The Neglected King: The Customer in the New Knowledge Ecology of Innovation

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abstract

Despite the universal mantra that "the customer is king," the role of the customer has so far seemed to have been confined to a passive recipient of products. Recently, however, this traditional perception has been challenged. On the one hand, users are increasingly appreciated as reflexive actors who are actively involved in the evaluation, modification, and configuration of products. On the other hand, beyond the established repertoire to access external knowledge through interorganizational networks, firms increasingly attempt to harness user knowledge. These two concurrent shifts do not result in a smooth convergence. Rather, they open up a highly contested terrain in which habitual distinctions between the producer and user are blurred. In this article, we map the evolving terrain of user-producer interaction in innovation processes. Specifically, we contrast more traditional approaches to incorporate customer knowledge with an emerging class of innovative user-producer relationships, provisionally dubbed "co-development." We then propose a typology of different modes of codevelopment that is organized along two dimensions: the degree of user involvement and the prevailing locus of knowledge production. This typology seeks to capture the heterogeneity of co-development approaches and to provide a conceptual template for further empirical research on user involvement in innovation.

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Open Firms, Active Customers: A New Convergence?

"The customer is king," of course. Despite this universal mantra, the role of the customer in economic geography so far seems to have been confined to that of a passive recipient of products at the end of the value chain. Innovation, in particular, has largely been seen as an affair within and between firms; the chief concern has been with the producer side. The customer, the alleged king, has largely been absent from the portrayals of geographic innovation models.

This producer-fixated view on innovation, however, is increasingly in retreat in light of scholarly work that has suggested that there is an interdependence between production and consumption, between technology-push and demand-pull (Schmookler 1966; Lancaster 1966, 1971). By shifting the perspective from the macrolevel of aggregate demand to the microlevel, a growing body of empirical research has subsequently elaborated the role of inventive users in technological innovation (for an overview, see Mowery and Rosenberg 1979; Rosenberg 1982). Innovation has increasingly come to be seen as an iterative process of direct user-producer interaction (Kline and Rosenberg 1986; Lundvall 1988). This line of reasoning, which ascribes the customer an active role in innovation, has gained increasing momentum against the background of profound shifts on both the producer and the customer sides.

On the *producer side,* firms from the 1980s onward began to embark on a broad spectrum of interorganizational arrangements, ranging from joint ventures to strategic alliances to research pacts. The locus of innovation thus expanded from internal resources to external networks with research partners, competitors, suppliers, and research institutions (Powell, Koput, and Smith-Doerr 1996). Most recently, this reorientation toward external knowledge pools culminated in the notion of "open innovation" (Chesbrough 2003).

A further shift involved a profound reconsideration of the nature of knowledge production within and across firms more generally. The traditional emphasis on deliberate knowledge production extended to a concern for the circulation and generation of knowledge as a by-product of shared practice. The focus widened from knowledge production in designated departments to learning in practicing communities. The rich scholar-

ship on "communities of practice" (Lave and Wenger 1991; Brown and Duguid 1991, 2001; Amin and Roberts 2008) epitomizes this shift.

On the *customer side,* consumers have increasingly been appreciated as calculative actors who are actively involved in the qualification of products (Callon, Meadel, and Rabeharisoa 2002; Callon and Muniesa 2005). This reflexivity has more recently been dramatically enhanced by an ever-extending arsenal of techniques to qualify and reconfigure products, from a new genre of customer-driven evaluation media to digital tools for customizing off-the shelf products as diverse as processors and Barbie dolls (von Hippel and Katz 2002; Franke and Piller 2004; Piller and Walcher 2006; Goodstein 2007). Evaluation and customization exert indirect feedback on product innovation through multiple channels, ranging from queries to FAQ (frequently asked questions) sites to customer rankings.

More direct influence is exerted by customers who become actively involved in innovation projects. This proactive role of the customer, conceptualized in the pioneering work of von Hippel (1976, 1978), has seemed to be largely confined to business-to-business environments with traditionally tight-knit and long-standing user-producer interactions in many industries, including medical equipment (Shaw 1985), semiconductor technology (Urban and von Hippel 1988), mechanical engineering (Herstatt and von Hippel 1992; Gruner and Homburg 2000), or pharmaceuticals (DeMonaco, Ali, and von Hippel 2006). Recent empirical work, however, has indicated that user-led innovation expands from business-to-business to business-to-customer relations. Initially, this expansion has affected only small niche markets, such as trendy sports equipment (Lüthje 2004). More recently, however, user-led innovation increasingly has pervaded outright mass markets like coffee machines or cookware (Mühlbacher, Füller, and Jawecki 2007), computer games (Jeppesen 2001; Jeppesen and Molin 2003), or information and communication technologies (Cawson, Haddon, and Miles 1995; Walsh, Cohen, and Richards 2001; Haddon 2002; Kristensson, Gustafsson, and Archer 2004).

The re-apprehension of consumption is shifting along a second dimension, from individual to collective action. The formation of tastes and preferences, the patterns of adoption, and the domestication of products or resistance, of course, are genuine social processes that are deeply enmeshed in a variety of networks (see, e.g., Howells 2003, 3–4; McMeekin, Green, Tomlinson, and Walsh 2002). However, the locus of these social processes—and this is novel—increasingly shifts to open arenas and public domains (Callon, Meadel, and Rabeharisoa 2002, 195). Moreover, beyond ephemeral forms of association, more enduring communities are mobilized for the collective production of knowledge. These communities not only contribute to producer-driven innovation processes, but also turn into producers themselves—the Schumpeterian momentum shifts from the producer to the customer (von Hippel 1978; Franke and Shah 2003; Lettl and Gemünden 2005; Hienerth 2006). The emblematic case in point, of course, is open-source communities like Linux (Kogut and Metiu 2001; Weber 2004; Lakhani and Wolf 2005). Entrepreneurial customer communities, though, are also driving innovation in fields as diverse as teenage fashion (Kawamura 2006), dance (Aoyama 2007), and astronomy equipment (Ferris 2002; Shah 2005).

Taken together, the opposing shifts toward increasingly open innovation architectures of producers, on the one hand, and new modes of customer self-organization, on the other hand, seem to have *converged.* This apparent convergence has already given rise to a polyphony of voices that herald a new era of innovation driven by communities that open access to one of the richest, yet costless, pools of knowledge—the "wisdom of crowds" (Surowiecki 2004). However, rather than the smooth convergence of open producers and active customers, we see a highly contested terrain that is shaped by a range

of approaches and experiments, some of which converge while others compete or clash, and most of which problematize the habitual distinctions between production and consumption. We provisionally dub this emerging class of user-producer relationships "codevelopment."

Codevelopment practices, although of growing interest in related disciplines and of increasing practical relevance, have so far barely attracted the attention of economic geographers. For various reasons, we think they should. Producer-fixated accounts tend to overlook or undervalue spatial arrangements in innovation processes that are created and enacted by innovative users or that sustain intensified user-producer interaction. Moreover, spatial innovation theories that neglect the customer unavoidably ignore an increasingly significant source of entrepreneurial dynamics. Furthermore, since the geographies of demand can radically differ from the spatialities of production, user-producer interaction offers a rich social laboratory for economic geography whose dimension cannot be fully anticipated.

