents for example should be treated as objects, in which knowledge is inscribed, rather than as mere indicators for a Platonic idea of knowledge, which is assumed to be at work as an immaterial essence.

2.2 *Local and trans-local notions of practice*

The second differentiation deals with the mode and intensity of interaction between members of a community. The classic concept of 'community of practice' represents an understanding of a group of people who interact frequently over longer periods of time and who perform a shared professional practice and address tasks which belong to a specific domain. In doing so, they continuously exchange experiences, learn from each other and strive to align upcoming challenges with their shared norms and perceptions (WENGER, 1998). They thus cultivate a shared repertoire of skilled conduct. Early studies of communities of practice focus on cases of highly routinized or traditional practices, such as insurance claims processing (WENGER, 1998), midwifery or active alcohol withdrawal in an AA group (LAVE and WENGER, 1991).

These cases highlight the shift in perception which came with the approach. Neither formal organization nor qualification are seen as the essential prerequisites for successful problem solving, but the way the completion of tasks is practiced, and the way these practices are contextualized: in a place-based, material and social nexus rich with identity, belonging, socializing, repetition, trial and error, discussion and disagreement, varying degrees of membership and participation, gossiping and storytelling. Storytelling in particular was found to be the essential practice by which communities share experiences, create a shared culture of understanding and assign fame to individual contributions (BROWN and DUGUID, 2000). Not surprisingly communities of practice as a concept have become popular in the business literature, as they provide an understanding of autonomous learning and problem solving in the context of everyday routines. Following NONAKA's and TAKEUCHI's (1995) account of the knowledge creating firm, communities were seen as a novel way of harnessing and managing knowledge at the firm level (FILIERI, 2010). The concept was turned into a normative prescription to an extent one might consider contradictory to the original emphasis on emergent self-organization (AMIN and ROBERTS, 2008). In this literature, in most cases communities are understood as social groupings within an organization (FAULCONBRIDGE, 2010).

The way communities operate cannot be understood by focusing on their locally situated processes alone. BROWN and DUGUID (2000a) address interactions across communities with their notion of the region as a knowledge ecology: Different communities (e.g. engineers, accountants) interact within a firm, while like-minded members of various communities addressing the same type of task in different firms interact in a 'network of practice', which spans across the region. The network of practice is portrayed as a highly efficient conductor of ideas, quickly guiding them towards the firm which provides the most

receptive environment. This concept, although having the charm of providing a spatial take on communities and networks, is problematic from the perspective of economic geography. It comes with a spatial fix, which does not address the diverse spatialities of communities and networks. Moreover the focus is on a very special region: Silicon Valley. The network of practice is partly credited for the Valley's ongoing entrepreneurial success. However, other regions may not display the same pattern of open trans-firm exchange (SAXENIAN, 1994).

WENGER (1998) provides a much more general differentiation by distinguishing "engagement with practice" from "participation in practice". Engagement with practice denotes the actual performance of practical tasks. It is thus necessarily localized and encompasses idiosyncratic interactions occurring between a discrete number of people and objects situated in a concrete, local setting. It may refer to interactions within one particular community of practice or interactions at the intersection of two particular communities situated in time and space. Participation in practice by contrast denotes membership in the perceived community of all who pursue a particular practice or trade. It is about "being" – a lawyer, an engineer or a reformed drug addict. Participation requires experiences of engagement, but it is not limited to particular places, time periods or instances. Practice encompasses an element of identity and imagined community, which remains meaningful even in the absence of other members or ongoing engagement.

This distinction has a similarly structured counterpart in economic geography, which conceptualizes space much more broadly: With reference to WENGER (1998) FAULCONBRIDGE (2010) sets apart 'communities of practice' from 'constellations of practice' using the example of international architectural firms. Communities of practice consist of individuals who discuss architectural models, explore materials and comment on each other's work in a studio environment on a day to day basis. Constellations of practice encompass countless localized communities across the globe, which cultivate and advance the professional state of the art in their shared domain. They do so, in the case of architecture, with the help of circulating objects (images, magazine articles) and travelling individuals (business travel, but also private travel to sites of iconic architecture). As long as relevant aspects in the conditions at distant places are sufficiently similar, it is possible to share practice without being at the same location (BROWN and DUGUID, 2001; GRABHER and IBER, 2014). Yet the term 'constellations of practice' still appears as merely a multi-nodal extension of the notion of localized communities.

