Communities of Creation:

Managing Distributed Innovation in Turbulent Markets

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In the network economy, no firm is an island. On the one hand, the knowledge required to compete in technology markets is becoming more diverse as markets converge and industries collide. On the other hand, firms are narrowing their knowledge base in an effort to specialize and focus. In this business environment, firms can no longer produce and manage knowledge autonomously. They need to co-operate with their trading partners and customers to create knowledge. While distributed innovation offers exciting possibilities for a firm to capitalize on the creativity of its partners and customers, the management of distributed innovation requires firms to re-examine the mechanisms they use to govern innovation.

An important issue in managing distributed innovation is to find a governance mechanism that strikes a balance between order and chaos. When the locus of innovation is internal to the boundaries of the firm, innovation is managed through a *hierarchical* governance mechanism. Traditional R&D departments epitomize this mechanism. The hierarchical governance mechanism is a closed model, because intellectual property is proprietary to the firm, and the firm retains full control over the development process. The closed model is efficient, because it reduces transaction costs that arise from coordination. However, it does not allow the firm to benefit from the creativity, diversity, and agility of its partners. In a world where innovation, change, and uncertainty are the rules, knowledge socialization is needed for increasing flexibility and reducing the risk of autonomous knowledge production. Firms that function as closed systems have no way to renew themselves. Their main goal is to minimize disturbances, perturbations, and change.[1] Over time, these "machine-like" firms tend to wind down and find it difficult to innovate.[2]

In recent years, a dramatically different model called the "open source movement" has gained currency as a *market-based* mechanism for coordinating distributed innovation. The open source movement, exemplified by products such as the Linux operating system and the Apache web server software, benefit from the creativity and collaborative efforts of a large number of developers. This governance mechanism is completely "open" in that intellectual property rights are not controlled by any single entity. However, the lack of strong governance and the absence of coordination mechanisms tend to make such open systems unstable and susceptible to chaos. Therefore, innovation systems that are either too closed or too open tend to be ineffective in turbulent environments.[3]

We propose a new governance mechanism for managing distributed innovation called a *"community of creation."* The community of creation is a permeable system, with ever-changing boundaries. It lies between the closed hierarchical model of innovation and the open market-based model. Intellectual property rights are owned by the entire community. The community is governed by a central firm that acts as the sponsor and defines the ground rules for participation.

The community of creation model blends the benefits of hierarchies and markets by offering a compromise between too much structure and complete chaos. Firms have traditionally tended to favor centralization and mechanisms to control and protect the knowledge they accumulate over time. On the other extreme, knowledge can be freely traded on the free market, but the free market tends to lack the coordination mechanisms for creating new knowledge. The community of creation is a governance mechanism that reconciles these antithetic tendencies. This mechanism is particularly relevant at a time when knowledge is the main source of economic rents and new knowledge is being created at a furious pace. Today's turbulent markets demand speed and flexibility, variety and cohesiveness. They also demand collaborative knowledge creation with players that are outside the direct control of the firm.

The community of creation model relies on extended participation and distributed production. It overcomes the lack of coordination typical of markets, while emphasizing the contribution to a shared project of all contributors, including peripheral contributors who are usually neglected by firms. Within the community, explicit knowledge as well as tacit knowledge can be shared because participants build up a common context of experience, allowing them to socialize knowledge developed in specific contexts.

The community of creation model is grounded in the concept of *"ba"* suggested by Nonaka and Konno.[4] A *ba* is a shared space for emerging relationships that serves as a foundation for knowledge creation. Participating in a *ba* means transcending one's own limited perspective or boundary and contributing to a dynamic process of knowledge development and sharing. Similarly, participating in a community of creation involves socializing one's individual knowledge and contributing to the creation of a joint output that is superior to the

sum of the individual outputs, because new knowledge is created through the emerging relationships. The community functions as a complex adaptive system, changing its configuration as a fractal entity on the basis of the specific contributions it is able to attract and select. It is neither closed nor completely open. Like the *ba*, the community can be physical as well as virtual or mental. Such an emergent system has the ability to self-organize and evolve into higher levels of order that are both more complex and more stable.[5]