We expect that the exploration of producer-customer relations will yield contributions to at least three debates in economic geography. First, conceptual and empirical work on codevelopment affords a new angle on current debates on permanent colocation versus temporary copresence. Codevelopment is rarely confined to the more familiar dynamics of agglomerated systems of innovation. Rather, we expect codevelopment to enhance our understanding of the forms and functions of personal mobility, temporary personal encounters, and shifting geographies of circulation of experts, knowledge, and artifacts (Maskell, Bathelt, and Malmberg 2006; Saxenian 2006).

Second, the study of codevelopment approaches invites us to appreciate that knowledge production is situated in concrete locations and that knowledge is often inscribed in material artifacts (mobile and immobile), as well as in actual work environments (Livingstone 2003; Amin and Cohendet 2004; Mattsson 2006; Ibert 2007). These practices offer unprecedented perspectives on how tacit knowledge is revealed through the observation of day-to-day practices or improvised workarounds or how knowledge is collaboratively created by producers and customers by tinkering with prototypes.

Third, a deeper empirical engagement with codevelopment practices promises to push forward ongoing debates on the relative importance of immediate face-to-face communication versus virtual communication. The emerging modes of user-producer interaction are pioneering new forms of synchronous and asynchronous virtual copresence that reach beyond those that are familiar from the realm of producer-producer interaction. They hence provide a vivid experimental ground to fathom more deeply the impact of the Internet on geographies of knowledge production and the multiple ways in which the virtual and the physical may blend (Grabher and Maintz 2006; Amin and Roberts 2008).

In this article, we attempt to open up a path toward an economic geographic exploration of the contested terrain of codevelopment. More specifically, we first scrutinize how economic geography has conceptualized the customer and his or her role in innovation processes. Second, we contrast the emerging class of codevelopment practices with more traditional inductive and deductive approaches to incorporate customers' knowledge. Third, we propose a typology of different modes of codevelopment that seeks to capture the heterogeneity of codevelopment approaches and to provide a conceptual template for further empirical research on user involvement in innovation. Finally, we speculate about some wider implications of codevelopment practices for theorizing social and spatial dynamics of knowledge production in economic geography.

The Study: Methodological Issues

This article is based on an initial analysis of data collected during the research project, "Mobile Places, Virtual Networks: The Geographies of User-Induced Innovation Processes." The research process was essentially explorative and shifted iteratively back and forth between conceptualization and empirical fieldwork in three steps.

In the first step, we deduced a preliminary typology of user-induced innovation practices along the analytical dimensions of degree of user involvement and type of knowledge community. A literature review of empirical case studies informed a preliminary typology that identified four of our six ideal typical constellations of producer-driven approaches to codevelopment—the "expressive user," the "consumer community," the "lead user," and the "user community" (see Table 3).

In the second step, we conducted a good-practice inquiry that embraced the analysis of secondary material and of original data from eight telephone interviews with leading experts (with an average duration of 45 minutes) in September and October 2006. These data afforded a provisional consolidation of our typology, the identification of paradigmatic sectors, and the selection of empirical cases for the following in-depth analysis. To select the cases, we applied two criteria. First, we tried to identify cases that corresponded to a high degree with the ideal types developed in our preliminary typology—whereas codevelopment in product design relies primarily on expressive users, codevelopment of body care shows an affinity to consumer communities; the medical equipment industry involves lead users in codevelopment, while the video game industry has pioneered codevelopment with user communities. Second, within these search fields, we further narrowed the focus on "good practice" (measured in terms of experts' and insiders' recommendations). The resulting sample embraces a sufficient diversity to highlight relevant differences among the ideal typical codevelopment approaches. The focus on good practice guarantees a concentration on relatively mature and elaborated practices in an emerging and still volatile knowledge ecology.

In the third step, during February and March 2007, we conducted 41 semistructured, in-depth qualitative interviews (with an average duration of 55 minutes) with selected representatives of 22 companies in the United States and Germany, most of whom are engaged in research and development, marketing, community management, or product design. We complemented this firsthand information with a comprehensive review of secondary material, such as the content of the companies' web sites, white papers published by practitioners, company brochures, and press releases. A thorough analysis of this fieldwork data advised us to realign our typology and to extend the four producer-driven modes of user integration by two unanticipated modes of user-driven practices: the "professional user" and the "interest community" (see Table 3).

The iterative and explorative character of our research prioritizes conceptual openness over methodical consistency and notional rigidity. As a consequence, the six cells of our typology are asymmetrically underpinned with empirical data. Thus, we could not investigate the two unanticipated forms of codevelopment (the professional user and the interest community) with the same rigor as the four anticipated ones. We tried to compensate for this imbalance, however, by considering additional secondary data and empirical case studies.

Black Boxes, Stylized Facts: The Customer in Geographic Innovation Models

How far does the reconfiguration of producer-customer relations resonate with current geographic reasoning on innovation? Our economic geographic theorizing produced a plethora of spatial innovation models; we also made some strides in opening up and embedding the proverbial black box of the firm, but the customer remains a stylized fact. If identifiable at all, the customer appears in one of three roles discussed next (see Table 1).

The "Anonymous"

The anonymous is the most widespread type of customer or, more to the point, the most common *assumption* about customers within economic geography. The anonymous is assigned the passive role of a *stand-in* for more general conjectures on aggregate demand. In other words, the anonymous is the proverbial stylized fact.

The anonymous populates the numerous accounts on (the first wave of) territorial innovation models that routinely start with the categorical premise of increasingly segmented and exceedingly volatile global markets. Industrial districts (Becattini 1978; Saxenian 1994) and innovative milieus (Camagni 1991; Maillat 1991), for example, are surrounded by such an increasingly competitive, if not hostile, environment of unstable demand conditions. To meet the shifting demands of this unpredictable and "aspatial customer" (Malmberg and Power 2005, 283) requires ever-more-flexible forms of production and accelerated cycles of innovation.

Since the anonymous disappears in the amorphous aggregate of the global market, producers and customers are close in neither physical nor relational terms. Rather an agglomeration of producers provides the safe harbor within the tempestuous seas of global markets and affords the social and institutional infrastructure for learning and innovation. The anonymous does not directly contribute to the localized mechanisms of learning; he or she is absent on the "island of innovation" (Amin and Cohendet 2004, 87). Although geographic theorizing has ventured beyond these islands of innovation (to explore nonlocal sources of knowledge) in the past two decades (see, e.g., Camagni 1991; Amin and Thrift 1992; Bunnell and Coe 2001; Bathelt, Malmberg, and Maskell 2004), the customer rarely appears in the viewfinder of this line of reasoning.

The "Smart Neighbor"

The smart neighbor shares much in common with the anonymous customer. Both appear in the background as passive stand-ins for the assumed characteristics of demand. Instead of generic conjectures about global market trends, however, markets are specified here as sophisticated demand. Moreover, in contrast to the aspatial anonymous, the smart neighbor inhabits the island of innovation.