By introducing the concept of 'culture' into the debate, an even more general conceptual counterpart to the singular, locally situated community of practice can be defined. For example, KNORR CETINA (1999) links scientific work in material, situated contexts to an individual's membership in an 'epistemic culture'. An epistemic culture does not only entail a set of methods and tools used in epistemic work, but also distinctive notions about the value of different bodies of knowledge, of questions and research trajectories. Similarly FAULCONBRIDGE portrays the 'cultures of work' adhered to by the employees of multinational law firms (2008). The element of culture, i.e. the assignment of values,

sense and biographic identity to particular types of practices, even in the absence of ongoing interaction, makes for a conceptual underpinning of socio-cognitive stability across local contexts. Therefore the term 'culture of practice' could be used as a mirror concept to the locally situated 'community of practice'. This is not to say that such cultures exist for themselves, disconnected from places, communities and the material world. Both their stabilization and their alteration require place-bound, material practice. But the cognitive aspect of norms, values and taken-for-grantedness (COLYVAS and POWELL, 2006), which is inherent in the term culture, together with the strong connection to identity and professional biographies help to explain both smooth collaboration within and friction at the fringes of such entities.

This differentiation between community and culture also opens up a path towards reconciling the economic geography perspective with the discourse on communities in sociology and political science. Here, the concept of community has undergone a pronounced shift in recent years: Community in the older sense, referring to theorists such as WEBER (1978), TÖNNIES (2002 [1897]), DURKHEIM (1889) and SIMMEL (1971) was understood as a pre-modern form of social organization, based on non-functional solidarity among its members, involving emotional bonds and individualized trust (as in families and tribes). By contrast, modern society was described as an aggregate composed of atomistic and anonymous individuals all pursuing their respective interests within a framework of specialized roles and institutional constraints. Today this opposition of "traditional communities" vs. "modern society" is under reconsideration and communities are increasingly conceived as vital elements *within* modern societies (DJELIC and QUACK, 2010). The persistence of communities has been the topic of a rich literature, which considers community in general (PUTNAM, 2000), but also 'ethnic communities' (DAHLES, 2010), 'interest communities' (FETZER, 2010), 'online communities' (FARAJ *et al.*, 2011) and various other forms. These concepts have in common, that they highlight a sense of belonging beyond the nuclear family or functional roles (in institutions, networks, organizations) as an important factor, which shapes peoples' perception of their social environment and the way they act in society. Most recently the term community has been explored for its usefulness in analyzing economic governance that should be considered a mode of governance on its own right beside hierarchy, market and network (MAYNTZ, 2010; IBERT and STEIN, 2012). Economic governance by communities is defined by pooling and sharing of resources rather than exchanging them reciprocally as is the case in networks (BELK, 2010). With the rise of open innovation and the commons movement in culture and software production, communities were increasingly recognized as shaping economic governance at the institutional level as well (DOBUSCH and QUACK, 2010).

Communities are not confined to territories or administrative boundaries, but neither are they fully independent of them. Like firms and networks they can operate transnationally and transmit impulses of change into national institutional systems, but they are also shaped by institutional frameworks and regional or national cultures (DAHLES, 2010; GRABHER and IBERT, 2014). Some transnational communities are defined by a common culture of practice, such as lawyers in international law firms (FAULCONBRIDGE, 2008). Herein lies the link between an economic geography of innovation through communities

and the literature on communities as social actors. Cultures of practice can be understood as the connotation of trans-local communities which is concerned with knowledge work.

The challenge to be addressed in the following chapter is to come up with a meaningful differentiation of communities and cultures of practice based on the knowledge practices pursued within them, to describe the way the community (“engagement with practice”) aspect relates to the culture (“participation in practice”) aspect and to explore how and in which constellations different communities are expected to create ideas which lead to innovation.