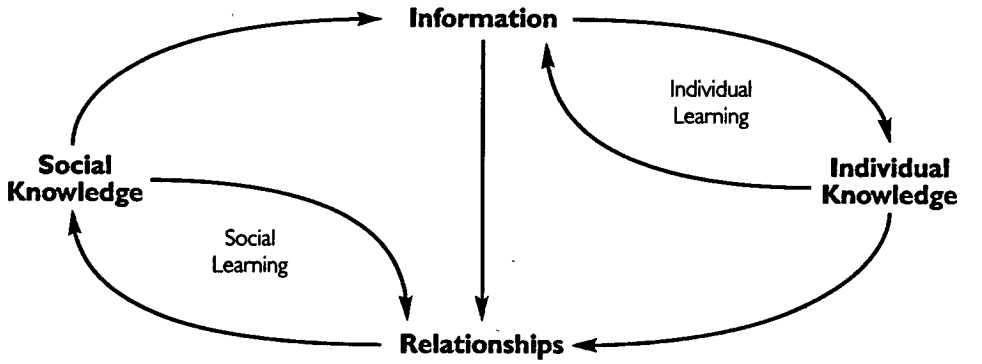
The literature on complexity theory and chaos has gained popularity in the areas of organizational design[6] and strategy.[7] However, these ideas can also be fruitfully applied to the management of innovation in turbulent environments. The community of creation allows firms to innovate in a complex environment by maintaining high internal variety and flexibility without degenerating into chaos. The locus of innovation is no longer within the firm; it is within a *community* of members in an opportunity arena. Every member of the community of creation can access and contribute to the community. However, the community has specific rules for membership, and it needs a sponsor as well as a system for managing intellectual property rights that allows members to extract rents from the intellectual property they help to create.

The Sociological Perspective on Knowledge Creation and Sharing

In recent years, several theorists have considered knowledge as the main source of competitive advantage.[8] These theorists argue that post-industrial society—and indeed the entire economy—is increasingly based on knowledge production. Therefore, the expression "Knowledge Society" is an apt description of the contemporary world. The emergence of the knowledge society can be conceptualized on a *relative* or on an *absolute* basis in relation to industrial society. From the relative perspective, the knowledge society is an evolutionary development, where the production of knowledge becomes *relatively* more important than the production of tangible goods in the economy. From the absolute perspective, the knowledge society represents a more radical change, because it enables new forms of knowledge socialization and new possibilities to store the output of learning across time and space. In the absolute approach, knowledge society is *contrasted* with industrial society as post-industrial society, with capitalism as post-capitalist society, and with modern society as postmodern society.[9]

We favor the absolute or radical point of view, based on the observation that two key factors are changing business in irreversible ways. First, advances in information technology are allowing more effective information and knowledge management. Interactive technologies reduce distances both in time and space, catalyzing knowledge sharing and transfer.[10] Physical distances are often becoming less relevant than cognitive distances. Indeed, the digital revolution can be seen as a "cognitive revolution," a revolutionary way to organize and share knowledge.[11] As Burrus argues, "The great opportunity and challenge . . . is to

FIGURE 1. The Sociological View of Knowledge Co-Creation and Sharing



move beyond information access to knowledge-sharing networks, because knowledge increases in value when it is shared."[12] Second, the increasing complexity of the business environment implies a stronger need for knowledge to reduce uncertainty. To overcome individual cognitive limits, knowledge mu st be shared through a process of socialization.

The importance of sharing in knowledge creation requires a sociological evolution of the traditional *epistemology* of knowledge that is concerned with understanding the origin, nature, and validity of knowledge.[13] In the information age, social, cultural, and technological changes present new challenges to ways of knowing and understanding. These changes require going beyond the traditional focus on solitary knowers, towards a social epistemology.[14]

In the sociological concept, relationships between several kinds of knowledge are social relationships between the individuals and the groups who develop and possess them.[15] As a consequence, creating new knowledge means creating new relationships or new ways to combine and manage existing relationships. Social learning processes based on interaction are increasingly important to transform information (data collected with a specific purpose) into knowledge (information with a specific meaning, integrating past and present information)[16] that is shared at a social level (see Figure 1). Several theoretical contributions support this thesis,[17] including the sociology of knowledge,[18] organizational behavior,[19] studies of the social impact of advanced technologies,[20] theories of learning,[21] social systems theories,[22] and international comparative analysis.[23]

From the sociological perspective, knowledge can be defined as:[24]