The cluster concept (à la Michael Porter) insists that the presence of sophisticated buyers in the cluster provides producers with a wider and deeper view of the market than is accessible to isolated producers. Colocation with the smart neighbor allows the producers to "plug into customer needs and trends with a speed difficult to match by companies located" outside a cluster (Porter 1998, 83). In a similar vein, contributions to the systems of innovation approach conceive of demand as an important ingredient of (regional) innovation systems (Lundvall 1992; Edquist 2001).

The "Principal"

The principal resembles the individual expert customer. By initiating and sponsoring the venture and providing rich experience and critical insights, the principal plays an active

Table 1

Customers in Geographic Innovation Models

	The "Anonymous"	The "Smart Neighbor"	The "Principal"
Notion of customer	General assumptions	Specific assumptions	Actor
Innovation input	Global demand	Sophisticated demand	Knowledge resource
Examples	Industrial district, Innovative milieu	Cluster, Regional innovation system	Project ecologies, Knowledge-intensive business services
Geography	Relational/Physical distance	Physical proximity/ Relational distance	Relational proximity/ Physical distance

role in the development process as a supplier of essential innovation resources. This kind of customer, for instance, populates project ecologies (Grabher 2002, 2004) and appears as the lead actor in knowledge-intensive business services (Wood 1996; Strambach 2002; Fostenløkken, Løwendahl, and Revang 2003).

In the geography of the relationship between the principal and the producer, relational proximity seems more critical than physical proximity. The accounts on the dense clusters of knowledge-intense service firms in global cities (Sassen 1994) or the thriving project ecologies in cultural industries (Grabher 2002), for example, have presented vivid portraits of the colocation of the specialized producers. The principal, whose assignments induce the shifting patterns of temporary collaboration within these production complexes, is rarely part of this centralized production complex. Nevertheless, physical proximity may facilitate the service producer's attempts to consolidate business relations with the principal (Isaksen 2004). Taken together, the relationship between the producer and the principal is shaped by relational proximity; physical proximity is not imperative, although at least occasional colocation may be helpful in building up and maintaining relational proximity.

Deficits of the Standard Cast of Customers

This brief introduction to the typical roles ascribed to the customer in economic geography points to some principal approaches to differentiate the demand side. It also reveals loopholes in grasping the functions and forms of user-producer interaction in innovation.

First, and most generally, economic geographic reasoning on innovation still reverberates with the productionist bias of economic geography as a whole (critically, Bridge and Smith 2003; Coe and Hess 2006, 19). Instead of explicitly conceived, the role of customers is more often implicitly assumed to be a reflection of market trends more broadly. Mostly, these assumptions hardly go beyond the granularity of the aggregate assumptions that are summarized under the heading Post-Fordism, which generally implies a shift toward more volatile markets and increasingly customized production regimes.

Second, approaches that acknowledge the customer as an actor and provider of feedback are concerned mainly with physical distance in space but neglect the relational dimension. Organizational and social practices through which customers' knowledge is integrated into development processes remain underspecified. The supposed causal link between physical proximity and user feedback, for example, seems to replicate one of the

cardinal assumptions that long directed economic geographers' thinking about the realm of production: colocation quasi-automatically induces interaction and collaboration. Physical proximity, phrased differently, cogenerates relational proximity (for a critique, see Allen 2000; Oinas 2000).

Third, in principle, it seems problematic simply to copy basic assumptions from the realm of production to the realm of consumption. There is no straightforward analogy between the interorganizational relations among producers and producer-customer relations. Producer geographies have been primarily concerned with more stable patterns of colocation, whereas producer-customer interaction is more about temporal copresence. Moreover, producer-producer relations are interorganizational ties, whereas producer-customer relations involve a more complex sociology that blends organizations, communities, and individuals.

Fourth, the various notions of customers in economic geography resonate mainly with the traditional approaches toward customer-producer links. Apart from a few case studies (see, e.g., Currah 2006, 2007), economic geography has tended until recently to neglect the emerging features of codevelopment that we discuss next.

Mobilizing Customer Knowledge: Situating Codevelopment

What, then, is so different and challenging about codevelopment that it deserves our attention? Learning from and with the customer is anything but a new challenge in innovation processes. The more traditional repertoire for involving the knowledge of customers is comprised of deductive as well as inductive approaches (see Table 2).

The Deductive Approach

Market research epitomizes the chief logic of the deductive approach that primarily targets general needs and knowledge *about* the customer. It has developed an extensive register of tools, ranging from large-scale quantitative surveys to more qualitative instruments, such as focus groups, usability tests, and field ethnographies. In economic geography, the anonymous and the smart neighbor embody this deductive approach.

Although market research continues to be perceived as an indispensable input into innovation processes, the increasing volatility of preferences and the segmentation of demand into differentiated niches drastically reveal the limitations of this approach, however sophisticated the tools. The concept of mass customization (Pine 1993; Gilmore and Pine 2000) is an attempt to compensate for the limitations of the deductive approach. While market research may provide critical parameters of general demand, mass customization offers the modular flexibility to specify products *beyond* this granular perception of the market: the Dell strategy. Since the design corridor is predefined, the locus of control rests firmly with the producer. The customized product is not a result of the user's direct involvement in the development process; rather it is assembled from a given variety of modules after development is complete. The customer, in other words, cannot exert "voice" to influence the innovation process directly, but is left with the "exit" option—simply to decline the offer—which provides, at best, indirect feedback to the producer.

The Inductive Approach

Whereas deductive strategies move top-down from the aggregate market to the representative customer, the inductive approach works bottom-up from the individual customer. And rather than harness knowledge *about* the customer, inductive strategies seek to acquire knowledge *of* the individual customer to draw wider conclusions on actual and potential markets. The quintessential organizational form of inductive user-producer interaction

Table 2

Mobilizing Customer Knowledge: Situating Codevelopment

	Deductive Approach	Codevelopment	Inductive Approach
Target group	Representative customer ("Market research")	Hybrid community	Individual customer ("Project")
Type of knowledge	Knowledge about the customer	Knowledge of the community	Knowledge of the customer
Locus of control	Producer	Producer and customer	Customer
Mode of governance	Exit	Exit, voice, and loyalty	Voice
Mode of interaction	Absence	Virtual copresence	Physical copresence
Learning trajectory	Customization	Iteration	Modularization

is the project that is built around the distinctive and rare needs of individual customers. Obviously, projects cannot be realized without the cooperation of the relevant customer. Projects, in fact, rather than *for* customers are performed *with* customers (Girard and Stark 2002, 1939). Like the principal in economic geography, the customer embodies essential knowledge that is needed for a successful project to be completed. Sometimes it is even necessary to locate the project within the customer's organization, since critical "sticky information" (von Hippel 1994) is inscribed in the customer's organizational routines or is sedimented in the technical infrastructure of the customer's "legacy systems" (Grabher 2004, 1499). As the project sponsor, the customer specifies the task to be achieved and contributes critical knowledge throughout the entire development process. The locus of control, in other words, rests primarily with the customer; his or her voice shapes the course of the project. In principle, the customer also has the power to cancel the whole endeavor; in fact, however, the exit option is generally not feasible because it entails high sunk costs.