3 A differentiated view on communities – toward a typology

With ‘knowing in practice’ clearly identified as a dynamic, reflexive, but highly situated and context specific process the stage is set for a differentiation of types of knowing in practice and the environments in which they take place. AMIN and ROBERTS (2008) rightly observe that the concept of communities of practice is too narrow. It focusses on skill- and craft-based practices and says little about those practices which are linked to knowledge creation in society as a whole, as in, for example, the sciences or in academically trained professions. In order to overcome this conceptual limitation, Amin and Roberts propose a typology consisting of four forms of knowing in practice: traditional craft- and skill-based knowing, epistemic and creative knowing, professional knowing and virtual knowing. In this typology, “craft- and skill-based knowing” (AMIN and ROBERTS, 2008) resembles the ‘original’ communities of practice approach the most. It refers to those kinds of knowing, which are to a large part embodied and synesthetic. The knowledge is acquired in the form of traditional apprenticeship, in which the relevant epistemic work involves repetition and imitation supervised by a senior practitioner. It is mostly tacit. The practice is strongly localized and takes place in co-presence with colleagues or clients as it involves either direct physical interaction or joint work on objects. “Professional knowing” (ibid.) by contrast requires lengthy institutional training episodes, in which explicit knowledge is acquired. The term refers to practices like those of lawyers, physicians and engineers. In these professions explicit, codified knowledge is acquired in academic institutions and used, but seldom purposefully altered, in practical application. This knowledge, as Amin and Roberts show extensively citing literature on the medical profession, is to a large degree synesthetic, embodied and tacit.

“Epistemic and creative knowing” (ibid.) is understood as work on the concepts and objects which make up knowledge itself. Rather than adapting existing knowledge to a particular practice, epistemic and creative knowing strive to constantly reflect upon and rewrite the conceptual foundations of any applied knowledge. The concept of epistemic and creative knowing covers both the work of scientists and artists. The knowledge used in this practice is explicit and the epistemic work is best understood as permanent explication. The forth type is labeled “virtual knowing” (ibid.) and covers the epistemic work done via virtual collaboration as in, for example, the Linux community. Virtual knowing is characterized by a combination of explicit knowledge, which is exchanged over

long distances and community specific cultures of working and understanding, which are known tacitly. Likewise formal qualification and institutionalized knowledge are used, but do not impose an entry barrier to participation.

The approach is to be credited with being the first comprehensive categorization of knowing in practice. AMIN and ROBERTS (2008) drew together a wide range of literature on knowing in practice and thus took a big step towards overcoming the limitations of the situated paradigm. There are still shortcomings however: Firstly, while three of the four categories are well founded on theoretical considerations of knowledge, knowing and their contextual underpinning, 'virtual knowing' appears to be more of a residual category which serves the purpose of accommodating the growing literature on online communities. Clearly the Internet has revolutionized many aspects of collaboration in knowledge work. Therefore it is crucial to take into account the importance of distant, virtual interaction in *all* forms of knowing in practice, as well as its interplay with physical co-presence. A second critical aspect is the equalization of epistemic and creative knowing. In our view there are substantial differences regarding the ways knowledge is created and knowing is organized in institutionally structured career paths between epistemic and creative contexts. Thirdly Amin and Roberts not only identify types of knowing, but also types of innovation associated with the former. However, as innovation by definition transcends the boundaries of communities and situated contexts, we think that identifying, for example, epistemic knowing with radical innovation may be premature.

3.1 Towards a new typology of communities and knowing in practice

Drawing on the work of AMIN and ROBERTS (2008) we propose a new typology of knowing in practice to guide future empirical inquiry into the role of communities in innovation processes. While the typology cited above is the result of an extensive literature review and therefore by necessity has an inductive quality, we aim at a more deductive approach. Our typology is a matrix based on the criteria 'type of knowledge' and 'modus of reflexivity'.

Under the criterion 'type of knowledge' we propose a distinction between scientific knowledge and socio-cultural knowledge as being meaningful to highlight important facets of a knowledge-based economy. We explicitly acknowledge that scientific knowledge is just another social practice (KNORR CETINA, 1981) and that it should not be treated as fundamentally distinct form that has to be treated separately from more mundane practices of knowing. However, we maintain that science has a particularly prominent position in knowledge societies and that there are some gradual differences in the relative importance of key aspects of knowing vis à vis socio-cultural knowledge that need to be addressed. For instance, scientific knowledge is produced according to the formally institutionalized rules and methods of academic practices of validation and of producing credibility (SHAPIN, 1995). Socio-cultural knowledge, in contrast, comprises all shared notions concerning the elements and meaning of our everyday lives: objects and the utilities they afford, places and their qualities, images, identities, routines, roles, norms and values, styles and ideals. While this kind of knowledge cannot be held up

against the standards of scientific proof, it is known to the degree in which people buy into it and share it as knowledge. Its valuation depends stronger on plausibility and persuasion against the background of a culturally shared general understanding than on formal proof. Moreover, even though for both, scientific and socio-cultural practices of knowing codification of documents and their interpretation against the background of implicitly shared mutual assumptions commonly occur, its relative importance is different. While any meaningful contribution to scientific knowledge needs to be codified at some point in time, many contributions to advance socio-cultural knowledge can also be achieved just by establishing new informal rules. Finally, scientific and socio-cultural practices differ with respect to their temporality. Whereas changes in the body of scientific knowledge occur only slowly the rules that underlie everyday behaviors seem much more volatile and fluent and can change quickly and in an unforeseeable manner.