- socially spread and influenced by social settings;[25]
- a social construction, embedded in a system of individual, lasting relationships;[26]
- based on the interaction of several meanings;[27]

- shared by "agents who process data" through cultural processes;[28]
- shared among organizational members, both demanding and allowing for languages;[29]
- material, but also mental and social;[30]
- developed through participation in "communities of practice";[31]
- catalyzed by the development of network organizational structures;[32] and
- continuously changing: from individual to social, and from tacit to explicit.[33]

The common denominator of all these approaches is their opposition to the traditional rational-cognitive assumptions about management and organization. The sociological approach views knowledge creation as an emerging, dynamic, and diffuse process.[34] New knowledge is the output of a synergistic interplay between individual contributions and social interactions.[35] These interactions foster the development of a common meaning that transcends individual contributions, as in Nonaka and Konno's concept of *ba*, where knowledge creation is achieved by self-transcendence through a spiraling process of interactions between explicit and tacit knowledge, involving individuals as well as organizations.[36] This process of deep and recurrent knowledge sharing explains the origins of every community—social or political, cultural or scientific—defining not only its shape, but also its goals.[37]

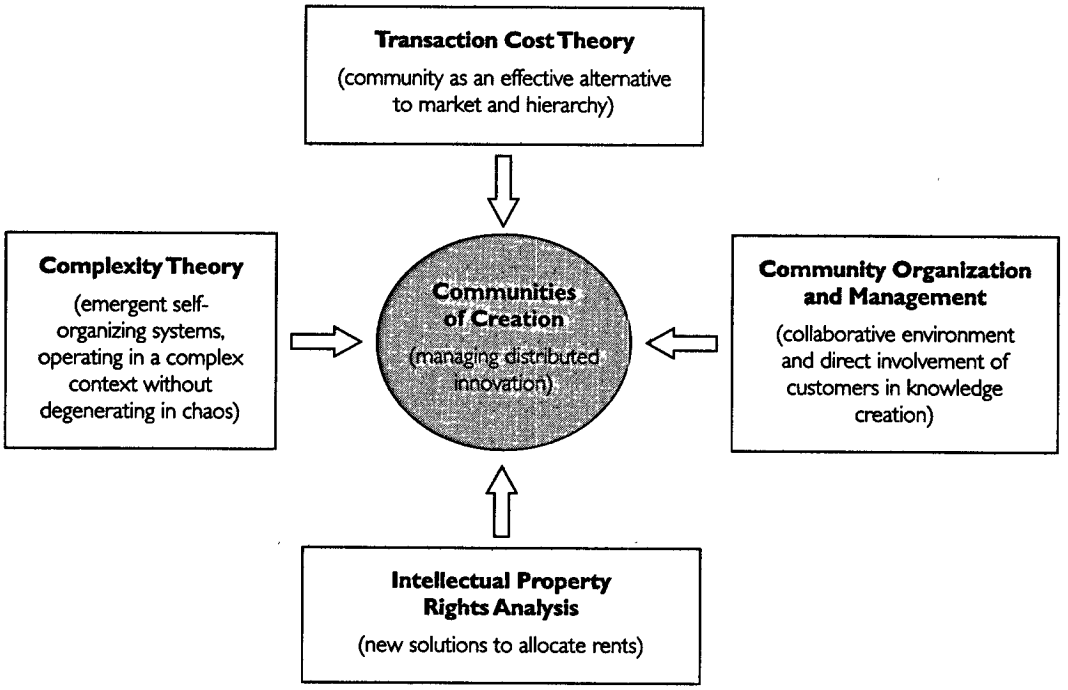
The sociological perspective on knowledge creation is consistent with the notion that the meaning of reality is the output of an enactment process.[38] It is also consistent with a view of individual and organizational behavior continually striving for innovation, instead of viewing innovation as an outcome of a rigid planning process. Finally, it supports the notion that knowledge is not necessarily owned by individuals, but that it can be distributed across a community of individuals.

Managing Distributed Innovation: Contributing Literatures

The sociological perspective on knowledge creation suggests a model for managing the knowledge creation process that is very different from traditional models for managing innovation. Specifically, it demands the recognition of the relevance of social interactions and communities in knowledge creation. Four research streams provide insight into this community-centric model for managing distributed innovation (see Figure 2).