Although projects are built around the specific needs of an individual customer, the knowledge that is generated in the course of the project may be useful beyond its clearly specified temporal and technical boundaries. Projects, in other words, are not isolated learning episodes; rather, the one-off mission can feed into a cumulative process of learning from a series of related ventures (Davies and Brady 2000; Brady and Davies 2004). Most important, knowledge created in a particular project can be captured in generic modules that can be reused in successive projects (Grabher 2004; Ibert 2004). Modularization that is derived from inductive learning approaches, then, opens up access to larger segments of the market by tailoring "customer-unique solutions from non-unique parts" (Hellström 2003).

Codevelopment

Deductive and inductive strategies do not exhaust the entire spectrum of approaches to activate customer knowledge; rather, they signify the poles of a continuum that is increasingly broadened by a class of new approaches. We seek to encapsulate the distinctive features of these approaches with the preliminary notion of codevelopment.

While producer-customer interaction is set up as a 1:*n*-environment in deductive approaches and as a 1:1 relation in inductive approaches, codevelopment is built around

"hybrid communities" (Kunz and Mangold 2004). The composition of these communities is heterogeneous and not restricted to the exclusive circle of researchers and professional product developers. Instead, these communities are also comprised of sophisticated customers with intimate knowledge of the product architecture and customers who are familiar with the product from everyday use but are not interested in the specifics of its architecture. Through their heterogeneous composition, hybrid communities do not dissolve the boundaries between expert and layperson; however, the boundaries become more porous (Neff and Stark 2003). Indeed, in the course of ongoing interaction and knowledge exchange, the expert status may shift among the professional developer, the sophisticated customer, and the heavy user.

Hybrid communities tap into sources of knowledge and catalyze the production of new knowledge in two ways. First, in the vertical relation between users and producers, they combine the iterative and intensive interaction of inductive strategies with the broader representation of the market of deductive strategies; they are deeply involved *and* widely focused at the same time. Second, and more critically, the circulation of ideas and knowledge is not restricted to the vertical dimension between customers and producers but also unfolds laterally between customers. The lateral exchange of individual users' experience, recommendations, and warnings, the revelation of individual workarounds and product modifications, makes explicit users' tacit knowledge and it "unsticks" von Hippel's (1994) "sticky information," at least partially.

Hybrid communities thus exert a powerful voice. At the same time, exit is a real option, since the termination of the relationship would incur only low sunk costs. Beyond this exit or voice calculus, however, hybrid communities are essentially governed by loyalty (Wiertz and de Ruyter 2007). Loyalty is what makes the community a community. It affords the social context for the circulation of rich knowledge that ranges from fairly personal experience to elaborate design proposals. Loyalty pushes the dynamics of interaction from the singular intervention to ongoing conversation (see, e.g., Beagle Research Group 2006).

The dynamics of knowledge circulation and lateral exchange in communities render an unambiguous location of control difficult. The locus of control indeed seems to shift back and forth between the customer and the producer in the course of a development cycle. Although control may eventually gravitate more strongly toward the producer or the customer, codevelopment essentially implies a redistribution of power, although an unstable and contested one. Codevelopment, in other words, affords neither the universal empowerment of users nor the generalized democratization of innovation (von Hippel 2005). Communities may be instrumentalized in a straightforward fashion or may develop "a life of their own" (Wiertz and de Ruyter 2007, 370) that evades the control of the producer or even turns against him or her (Thrift 2006, 290).

While direct physical copresence is the prime constellation of inductive approaches and deductive strategies are limited to indirect interaction, codevelopment pioneers novel modes of virtual copresence, both synchronous and asynchronous. The Internet, however, does not induce codevelopment in a deterministic fashion; instead, the social practices of codevelopment and the technical affordances of Internet tools coevolve (Haythornthwaite 2005; Wellman 2001). The Internet pushes the development process beyond the familiar organizational domains and transforms innovation into an activity that is spread across multiple locations and that mobilizes ever-more-heterogeneous sources of knowledge in real time. Yet, the Internet does not only afford a passive link *between* globally dispersed sites. Rather, it *is* a site of collaborative knowledge production (Boczkowski 2004).

The key features of codevelopment—hybrid communities, the redistribution of power between the customer and producer, and virtuality—are largely absent from economic

geographic accounts on innovation. Rather than a single pristine category, these features denote a wide corridor within which producer-customer interactions are reshaped. In the next section, we offer pathways to explore this corridor in economic geography.

Toward a New Knowledge Ecology of Innovation: Mapping Codevelopment

To capture the width and breadth of this phenomenon, we propose a typology that unfolds along two dimensions (see Table 3). The horizontal dimension denotes the *degree of involvement* and stretches from consultation to participation to generation (see also Dahan and Hauser 2002, 350; Rowley 2002, 501). *Consultation* designates a type of limited and producer-driven interaction in which the customer primarily collaborates in the role of a layperson. *Participation* entails a deeper, although still primarily producer-driven, form of involvement in which the customer holds the status of an expert. *Generation* similarly involves expert knowledge that is accumulated by using and modifying the product. Generation, however, denotes a shift from producer- to user-driven development.

In the vertical dimension, the proposed typology draws a distinction according to the prevailing *locus of knowledge production.* The first type corresponds with a process of deliberate and goal-oriented knowledge production. Knowledge is produced in the vertical producer-customer relation that is strictly focused on the specific "epistemic object" (Knorr Cetina 2001, 181–84) and is governed by an accepted procedural authority. The second type refers to a practice in which knowledge is produced as a byproduct of socializing and situated learning. In this instance, knowledge is not only produced in the orchestrated vertical producer-customer relation but also crucially unfolds in the horizontal exchange and evolving socializing among customers. The vertical dimension, put briefly, distinguishes between the epistemic community (Knorr Cetina 1999; Cowan, David, and Foray 2000) and the practicing community (Neff and Stark 2003).

By moving along these two axes, we differentiate six types of codevelopment that embody unique constellations of types of *knowledge, geographies* of interaction, and structures of *motivation.* Despite the essential differences among these six modes of co-

Table 3

The Emerging Knowledge Ecology of Codevelopment

	Producer Driven		User Driven
	Consultation	Participation	Generation
Epistemic community	Expressive user *Product design*	Lead user *Medical equipment*	Professional user *Open source*
	Usage knowledge Physical copresence Extrinsic motivation	Design knowledge Physical copresence Extrinsic motivation	Procedural knowledge Virtual copresence Intrinsic/social/extrinsic motivations
Practicing community	Consumer community *Body care*	User community *PC games*	Interest community *Remix culture web 2.0*
	Usage knowledge Virtual copresence Social motivation	Design knowledge Blended copresence Intrinsic/social motivations	Procedural knowledge Blended copresence Intrinsic/social motivations

development, they do not signify "arithmomorphic concepts" (Georgescu-Roegen 1971) demarcated by strict boundaries. In fact, they typically overlap to some degree, and their boundaries are fuzzy and permeable. Communities are prone to social dynamics that may eventually transform one type of codevelopment into a different type. The very notion of the knowledge *ecology* is intended to appreciate this generative dimension within our typology. In this sense, our codevelopment typology should not be read as a rigid grid of hermetically sealed categories. Rather, it is a continuum along which we identify ideal-typical constellations that may move in the course of their life in one direction or the other.