The criterion ‘modus of reflexivity’ refers to the logics in which knowledge is created. In a push-logic, actors search for new knowledge according to specific rules and evaluative logics. They address an *ex ante* defined body of knowledge and work to expand and modify it. In a pull-logic actors are confronted with problems while performing a practice and strive to solve them by working with existing knowledge and changing it in the process. In knowledge creation following a pull-logic, actors frequently cross and redraw the boundaries of knowledge domains. More traditional forms of reflexivity, that rely on organized and purposeful and thus also limited and expensive procedures of questioning established knowledge are called “push”. In contrast to push, pull refers to practices of mobilizing resources for innovation processes that are produced by actors or social movements anyway. Pull in other words denotes a logic of reflexivity in which enthusiasm and intrinsically motivated action is harnessed, amplified and carefully re-directed. ‘Pull’ in general is seen as an increasingly influential principle in knowledge creation (HAGEL *et al.*, 2012).

Table 1 – Types of communities of practice

		Domains of knowing	
		Scientific	Socio-cultural
Modes of reflexivity	Push	Epistemic community	Creative Community
	Pull	Professional Community	Interest Community

Source: Own design on the basis of Amin and Roberts 2008

In this typology we bring together distinctions that were generated inductively in the course of an extensive literature review with conceptually deduced distinctions that represent relevant dimensions of modern knowledge societies. We do not claim that our

typology embraces all kinds of communities of practice. However, by introducing an element of deduction our typology can uncover some systematic differences that seem particularly relevant for an investigation of innovation dynamics. The typology thus affords comparisons between empirical cases that would otherwise be difficult to achieve. When elaborating these types, we build on the literature originally reviewed by AMIN and ROBERTS (2008). Some of their findings had to be reorganized in the light of our systematization. Moreover, we added new evidence from more recently published work on communities of practice including our own.

3.2 *Types of communities*

Table 1 shows the resulting types of communities. In comparison to AMIN and ROBERTS' (2008) types of knowing in practice, epistemic and creative communities now occupy two separate types. Both rely on forms of organized creativity and thus can be characterized by a push-logic of reflexivity. The criterion setting the two apart is the type of knowledge which is involved: Epistemic knowing uses and changes scientific knowledge, while creative knowing refers to socio-cultural knowledge. The type 'traditional and craft based knowing' does not occur anymore in our typology. As our interest is in innovation, we see knowing from the angle of its ability to change knowledge. Purely traditional forms of knowing, which exclusively cultivate and pass on knowledge, should these exist, could not act on innovation and would at best be replaced by it. Other examples of craft based knowing, which allow for changes to the existing stock of knowledge, would be reassigned to either creative (if there is an artistic aspect) or professional (if there are standards which ultimately have a scientific foundation, as for example in midwifery) communities. Many crafts have aspects of both. Professional knowing translates into professional communities in our typology.

One type of community is newly introduced here: Interest communities apply and change socio-cultural knowledge in a pull logic. This type accounts for the growing number of communal, knowledge creating grassroots initiatives and projects based on enthusiasm rather than professional cognizance. Empirically this type overlaps with Amin and Roberts's 'virtual knowing'. However there will be noticeable differences too, as for example the growing number of institutional online teaching or online medical consulting services will now occur as elements of professional communities. The virtue of this separation lies in the increase in conceptual coherence it brings: The criteria 'type of knowledge' and 'mode of reflexivity' define the community types, while specific combinations of virtual and physical interactions occur in all of them (GRABHER and IBERT, 2014). In the following sections we further elucidate the analytical utility of this classification.

3.2.1 *Epistemic Communities*

The knowledge practice in epistemic communities is characterized by an ongoing reflection on its own conceptual and instrumental foundations. Some rules and elements of identity, such as the established ways in which knowledge is produced, shared and validated, are deeply entrenched in institutional self-regulation and strongly tied to

participants' self-worth. They are either shared across faculties or within larger sections (such as the natural sciences). Disagreements at this front tend to be harsh and personal (as in the "Methodenstreit" in the social sciences). Beyond the very fundamental rules of the trade, cultures of practice in the epistemic realm are highly dynamic. Challenging one's claim to truth is common within and between epistemic cultures, and is understood as a necessary part of the practice.