First, mechanisms are needed to understand governing organizations that are "partially open." Transaction cost analysis explains why the evolution from markets to hierarchies can be reconciled with an opposite shift from hierarchies to markets or communities. Next, understanding is needed about the nature of communities, different types of communities, and the techniques to manage

FIGURE 2. Communities of Creation: Contributing Literatures



them. Third, complexity theory provides insights into how such communities can be designed to operate in a complex environment without degenerating into chaos. Specifically, community-based organizations behave like complex adaptive systems, creatively evolving and self-organizing to renew themselves to maintain internal coherence. Finally, it is difficult to sustain the collaborative approach to innovation without appropriate incentives. The important implication of community-based knowledge creation is that intellectual property rights should also be distributed across the community.

Governance of Distributed Innovation

The transaction cost analysis (TCA) literature argues that a shift from markets to hierarchies will reduce transaction costs in situations characterized by uncertainty, bounded rationality, and opportunism.[39] TCA is "a perspective that examines the efficiency of alternative mechanisms for minimizing the risk of being exploited by one's exchange partner."[40] This perspective is limited because it focuses on the benefits to the individual firm. Within an economy where processes of knowledge socialization are needed to overcome individual cognitive limits, this firm-centric approach is inadequate. It emphasizes a single-party cost minimization and neglects the interdependence among exchange partners

in the pursuit of joint value. Further, it emphasizes the structural features of interorganizational exchange but neglects the processual and behavioral aspects of interorganizational exchange.[41]

At a time when the value chain concept is giving way to value constellations[42] or value networks,[43] the emphasis needs to shift from *minimizing transaction costs* incurred by *individual firms* to *maximizing transactional value* created by *networks of firms*. The transactional value perspective argues that minimizing the transaction costs associated with pre-empting opportunistic behavior is less meaningful than maximizing "net present value of exchange relationships."[44] Thus, interorganizational strategies that have greater joint value may be more *effective*, even though they may involve the use of less *efficient* governance mechanisms from a transaction cost perspective. Consequently, to increase the variety of organizational knowledge and its potential for innovation, a shift may be needed from hierarchies to markets. This is the reverse of what classic TCA would predict.

Within the software industry, this shift has been called the evolution of "agoric systems," where "agora" is the Greek term for a meeting and market place.[45] An agoric system is a software system using market mechanisms, allowing for software to be distributed across and to serve different owners pursuing different goals. The proponents of agoric systems argue that decentralized planning is potentially more rational, since it involves more minds taking into account more information. However, the agoric system is more complex than classic decentralization, because decentralization has to be combined with a central direction of resource allocation. Therefore, a hierarchical structure remains the basic governance mechanism for coordinating knowledge socialization processes, but these processes are fed and catalyzed with the contribution of the market for transaction types that are not effectively supported within hierarchical organizations. For instance, computers have become too complex for central planning, and managing computer networks requires harnessing more knowledge than contained in any one mind. Thus, instead of designing rules that embody fixed decisions, the firm needs to act as a coordinator, designing rules that enable flexible decision making.[46] This idea of combining market and hierarchical models is a central insight in our conception of the community of creation.

Knowledge exchange and co-creation also have important implications for the cost of innovation. Unlike the sharing of physical assets, knowledge sharing does not imply a simple re-distribution of the initial stock of resources. On the contrary, knowledge increases in value when it is shared, thanks to a process of incremental development and diffusion.[47] Therefore, the value of knowledge that is shared can increase more than compensating transaction costs associated with sharing the intellectual capital. The increasing returns to sharing knowledge present new opportunities for developing knowledge assets beyond hierarchies, but within a community of creation that facilitates the shared creation of knowledge.

Shifting the Locus of Innovation to the Community

The network economy requires firms to re-think their boundaries. The distinction between the firm and its customers, suppliers, and competitors is getting blurred. Each of these "interlocutors" of the firm possesses specific and specialized knowledge.[48] Creating barriers to "protect" a company from its suppliers and its clients may be counter-productive, and could even be dangerous, because it reduces the potential variety of knowledge firms need to increase their innovation potential.[49] The firm's problem becomes not how to "defend" itself from the members of its value network, but how to involve them in its processes of knowledge creation.