Consultation (see Table 3) designates a type of limited and producer-driven interaction in which the customer primarily collaborates in the role of a layperson.

The Expressive User

An example of this type of producer-user integration is the consultation of bike messengers and hard-nosed car users in a project on the design of bicycles (interview, IDEO, Chicago, 1 March 2007).

Knowledge. Expressive users do not contribute expert knowledge (such as deep insights into the geometric parameters of muscle power transmission). Rather, they are valued for their capacity to explicate eloquently the experiences they have gained in everyday practice and to convey motivations of adoption or consistent nonadoption. The interaction between the producer and expressive user is orchestrated by the producer and focuses strictly on the object; social dynamics among users are negligible and inconsequential for the knowledge dynamics.

Geography. The rich experience of the expressive user cannot be reached through the traditional repertoire of deductive approaches, such as the standard questionnaire of market research. Rather, it is often "embodied" (Blackler 1995, 1024) knowledge that eludes the user's full awareness. The collaborative production of knowledge unfolds largely through selecting and testing prototypes in a real-life context, so the user can be observed instantaneously while interacting with the product (Suchman 1987). For a meaningful interpretation of the observed behavior, however, additional interview data may provide helpful background information on the user's irritations or emotions during the test situation (interview, frog design, Palo Alto, 2 March 2007).

The involvement of expressive users may thus push stages of the development process outside corporate boundaries, but not far from the producer's site for pragmatic reasons. Since the knowledge of the expressive user is rich but not specialized, cost considerations are a key determinant of the geographic pattern of this type of producer-user interaction. Through this pattern of physical colocation around the producer, the expressive user indeed may resemble the smart neighbor.

Motivation. Expressive users seem primarily motivated to share their experience by the (vague) expectation that they will make a useful contribution to a solution, which may eventually meet their needs in a more appropriate fashion (like a bicycle that is foldable yet robust). The prevailing incentive, in other words, is extrinsic.

The Consumer Community

Illustrative cases in point are communities like the Consumer Channel of Kraft Foods or the Huggies-Baby-Network of Kimberly-Clark (interview, Kimberly Clark Corporation, Neenah, 28 February 2007).

Knowledge. Like expressive users, members of this community are assumed to contribute not expert knowledge, such as on the chemical compounds of a deodorant, but knowledge accumulated in everyday use. The categorical difference between these two types of involvement is denoted by the locus of knowledge circulation and production. In contrast to the "intimacy averse" (Mateos-Garcia and Steinmueller 2006, 5) product-focused dialogue between the producer and the expressive user, in this community, the exchange of knowledge is, to a significant extent, a by-product of ongoing conversation within a community that provides sociability, information, support, and a sense of belonging, however ephemeral (Wellman, Boase, and Chen 2002, 153; Ren, Kraut, and Kiesler 2007; Wiertz and de Ruyter 2007).

Consumer communities are particularly appreciated for the conversations that unfold around mutual advice in solving everyday problems but may also crystallize around shared hobbies or current events that are not related to the focal product or brand. These conversations are not derided as detracting noise, but are valued as catalysts that foreground coping strategies in everyday life and as filters and gauges of unmet needs and wider concerns. Knowledge revealed in lateral exchange is regarded as more authentic, reliable, and richer than information solicited through the traditional repertoire of deductive approaches, such as the standard questionnaire.

Geography. Consumer communities are dispersed online communities, and interaction occurs almost exclusively in virtual copresence. If face-to-face events are arranged at all, they are staged as a forum for public gratification. They are regarded as instrumental neither for creating the social dynamics of community formation nor for accessing concealed layers of knowledge.

To the contrary, more surprising insights may surface because the community members remain within their diverse local contexts while interacting. In cases of dissent and misunderstanding, for instance, the members have to enrich their contributions with additional contextual information to clarify their statements for the physically absent interaction partners. These parts of lateral conversation may be useful for producers because they unveil the multitude of locally situated strategies that users apply to integrate a commodity into their daily lives.

Motivation. Although producers tend to offer some form of compensation for involvement in consumer communities, material reward is symbolic at best. A much more potent motivation to enroll in a community that can take up to 10 hours a week is the aspiration of "being heard" and being taken seriously as a customer (Lerman and Austin 2006, 4). As communities consolidate, involvement is sustained by the lateral dynamics of socializing and mutual support.

By moving from consultation to *participation* (see Table 3), we shift to a more profound and enduring form of involvement in which the customer is incorporated as an expert.

The Lead User

Pioneering physicians who contribute to the specification of functions and the interface design of tomography scanners, for example, epitomize the principal features of lead users (interview, General Electric Healthcare, Waukesha, 28 February 2007). They are integrated into the development project because they are at the frontend of the adoption curve and ahead of the market (von Hippel 1986, 795).

Knowledge. The lead user embodies close-to-expert knowledge about the architecture and modus operandi of the product, like the technical sequences of diagnostics

performed by the scanner. This design knowledge defies any straightforward transfer from user to producer. Rather, it is coproduced through joint reflection in the context of application, such as the diagnostic department of a hospital, for example. Relevant knowledge is "sticky" and place bound, since it is also inscribed in the physical layout of workflows. Observation and socializing in practice, however short-lived, is imperative because users are generally no longer aware of the problems they have already "solved" through their own idiosyncratic workarounds (Obradovich and Woods 1996).

The circulation and generation of knowledge are focused on the product and do not evolve in lateral conversations in communities. Instead, the particular setting of producer-user interaction may even preclude community building since peer dynamics (like status competition among physicians) may distract the development process from more general market needs (interview, DraegerMedical, Koblenz, 15 February 2007).

Geography. Although frequent face-to-face communication is one of the most noticeable characteristics of lead user-producer interaction, the prerequisites to initiate physical copresence quickly are not the main driver of the respective geography of knowledge creation. Rather, the situated nature of the lead user's knowledge and the information that virtually "sticks" (von Hippel 1994) at the place of application induce time-spatial practices that alternate between basic research in the producer's laboratory and phases of collaborative knowledge production "in the wild." Hence, in spatial terms, the integration of lead users unfolds a dispersed and temporary geography that follows the pattern of user locations right to the diagnostic centers and hospitals in the case of medical equipment. Since physical copresence at the site of usage is indispensable, lead users are most likely not the smart neighbors located within the production cluster.

Motivation. The motivation to share critical and apparently useful knowledge with producers particularly in a high-pressured real-life context is obviously driven by powerful incentives. As advanced and challenging customers, lead users become keenly aware of the limitations of a product's design at an early stage. Dissatisfaction, however, does not translate into committed involvement in codevelopment unless the lead users can expect tangible economic benefits from a solution that meets their needs. Lead users must be in a position to capitalize on their engagement; they are, in other words, extrinsically motivated to conjoin in producer-driven innovation (von Hippel 1986; Olson and Bakke 2001).