Epistemic practice has two typical spatial materializations: Longer-term continuous work in specialized places of knowledge creation (e.g. laboratories), which build a reputation for a specific approach, and temporary co-presence on cyclical formats like conferences and workshops, which serve to contextualize contributions in the culture (KNORR CETINA, 1981; LAW and MOL, 2001). While participation requires prior institutional education, the decisive locales of knowledge creation are project teams, which are located in places with idiosyncratic, creative qualities (KNORR CETINA, 1981, 1999). These localities of project based work are both connected laterally through ongoing exchange (IBERT, 2010), and sequentially in time, as individuals combine work experiences in various project environments in their professional biographies.

Creating new knowledge is the daily practice of epistemic communities. More radical novelties emerge, when different cultures of practice meet in localized settings, either through temporary co-presence (conferences) or through co-location. Often new epistemic communities and consequently epistemic cultures emerge out of such constellations, opening up a wider research agenda which is pursued in multiple locations. While AMIN and ROBERTS (2008) associate epistemic knowledge work with radical innovation on general principles, we advise caution. The degree to which innovation can be understood as radical or incremental in a practice perspective depends on the changes to any given practice in an application environment which result from it. Even radical scientific novelty does not necessary translate into radical changes in application practices. Innovation trajectories emerging from epistemic communities are subject to multiple translations of the innovative knowledge (LATOUR, 1987; IBERT *et al.*, 2014).

While epistemic work itself is largely a-territorial in its internal logic (although national research funding creates strong territorial differences), territoriality is increasingly imprinted into the process, e.g. by market regulations and industrial standards. Innovation is often inspired by encounters of academics with practitioners. In most cases this constellation lacks the resources to successfully create an innovation. The innovation then has to pass through a number of selective environments, such as investor preferences and industrial product strategies, which are likely to bring about a result less radical than conceived by its inventors.

3.2.2 *Creative communities*

Similar to epistemic communities, creative communities constantly challenge established claims of truth and irritate established patterns of sense making (AMIN and ROBERTS, 2008). However, they do not challenge a well institutionalized, disciplinary organized body of

mostly codified knowledge. Rather, they challenge the often implicit cultural rules that guide everyday behavior in a reflective manner. Creative communities systematically push towards reflexivity by establishing procedural rules and appointing procedural authorities. Project-based work is the archetypal organizational form to set up temporary arenas within which overlaps between divergent or even rivaling knowledge practices become tolerable and can be oriented onto a shared goal (GRABHER, 2002).

Innovation in the strict sense of the word happens probably far less frequently in creative communities than one might expect. The systematic reflexivity prevailing in creative communities aims at a continuous creation of 'freshness' (GRABHER, 2002) and distinctiveness (POWER 2010; HRACS *et al.*, 2013) but less frequent to radically new formats or ways of organizing creative work or presenting novel content. The limitations that are necessary to create the desired novelty are often set by practices that represent a rather strange logic, for instance a managerial logic or the internal logic of a customer's organization (PINCH *et al.*, 2010). Even though these encounters are frequent and thus rather normal, they are often experienced as being full of tension and rivalry (GRABHER, 2002). Cultural-symbolic practices often draw inspiration by directly interacting with broader audiences, as is perhaps most obvious the case in electronic club music (LANGE and BÜRKNER, 2013). Furthermore, many creative practices employ deeply embodied techniques and skills of performing, such as singing, dancing, acting, painting or playing an instrument. Further, creative practice frequently embraces the mutual engagement of complementary creative skills, e.g. in music bands, film crews, video games development teams or the twin competences of texting and graphic design in advertising. Finally, creative communities overlap with professional communities, some of them dealing with technologies, like audio specialists or hard- and software engineers, while other deal with businesses, like lectors or account managers.

In terms of *engagement with practice* creative communities create a rich ecology of diverse locally situated practices. These practices are performed, for instance, in sites of *knowledge performance*, like studios, stages, dance-floors. Also, creative practices require *sites of interaction with audiences*, e.g. theatres, clubs, cinemas, exhibition halls or galleries. Sites of project-based interaction are frequently established by creative communities, among them agencies or self-organized co-working spaces, in which the rivaling logics of creative and business-related practices can play out. In terms of participation in practice creative communities are organized alongside genres and styles. These can manifest themselves in local scenes, situated in sometimes global centers (like Nashville for country music). Generic techniques of creative expression, for instance, techniques to stimulate emotionality are negotiated in globally spanning knowledge spaces (FAULCONBRIDGE, 2006). Finally, events like opening night celebrations, creative competitions or festivals, can be regarded as time-spatial bundles of people and artifacts, in which genres are constituted, networked reputation is built up and new trends can be experienced and negotiated among peers.