This perspective of blending production and consumption is reminiscent of the notion of *prosumption* suggested by Alvin Toffler. However, our perspective is different in important ways. Alvin Toffler argues that production and consumption activities are becoming more and more close, often tending to collapse. Toffler suggests that this trend favors the consumption of goods that are self-produced by their final user, within an autarchic regime. In contrast, we argue that the most significant effect of the overlap between production and consumption activities is in a new open and democratic regime of knowledge creation and idea sharing. This model favors socialization of individual contributions and participation in a common final output, to which consumers as well as producers actively contribute.[50]

Any process of knowledge socialization and collective learning is based on relationships of meaning building and sharing. Such relationships cannot be enacted in the absence of a context of co-participation. It is important to create a "cognitive minimum common denominator" for all the individuals and the groups participating in knowledge creation. This context promotes the development of shared values, reciprocity, and mutual trust.[51]

These pre-requisites allow for the emergence of various kinds of communities[52]—"communities of practice"[53] and "communities of knowing,"[54] to name a few.

However, the emergence of the Internet is changing the scale of the community phenomenon.[55] As millions of computer users get connected to the Internet, a number of communities[56] have sprung up to serve consumer needs for communication, information, and entertainment.[57]

In the context of knowledge creation, a key challenge is to create incentives for participation and co-operation within the community by recognizing the contribution of any actor who shares his knowledge assets. In particular, firms need to involve customers who lead their user communities.[58] The concept of direct involvement of customers to create knowledge assets is not new.[59] However, what is new is to shift from a perspective of "exploiting customer knowledge" by the firm to a perspective of "knowledge co-creation" with customers by allowing customers to interact among themselves and involving them as partners in innovation. This is the essence of community-centric innovation

development, where co-learning and new knowledge co-development activities are the basis of community formation and operation. To preserve a semblance of order, such a community requires a coordinator, as well as screening mechanisms to avoid misleading contributions. It functions like a "gated community," where residents move about freely inside the community, but only if they satisfy some pre-specified access rules.

The governance structures for a community of creation are informal, but this does not mean that they are necessarily weak. In some cases, control can be based on restricting access to the best information assets. Therefore, the problem becomes how to define the required contribution, as well as the "business card" that allows participation to its holder. Further, the community needs a sponsor who defines the architecture and the standards around which the community is organized. The sponsor facilitates the interaction, and assures that the emergent organization is both efficient and effective. However, facilitator roles typically represent a small component of the community. Most of the community members are "adapters," contributing distinct pieces of the overall value offering. This is the revolutionary aspect of the community—there is a new relevance to the "periphery" relative to the "center" of the network.[60] This is crucial for creating an effective environment for new knowledge creation in a world where knowledge is increasingly distributed and embedded in specific contexts of experience, making it tacit and difficult to communicate. The community-centric innovation model is more democratic than the traditional hierarchical innovation model, because it empowers peripheral players, giving them the right to contribute their own experience and individual knowledge to the final output.[61]

Maintaining Balance between Order and Chaos

Distributed innovation is by nature more chaotic than innovation within a firm's boundaries. Complexity theory is useful for understanding the role of chaos and order in the behavior of systems. Complexity theory argues that organizations that mirror the functioning of natural (organic) systems are better suited for turbulent business environments because of their ability to create and adapt. Firms that structure themselves as complex adaptive systems are able to operate in complex contexts with high degree of flexibility, without degenerating into chaos. They are organic systems open to their environment, creatively evolving and self-organizing to renew themselves maintaining internal coherence.[62]

Such firms focus not only on "how to be a good competitor," but also on "how to be a good evolver," i.e., an adaptive innovator. Their strategies are more robust than focused, calling for the ability to pursue a set of potentially conflicting paths at the same time. Long-term superior performance is achieved by continuously developing and adapting new sources of temporary advantage. These firms continually search for a balance, standardizing designs that work but seeding the population with enough variation to provide a basis for future innovation.[63] The proponents of agoric systems, for instance, argue that the shaping

force of consumer choices can result in "computational market ecosystems" that serve human purposes better than anything programmers could plan. This increase in the ability to exploit knowledge may be essential to harness the power of large computational systems.[64]

Complex adaptive systems also call for a very different role of leadership within a firm, and within a firm's ecosystem of partners. Instead of "command-and-control" planning towards well-known goals, leadership needs to promote the richest possible environment for self-organization to occur. This involves three main tasks for the leader.[65] First, the leader needs to promote a clear organizational identity through purpose, principles, strategy, and culture, all of which cumulate into a "shared vision." Second, the leader needs to work to sufficiently de-stabilize the organization: "perturbations" are needed from the equilibrium state of the system[66] to allow the development of a "creative chaos," that in turn favors new knowledge creation in a continuously changing context.[67] Finally, the leader needs to nurture the relationships in an organization, just as a gardener cultivates his garden. This involves promoting the sense of ownership of participants in the success of the joint enterprise; actively favoring collaboration and mutual enrichment within a web-like structure. It also involves promotion of mechanisms for diffused learning that not only favor trial-and-error and risk-taking, but also a tolerance for failures and mistakes.