The User Community

The Command & Conquer III computer-game community (interviews, Electronic Arts, Cologne, 6 February 2007, and Los Angeles, 9 March 2007), the Sims Community (interview, Electronic Arts, San Francisco, 2 March 2007), or the Adult Fans of Lego (Tapscott and Williams 2006, 130–31) epitomize the principal features of a user community.

Knowledge. Similar to lead users, members of a user community contribute an intricate design knowledge to producer-driven innovation that they have acquired through intense use and ongoing tinkering. The accumulation of this close-to-expert knowledge, however, does not resemble the goal-oriented and systematic codevelopment with the lead user; rather, it is an unfocused socialized process that evolves within the community. Like the consumer community, user communities combine the vertical dimension of dialogue with the producer and the lateral dynamics of conversation among users.

User communities typically evolve into enduring and socially differentiated formations with status hierarchies, community norms, and conventions. At the periphery of the commu-

nity, the vast majority of members lurk in the background and silently observe. Closer to the core of the community, a smaller group of temporary active members provide "focal feedback" (Jeppesen 2001, 17) by testing variants, revealing "bugs," mutually solving problems, or simply spreading more or less relevant information to a responsive audience (Stegbauer 2004, 28). The input of the small core of the community also involves suggestions for solutions and "home-brewed" (Jeppesen 2001, 17) innovations. Producers like Lego explicitly encourage inventive tinkering in their copyright management by publicly granting a "right to hack" (Tapscott and Williams 2006, 130). As they reach the top of the status hierarchy, members of the core group not only enjoy the highest esteem and professional authority of the community members, but also become formally acknowledged as community leaders or "helpful authorities" (Jeppesen 2001, 22) by the producer.

Geography. The geography of collaborative knowledge production in user communities blends virtual exchange with transient physical encounters. Although computer gamers, not surprisingly, rely excessively on virtual means, interaction is not restricted to the virtual realm. Rather, the community occasionally gathers at particular events, like game conventions or LAN parties, in the case of computer gamers, or the Lego World exhibits, in the case of the Adult Fans of Lego. These events temporarily enact conditions for the material encounter with knowledge in action and constitute both sites of knowledge performance (Thrift 2000) and sites of knowledge display (Livingstone 2003). First, being there offers opportunities to experience corporeally not only the "look'n feel" of different products, but also to engage physically with their actual performance and to compare functionalities and features directly during collective and challenging application (at a gamers' LAN party, for example). During an event, participants experience the resonance of the community to modified features and new versions of products, and vaguely perceived user preferences become manifest through critique or encouragement. Second, as a showcase, the event represents the achievements of a community. The choice of items that are deemed worthy of display and their proper placement, in a sense, map the involved knowledge domains and hint at relational structures within and between them (Livingstone 2002, 22). Community gatherings, however, are also conducive to strengthening the social cohesion of the spatially dispersed community (Franke and Shah 2003, 160–61); conventions are about not only shoptalk but also partying.

Motivation. Events also reveal the incentive structure of users to share their knowledge freely with other members and the producer. On the one hand, members of user communities are strongly driven by intrinsic motivations; they are obviously passionate about gaming and seek competitive challenges. On the other hand, they also thrive on a bundle of social motivations, the competition for reputation and recognition from both their peers and the producer chief among them. Producers seek to fuel this motivation through a repertoire of symbolic practices that range, in the gaming business, from providing early access to prototypes to invitations to prestigious conventions and meetings with star developers. Direct financial incentives are rare; experience suggests that financial incentives and the quality of feedback seem inversely related. Moreover, financial incentives are at odds with the collaborative ethos of communities and undermine credibility, which is built on passion, not on profit.

By moving from consultation and participation to *generation* (see Table 3), the direction of the dynamics of development fundamentally shifts. Consultation and participation encompass different degrees of integrating customers; however, the producer is still the key driver of the development process. The user is involved in the process of knowledge production, but the process is initiated and largely formatted and controlled by the

producer. By completely turning around the perspective on innovation, we now follow development trajectories that start from the opposite direction: users initiate and largely (or entirely) control the development process. The Schumpeterian momentum of creating a new combination shifts more permanently to the user side; we move from innovation *with* users to innovation *by* users.

The Professional User

The emblematic cases of generation by professional users are open-source projects. Open source, pioneered in the software field with Mozilla (a browser), with Apache (server software), and, most prominently, of course, with Linux (an operating system), is founded on two chief principles: public ownership of the intellectual property and a production model of generating knowledge in a dispersed context (see, e.g., Lakhani and von Hippel 2003). More recently, initiatives that seek to exploit the principles of open source have emerged beyond software, in the development of drugs, for example. Open-source projects have been launched particularly in the development of treatments for diseases that affect a comparatively small number of people (such as those with Parkinson's disease) or that mainly affect poor countries (with diseases such as malaria or typhoid) (Tapscott and Williams 2006, 169–72).

Knowledge. These diverse projects share a strict focus on the "epistemic object" (Knorr Cetina 2001, 181–84) and a deliberate organization toward generating knowledge about the joint project, whether it is an operating system or a vaccine against typhoid. In the case of Linux, a committee, in charge of evaluating inputs from dispersed users, represents a procedural authority to guide the process of knowledge generation (Edwards 2001). Lateral conversation and sociability are not typically part of the repertoire of these communities, which frequently are explicitly precluded from the circulation of knowledge. The code of conduct emphasizes strict "on-topic" (Ren, Kraut, and Kiesler 2007) professionalism. Users not only contribute design knowledge, but also, as this case amply illustrates, generate knowledge of how to produce the solution collectively.

Geography. As exemplified by open-source projects, professional communities typically, but not exclusively, are virtual communities. Software projects like Linux indicate that even complex tasks can be achieved over longer periods in Internet-only global communities. Physical interaction may occur, but it does not seem imperative. On the one hand, face-to-face interaction hardly appears necessary for reasons related to the exchange of knowledge, at least for projects in which tasks can be parsed and modularized and the product is digital or can be transformed into a digital form (Mateos-Garcia and Steinmueller 2006). On the other hand, face-to-face encounters do not seem indispensable for strengthening the social coherence or reinforcing the relational ties within the community (Amin and Roberts 2008). Rather, identification with the goal of the project and procedural authority that guides the production of knowledge affords the resilience of these communities and their tolerance of member turnover (Ren, Kraut, and Kiesler 2007, 400).