3.2.3 Professional communities

Professional communities operate in a pull logic, in which a specific domain of often scientific, academically institutionalized knowledge is continuously applied to practical problems. This entails on the one hand an ongoing, highly repetitive practice with a high degree of internal momentum, and on the other hand unsystematic forms of reflexivity. Situations in which the existing knowledge is insufficient are experienced *ad hoc* and unintentionally (ORR, 1996) much in contrast to the logic of continuing systematic reflexivity in epistemic communities. Reputation in professional communities is based upon one's background of institutional training. More importantly, however, this fundamental expertise is complemented with acquired experience and expertise through practice. Therefore even academically trained practitioners (like surgeons) go through a phase of practical training that resembles apprenticeship (AMIN and ROBERTS, 2008). While materializations of codified knowledge are important during the period of institutional training, codification and explication are not part of the practice itself. Here, tacit, embodied knowing dominates. The cultivated rules and routines of knowing change only gradually with little overall diversity and remain well inside the boundaries of the profession. Boundaries to peripheral communities are rather sharp.

Engagement with practice unfolds along the paths of everyday business with a certain tendency (depending on the trade) to regionally bound experiences. The actual work is conducted in well-defined, standardized types of places (courtrooms, operating theatres), which are more commonplace than creative or epistemic locales. Participation in practice involves sharing a repertoire of accepted rules and behaviors and using a common set of tools and techniques. These tend to be institutionally regulated and specific for a territorialized institutional framework, most frequently a nation state. The rules, tools and techniques are acquired, along with typical elements of identity and "habitus", during the periods of institutional training. Training itself may be considered a special form of engagement with practice bound to particular localities – one which links each professional biography to a localized academic or educational environment (HALL, 2008, 2009).

According to our own research (IBERT *et al.*, 2014) innovation or novelty is usually not part of the 'job description' in professional communities, although different styles and interpretations of how the practice is to be performed may arise, often in conjunction with a specific 'school' of institutionalized training. Some (like lawyers) value continuity and uniformity as an essential asset. Innovation is created at the overlap of two or more professional communities (or one professional community with another type). These situations are highly contingent on time-spatial and institutional opportunity structures. The interaction across community boundaries often involves a conflict of cultures. It requires exceptional boundary spanning practitioners. Interestingly, epistemic reasoning, academic discourse and explication of new knowledge seem to be necessary practices when boundary spanners endeavor to come to terms with new rules and techniques. Therefore, in addition to the necessary presence of a challenging problem and ambitious boundary spanners, an academic environment at the periphery of the respective professional practice seems to be a local context condition conducive to innovation. The

resulting innovative solutions are tied to the local context, but can be applied immediately. They spread slowly, typically within a territory, during which they change gradually. An abstract idea of what the innovation is, beyond the individual case, emerges inductively and incrementally. The corresponding narrative is formulated, typically alongside the formation of an organizational structure which markets the innovation.

3.2.4 *Interest communities*

The concept of “interest community” (GRABHER *et al.*, 2008; GRABHER and IBERT, 2014) connects a greater variety of communities and knowing in practice than the other three types, which each reflect types of knowing in practice described by AMIN and ROBERTS (2008). Interest communities operate under a pull-logic to domains of socio-cultural, i. e. experience related knowledge. What connects members of interest communities, is shared enthusiasm for objects, styles or activities. In some cases it can also be shared anger about restrictions imposed by society or society’s neglect of certain problems (like rare diseases). Both forms of motivation can come together, as in the case of handicapped sports (FRANKE and SHAH, 2003). Apart from the shared interest in one topic, interest communities are highly heterogeneous in terms of professional backgrounds, training, income or social status. Boundaries to other communities are sharp with no systematic interaction beyond multiple memberships of some individuals.