However, virtual interaction does not necessarily lead to arbitrary geographies. Rather, the spatial patterns are shaped by the unevenly distributed material and locally situated preconditions for knowledge production. Virtually transmitted data can be turned into productive use only if they will be put into practice in an adequate work setting. Reanimating a sequence of open-source code requires little more than an up-to-date computer system with a fitting development environment (besides reliable Internet access, of course). Testing a modified formula of a vaccine, in contrast, can be achieved only in specific places that provide, for instance, a well-equipped laboratory. Virtual interaction

within professional user communities, in other words, substitutes virtual communication *across similar places* for face-to-face interaction *at the same location.*

Motivation. The dynamics of knowledge circulation are driven by a mixture of motivations (Lerner and Tirole 2000). The intellectual challenge and the learning effects that are expected from being involved in solving complex tasks provide basic intrinsic motivations. Although the development of solutions is mostly an individualized task, and the community is socially "light," such considerations as the perception of reciprocity, solidarity, and fairness are powerful stimuli for contributing to the joint project. Nevertheless, the incentive structure of professional communities cannot be fully captured in terms of a "gift economy" (Kollock 1999; Currah 2007). Professional communities also offer potent extrinsic incentives, either directly by providing quick solutions to immediate problems or by affording signaling functions to potential employers, project partners (Grabher and Ibert 2006), or venture capitalists. Professional communities, then, allow the transformation of reputation capital into business capital.

The Interest Community

Interest communities had already evolved in the pre-Internet area around sports like mountain biking (Lüthje, Herstatt, and von Hippel 2005), kayaking (Hienerth 2006), or windsurfing (Shah 2000). However, they have spectacularly taken off with the Internet in the vast and rapidly expanding universe dubbed Web 2.0. Formerly primarily the terrain of experts and professionals, Web 2.0 enables globally dispersed hobbyists and amateur creators to generate contents in "remix genres" (Lawrence Lessig) like music- or video production or in pioneering new forms of journalism in the blogosphere. Empowered by a new generation of digital tools, users in this expanding universe increasingly differentiate into niche communities that are organized around shared interests like specific music genres, presidential campaigns, cultural events, or coordinating rescue activities in the aftermath of hurricane Katrina.

Knowledge. The evolution of these genres is not the result of a goal-oriented and systematic endeavor of a collective project to invent. Typically, these genres metamorphosed out of combinations of everyday problem solving, competitive performance, piecemeal improvements, and serendipitous encounters. Accidental discoveries resulted from using products and technologies in ways for which they were originally not conceived: combining a laptop computer and the Internet for sampling music; using multimedia mobile phones in journalism; before the Internet era, using record turntables for "scratching"; riding bikes off-road through treacherous terrain, and so on.

There is nothing particularly heroic or technologically spectacular about these reconfigurations. They elucidate, however, how lifting products and technologies out of their prescribed context, reconfiguring them, and placing them in a new context opens up a development trajectory that may even engender a new genre that subsequently continues to be driven by users (see also Oudshoorn and Pinch 2003; Pinch 2003). The idea of "rip, mix, burn" (Currah 2006, 444) has made the decontextualization, recombination, and recontectualization of media contents its key production principle. Knowledge created here, as in the case of the professional user, extends beyond design knowledge and encompasses knowledge about how to produce it. In the infant stages of mountain biking, production was also performed by the bikers, who began to build bikes commercially for others and thus laid the foundation of a small cottage industry (Lüthje, Herstatt, and von Hippel 2005, 954).

Geography. The more traditional interest communities combine physical encounter and virtual copresence in various combinations. In the case of sports, in which competition and performance are at the essence of the activity, temporary physical copresence at events is indispensable. Particularly, competitions afford the key sites for display, comparison, and collective tinkering. In the case of fashion, innovations by interest communities are urban phenomena (Kawamura 2006)—the dense colocation of various overlapping subcultures is conducive to cross-cultural recontextualization (Jacobs 1969). The vast domain of the "remix cultures" (Tapscott and Williams 2006, 137) or blogosphere, however, typically are predominantly virtual communities. Physical copresence appears imperative neither for inducing social coherence nor for knowledge circulation. The physical, though, is not entirely absent. Physical colocation can provide the chief criterion for branching off into local subcommunities; moreover, a physical environment can, as in the case of Second Life, provide the template for organizing social interaction online.

Motivation. Interest communities grow out of the shared passion of individual members who push the given design space by exploring new genres of self-expression, raising the bar in competitive performance, or trying to overcome the lack of necessary gear or technical solution with the simple means at hand (Hienerth 2006, 288), as in the case of YouTube, which evolved from an improvised solution by some software amateurs to share videos of a college party with some friends. In the course of their life cycle, interest communities are increasingly sustained by social incentives like competitive aspirations, peer recognition, and a sense of belonging (Boyd 2004). This identification with a community is frequently nurtured by the ambition to challenge established monopolies of experts in fields like journalism or preserving societal knowledge as in the case of Wikipedia.

A New Master Paradigm of Innovation? Evolution and Conflict in Codevelopment

These different modes of codevelopment, then, seem to hold a double promise. For the customers, new digital tools afford unprecedented opportunities of collective creativity and self-expression; for the producers, the allure of codevelopment lies in its capacity to tap into an obviously inexhaustible pool of knowledge. While the potentials of this blend of social dynamics and new technical affordances appear remarkable, the mobilization of these potentials is anything but trivial. There may be "wisdom in crowds" (Surowiecki 2004), but harnessing that wisdom poses formidable challenges. There is no straightforward solution to the paradigmatic problem that "not all the smart people work for you" (Chesbrough 2003, xxiv).

In particular, the practicing communities (see Table 3), rather than static and sterile, are fuzzy and unruly social formations. They are driven by a delicate amalgamation of intrinsic, social, and extrinsic motivations that may easily turn into a disruptive mixture. In the course of codevelopment, communities learn and forget, get bored or turn angry, consolidate or drift apart. Communities, in short, evolve. Especially in codevelopment that involves longer time horizons, communities may even migrate across the boundaries of our typology. Although we have not studied the trajectories of these metamorphoses in a systematic fashion, our empirical insights into the sociology of the communities suggest that some of these transformative paths are significantly more likely than are others.

Social Closure

Particularly in practicing communities that are more tightly controlled by producers, the uneasy combination of lateral social dynamics and corporate imperatives unavoidably runs into paradoxes. On the one hand, the producer is interested in communities evolving into self-sustained active social formations, since critical knowledge is generated, to a considerable extent, in lateral conversation that is not solicited by the producer. On the other hand, self-organization, by its very definition, implies that communities unfold a "life of their own" (Wiertz and de Ruyter 2007, 370). Users' passions, once unfolded, cannot simply be switched off. Loyalties may turn from the sponsoring producer to the community, which, when it feels that it has been treated unfairly, may even turn against the producer (Thrift 2006, 301). Communities can quickly reach that mysterious tipping point that transforms a passionate community of devotees into an agile movement that mobilizes mass complaints and public protests. A complete decoupling of the community from the sponsoring producer and migration toward a more self-organized interest community does not appear to be a feasible option. Our case study evidence (interview, Communispace, Boston, 23 February 2007) suggests that termination of the link between the producer and the community (for whatever reasons) sooner or later leads to a disintegration of the community.

Erosion

Especially in settings that involve intricate usage or procedural knowledge, interactive learning processes engender social formations with differentiated status hierarchies. Core members at the top of the status hierarchy of the community, as evidence from the field of computer games indicates (interview, Electronic Arts, Los Angeles, 9 March 2007), are usually drawn toward the corporate hierarchy of the producer. Typically, they are formally acknowledged as community leaders by the producer and thus instituted as formal gatekeepers (Jeppesen 2001, 17). This Janus-faced identity of a respected leader of a community built on a hacker ethos and a loyal associate of one of the corporate behemoths, however, puts the credibility of the core members at risk (interview, Electronic Arts, Cologne, 6 February 2007). By turning community leaders into corporate gatekeepers, producers may gain control over the community in the short run, but may undermine the social cohesion of the community in the long term.

Professionalization

User-driven generation in self-organized interest communities in particular is an inherently unstable phenomenon. The more an interest community codifies and memorizes procedural knowledge in repositories (ranging from help sites to podcasts of sports events), the more it drifts toward a professional community: the story of Linux, which started as an informal interest community of passionate hackers and evolved into a professional community governed by a procedural authority (Amin and Cohendet 2004, 83–84), is an example. The trajectory of interest communities, however, may extend beyond professional communities when the procedural knowledge and reputation capital that the communities have accumulated is transformed into business capital. This switch from professional user to professional producer is particularly likely when extrinsic incentives supersede intrinsic and social motivations that provide cohesion in the nascent phase. Free software norms like "copyleft" (www.gnu.org/copyleft), which explicitly set strict limits to the commercialization in cases that would harm other users' fundamental freedoms to use, share, distribute, and modify the respective sections of code, indirectly attest to the feasibility of such a switch from the user to the producer side.

Absorption

In the move from collective exploration to commercial exploitation, the initiative may rapidly switch from the community to the producer side. By gradually transforming amateur practices into a widely practiced new genre (like DJing), interest communities also reveal a path toward profitable marketization, although usually not by intention. In the course of this metamorphosis of tinkering and improvisation into a business opportunity, the interest community is transformed into a user community or even more radically dissolved into a collective of consumers, as in the case of YouTube or, in the pre-Internet era, of mountain biking. Commercial absorption may also be a response of established producers whose predominance interest communities deliberately intended to challenge. The aggressive attempts of the "majors" to retain control over the marketization of popular music (Leyshon et al. 2005), the efforts of Hollywood studios to create a "closed sphere of innovation" (Currah 2007), or the conflicts between the so-called mainstream mass media and the blogosphere over the journalism domain are prominent indications that shifting boundaries between expert and layperson, between professional and amateur production, is not necessarily a smooth transition but charged with conflict.

This discussion of the generative moment of codevelopment is not exhaustive; rather, it is indicative of the most likely evolutionary trajectories. More generally, the discussion seeks to substantiate that codevelopment, rather than a standard toolbox of readily applicable managerial techniques, designates a highly contested terrain, a social construction site of sorts, but one that deserves attention in economic geography for various reasons.

So What?—Conclusions for Economic Geography

Codevelopment, most generally, problematizes some of the key notions of the economic that economic geographers implicitly assume, for good reasons, as given. First, codevelopment practices transform the product from a fixed and frozen thing into a "variable" (Callon, Meadel, and Rabeharisoa 2002, 197), into a state within an iterative, never-ending process of experiment, negotiation, modification, and so on. The product, in other words, is never finished; it remains "permanently beta" (Neff and Stark 2003). As a variable, the product consists of a sequence of transformations (*producere:* to bring forward) that relentlessly reconfigure the intermingling networks of actors, practices, and things that are involved in production and consumption. With their identities less certain and their properties more mutable, products are not passively pushed down a linear commodity chain but, rather, turn into active constituents of social relations (Bridge and Smith 2003, 258). Relieved of their traditional passive role of yet another prop in our arsenal of stylized facts, products afford a view of the shifting networks that make up production and consumption (see, e.g., Harvey, Quilley, and Beynon 2002).

Second, codevelopment also questions the notion of markets as simple means of selling products that are composed at the terminus of the value chain. The market becomes a forum for an ongoing dialogue between producers and consumer communities (Thrift 2006, 287), a dialogue that is deeper than in the classical deductive and broader than in the traditional inductive approaches. The market is no longer *outside* the value chain, acting as the locus of interchange between the producer and the consumer. Greater interactivity means that the market, in a sense, "pervades the entire system" (Prahalad and Ramaswamy 2004, 125). Not far from the invisible hand that is ritually criticized as an unrealistic assumption of mainstream economics, markets are frequently absent from economic geographic analyses. Codevelopment shifts this absent assumption to the center stage of the analysis. The notion of markets is brought down from the totalizing force

"out there" to the level of actual practices of negotiation between producers and consumers (Callon and Muniesa 2005).

Third, a basic tenet of traditional theorizing is the categorization of producers and consumers into separate, distinct, and predetermined roles. Particularly in the emerging codevelopment practices of professional and interest communities, the strict separation between these roles and their ascription to distinct groups of actors becomes more porous, contested, and shifting (Prahalad and Ramaswamy 2004, 135; Wiertz and de Ruyter 2007, 370). The challenges posed by codevelopment, then, go beyond a more intense engagement with consumption. Of chief concern here are the shifting interrelations between production and consumption that, perhaps with the exception of ethical consumption (see, e.g., Barnett, Cloke, Clarke, and Malpass 2004; Hughes 2006), have rarely been conceptualized in explicit terms. Recently, this deficit has been questioned and has been placed prominently on the research agenda of the global production networks approach (Coe and Hess 2006, 19–21).

More specifically, codevelopment provides some linchpins to push theorizing on the geography of knowledge production further in several aspects. First, collaborative knowledge production through producer-customer interaction does not fit well into the registers of the more enduring geographies of knowledge creation among producers. Rather it leaves an ephemeral spatial imprint around temporary physical encounters: at the trade fair, the LAN party, or the sports contest. Temporary copresence is, by no means, confined to these obvious and outstanding occasions, however. On the contrary, encounters at mundane sites of everyday practice, such as the home kitchen or the bike trail, are less spectacular, but not less important. Collaborative knowledge production at temporary encounters is sustained through the physical mobility of experts, users, and prototypes. Codevelopment practices, in other words, are sustained by shifting physical geographies of circulation (Urry 2003), a theme that has been picked up in debates on temporary clusters (Maskell, Bathelt, and Malmberg 2006), for example.

Second, this ephemeral geography reiterates the importance of the specific physical site of encounter and interaction. User knowledge is inscribed in the physical layout of the workplace, in the temporal sequencing of everyday routines, and in improvised workarounds. Codevelopment, in other words, is not only about talking to customers, but also about interaction at the unique constellation of things and objects that make up the site of usage. It thus shifts the locus of knowledge production from the R&D department to the site of usage or, more generally, pushes knowledge production from the context of discovery to the "context of application" (Gibbons et al. 1994), at least temporarily.

Third, codevelopment dramatically revalues the role of virtual copresence. The Internet, however, is not merely about speeding up, spreading out, and lowering costs of communication. Nor is it a simple substitute or an artificial extension of face-to-face communication. The Internet is increasingly charged with social software that tracks, categorizes, and channels information; sediments memory or automates word-of-mouth; aggregates idiosyncratic interests in the "long tails"; induces connectivity; and sustains communities. In a sense, social software turns networks "inside out" (Riles 2000); it turns networks from latent social embeddedness into a strategic practice to furnish knowledge ecologies deliberately.

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