Interest communities are notoriously un-professional in the sense that members make a point of the non-existence of their particular perception in institutional and organizational contexts. The distinction between engagement with and participation in practice is more difficult than in the other types. In the absence of an established culture of practice, there is no “pure” participation in practice beyond the state of being fascinated or affected by something in daily life, which constitutes the entry ticket, a kind of proto-membership to the community. Actual membership emerges when individuals share ideas on the respective focal topic. There are various densities of “engagement with practice”, almost all of which are mediated by online technology. Therefore, human-screen interaction is the quintessential form of engagement with practice in interest communities, yet not the exclusive one (GRABHER and IBERT, 2014). At this basal level there is no need for time-spatial synchronization. Through online exchange, community members strive to free themselves from “tyrannies of the neighborhood” (HAYTHORNETHWAITE, 2002), where they usually cannot share their enthusiasm or predicament. Mastering a relevant community language (in most cases English) and access to the internet are the two essential constraints to participation or membership. The next stage in the intensity of engagement is temporary co-presence on community events. What seems to be more important than personal contact here is experiencing passion-related objects in challenging situations and directly comparing different solutions, styles and performances.

Interest communities as sources of innovation are subject to lively debate. Many authors stress the relevance of enthusiasm and free sharing on knowledge as a driving force behind innovation by interest communities. Sharing and exchange take place over large physical distances via online communication. In the early stages of a community, temporary co-presence of key activists (as in the case of the Linux community) or specific

local conditions (as in the case of the surfing and mountain biking communities) seem to be necessary to identify the topic of common interest. There are different accounts of the logic and dynamic of innovation processes emerging from interest communities. Some authors claim a reciprocal relationship between companies and interest communities, in which community input and feedback helps companies to gradually test and improve their products (“permanently beta”, NEFF and STARK, 2003; HAGEL *et al.*, 2012). FRANKE and SHAH (2003) on the other hand suggest the notion of a “community based innovation system”, in which intrinsically motivated innovators are supported by a community according to a sharing logic, which differs sharply from the internal workings of innovating companies and brings about different results. How community members act as “accidental entrepreneurs” (SHAH and TRIPSAS, 2007), who unfold commercial activity based on communal knowledge sharing, is a relatively under-researched topic, especially with regard to its spatiality.

4 Communities of practice and paths of innovation

We regard innovation as the establishment of novel solutions in an application environment. While reaching full penetration of a market or another realm of society is not a necessary criterion, a general acceptance throughout society, that the respective solution is in fact a possible, appropriate response to a specified problem, is one. For this reason, innovation transcends individual communities of practice and in most cases also cultures of practice. It involves organizations, institutional regulation, markets and knowledge networks, which connect various contexts of knowing. While not being identical with them, communities relate to all these societal entities or assume positions within them.

Innovation thus has to be appreciated as a process unfolding in time and space simultaneously. While much of the recent innovation literature highlights the open-endedness and the iterative, feedback-driven nature of innovation (‘permanently beta’, NEFF and STARK, 2003), there is still reason to think in linear terms (BALCONI *et al.*, 2010). Innovations unfold along a path, which involves both conscious choices and contingencies. Re-combinations of knowledge are created by serendipitous encounters, which in turn occur in specific, often unique socio-spatial settings. Once certain steps are made, they can never be fully reversed. This applies even if the taken steps are not radical: Small, incremental choices of direction, often unconscious or taken for granted under the orders of worth (STARK, 2009) the actors adhere to, can add up to great differences in the entire trajectory. Innovation biographies as an approach to collect data about the unfolding of innovation processes (BUTZIN and WIDMAYER, 2012; STRAMBACH, 2012; IBERT *et al.*, 2014) put this notion into practice. Communities of practice can intervene with paths of innovation in two distinct yet related forms.

4.1 Sources of innovation

The argument of communities of practice as *sources of innovation* focuses on the situation in which ideas for innovations emerge. Communities matter as they – incidentally or purposefully – create knowledge asymmetries and thereby evoke opportunities for structural change and entrepreneurship. In order to understand an innovation, it is essential to determine where and when it began and how its path was consequently chosen. Getting an innovation on track requires that a novel idea be conceived, explicated and explored. Initially no one outside a narrow circle of knowledge practitioners is capable of receiving, valuing or discussing a new concept. Therefore “knowing communities” (COHENDET *et al.*, 2013, p. 45) are required as the social nexus or platform, in which the active and deliberate work of explication is undertaken. In the absence of monetary value, intrinsic and idealistic motivation drives this action: "Without collective effort to reach a critical mass of common understanding between the various actors committed to the emergence phase of an idea, the innovation process cannot be viable. The group of agents at the origin of an innovation must go to great length to alert other actors or communities to the usefulness and potentials of its discovery" (ibid, p. 45).

It makes a great deal of difference, whether an idea is first formulated in an epistemic, a professional, a creative or an interest community context. The elaborated systematic typology (table 1) of different forms of communities of practices can thus be used to identify theoretically relevant starting points for innovation processes. Innovations starting in epistemic environments have the strongest resemblance to the conventional linear innovation model that starts with scientific discovery and eventually ends with a new technology. All the other forms are more or less under-researched. They involve many more ordinary players in the innovation process, for instance, audiences, users, enthusiasts or experienced practitioners. Innovations that originate from professional or interest communities, for instance, are not developed in a research lab. Rather they are inspired by deficiencies experienced and negotiated during usage. This implies that users and clients are already involved in the process of knowledge generation at very early stages but also that desired solutions might fail when it turns out that they are technically unfeasible. The notion of sources of innovation highlights that the initial conditions provide comparable patterns of challenges and affordances that to an extent pre-configure the whole subsequent innovation process.

4.2 Resources of innovation

Communities of practices can additionally be treated as *resources for innovation*. This notion highlights that all stations in implementing an innovation involve knowledge practices, which are likely to be embedded in some sort of community context. Therefore, communities can be expected to matter all the way.

Across all types of communities, innovation processes can be described in phases. Innovation is initialized, when a novel practice, which goes beyond the usual range of novelty (“freshness”), is established and tested in a community context. Once an innovative idea is formulated and an innovation project is defined, a path needs to be

chosen and new sources of knowledge (especially with regard to pioneering technical and organizational implementations of new ideas) need to be enrolled. The communities, which are already present in the places at or near the origin, exert influence on innovation trajectories.

Once a pioneering innovation project is completed, the following expansion path and its spatial characteristics are strongly influenced by the way the underlying knowledge practices and their communities are embedded in a societal context, most notably in institutions. This embedding has a functional and a territorial component. There may or may not be institutionalized mechanisms of validating a new idea's appropriateness to address a specific problem. Such mechanisms (e.g. clinical trials) involve designated knowledge practices and specialized communities. Furthermore there may or may not be a territorial component to the institutional framing of practices (e.g. the legal practice of lawyers). Depending on these two elements, an innovation is either 'filtered' by specialized knowledge practitioners and communities, thus expanding as it were in pipes, or incrementally negotiated and adopted by more and more members of the original communities (including users), thus expanding like an oil stain. An innovation is completed once a new product is established on a market. Markets are defined in socioeconomic terms (e.g. an age or income group) and have both cultural and territorial connotations. However communities can hold a sovereignty of interpretation regarding the appropriateness of a new product. Likewise consumers can be identical with community members. Depending on this gatekeeping position communities have varying influence on a new product's acceptance and will remain involved in its marketing and incremental change (GRABHER *et al.*, 2008).

In this analytical perspective the proposed typology contains different fields of practices as well as regions of overlapping practices providing particular resources for an innovation process. Successful innovation processes harness these socially and spatially distributed resources and recombine them in a meaningful way. Thereby the process enacts a time-spatial path connecting places and people – spanning distances and taking advantage of proximities – to ultimately organize all the required resources around an evolving idea.

5 Conclusions

In this paper we are concerned with the functions of communities of practice in innovation practices. For such an endeavor the notion of communities of practice is too narrow and too wide at the same time. Too narrow when restricted to the original understanding of mainly craft-based and apprenticeship-like practices of knowing but too wide to encompass all possible expressions under only one term. We thus used a typology inductively generated by AMIN and ROBERTS (2008) and rearranged it according in a conceptually deduced matrix. We thereby introduced different forms of knowing – scientific and socio-cultural knowing – and different dynamics of reflexivity – push vs. pull. The resulting typology embraces epistemic and creative, professional and interest

communities. We showed that in each of these communities particular and different learning practices prevail and different ways of situating practices exist.

As the title of this paper suggests we argue that the role of communities of practice in innovation processes can at least be accounted in two ways: as *sources* and *resources of innovation*. Both views highlight the time-spatial dynamics of innovation processes and both seek to benefit from the proposed typology. In the former case, the typology is conducive for comparative empirical studies of interactive innovation processes in economic geography as it allows a systematic comparison of processes originating from different types of community (sources). In the latter case, innovation is regarded as a recombination of elements that belong to so far unrelated practices. Again the typology provides a helpful framework to identity potential fields of overlapping practices (resources) that provide opportunities to take further steps in the course of innovation processes. Both approaches individually or in combination with each other provide useful starting points for a geography of knowledge creation. Such a geography is not interested anymore in a knowledge-centered theory of spatial clustering but in establishing a time-spatial view on innovation processes.

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