In summary, the healthy functioning of "living organizations" requires the transfer of both authority and accountability to all the individuals, groups, or institutions who accept responsibility for producing results.[68] This distributed authority favors emergent learning and innovation. The nature of this learning is collective and diffused, and it allows for the enactment of differentiated knowledge contributions within a "map of distributed knowledge."

At the same time, the co-operative nature of such a process favors a strong identification within the group of collaborating partners, who share a common purpose and a specific culture, either professional or social, economic or political. The gradual strengthening of relationships among the members of the group transforms it into a community. This community has a stable structure and basis for existence, but simultaneously evolves and self-organizes to face the challenges of a complex and uncertain environment. Sustaining such a self-organizing community, however, requires that the management of intellectual property rights be addressed.

Allocating Economic Rents from Distributed Innovation

If knowledge increases in value when it is shared, and it can be easily reproduced and distributed, how can knowledge be protected and how can its creators capture economic rents? In other words, what incentives can assure the continuous creation and distribution of knowledge needed to fuel innovation?

These questions require reconsideration of existing frameworks for intellectual property rights management. Knowledge socialization and digitization

of information progressively detach information from tangible objects, by allowing information to be transported freely and instantaneously. Traditional intellectual property law, with its history of copyrights and patents, was created to protect expression—the "physical transformation" of ideas. In a world where expression and physical transformation are no longer synonymous, and no relevant knowledge can be produced within an autarchic regime, a new approach is needed to assure reliable payment for knowledge creation and sharing. Otherwise, the risk of piracy may stifle innovation, because the only way to protect ideas is not to communicate them, which in turn dramatically reduces their intrinsic value.

Co-operation in knowledge creation requires recognition of the property rights of *ideas*, and not only of their *expressions*. At the same time, intellectual property ownership associated with the product can be separated from the brand. This is what Red Hat Inc. has done by creating Red Hat Linux, a branded version of the Linux operating system. Red Hat owns no intellectual property in Linux, because Linux was developed within a community of creation that owns and maintains the intellectual property upon the product. However, Red Hat adds its brand, services, and support and uses its trademarks as a coordination tool.

Such a model of innovation seems particularly important at a time when most knowledge is being created collaboratively in cyberspace, when networks are what build value and when networks are often created by "giving things away," as both Netscape and Microsoft did.[69] In fact, new technologies seem to have made old rights unenforceable and, at the same time, to have created new potential forms of intellectual property rights. As Thurow argues, "pieces of a human being can not be patented."[70] So the best way to protect intellectual property is to act on it. It is not enough to invent and patent. It is important to apply and innovate. This is the basis of competition in the new "Economy of Participation," where value is based more on relationships than on possession, and more on partnership that on ownership.[71] This shift calls into question much of what is known about managing intellectual property.

While traditional intellectual property management frameworks are inadequate to mange the allocation of rents in the community-centric innovation model, it is unclear what mechanisms can take their place. The only certainty is the need for new approaches that recognize that the most innovative ideas are often the output of a joint process, within which it is difficult to discern the specific contributions of single actors. As such, intellectual property rights should vest in the community that creates innovation, rather than belonging to individuals within the community who participate in the process. Further, the new approaches should recognize the trade-off between two inherently conflicting objectives: more production of ideas versus faster distribution. More production can be encouraged by rewarding individual inventors within the community to bring new ideas into existence. However, once a piece of knowledge exists, the social incentives are completely reversed. The wider the use and the faster the

distribution of the new knowledge (ideally, by giving the ideas away), the greater the benefit to the community to society.[72] As monopoly power wanes and social interest in encouraging the development of new intellectual property grows, the balance should shift toward favoring the production of new knowledge, and away from being concerned about the distribution of existing knowledge.

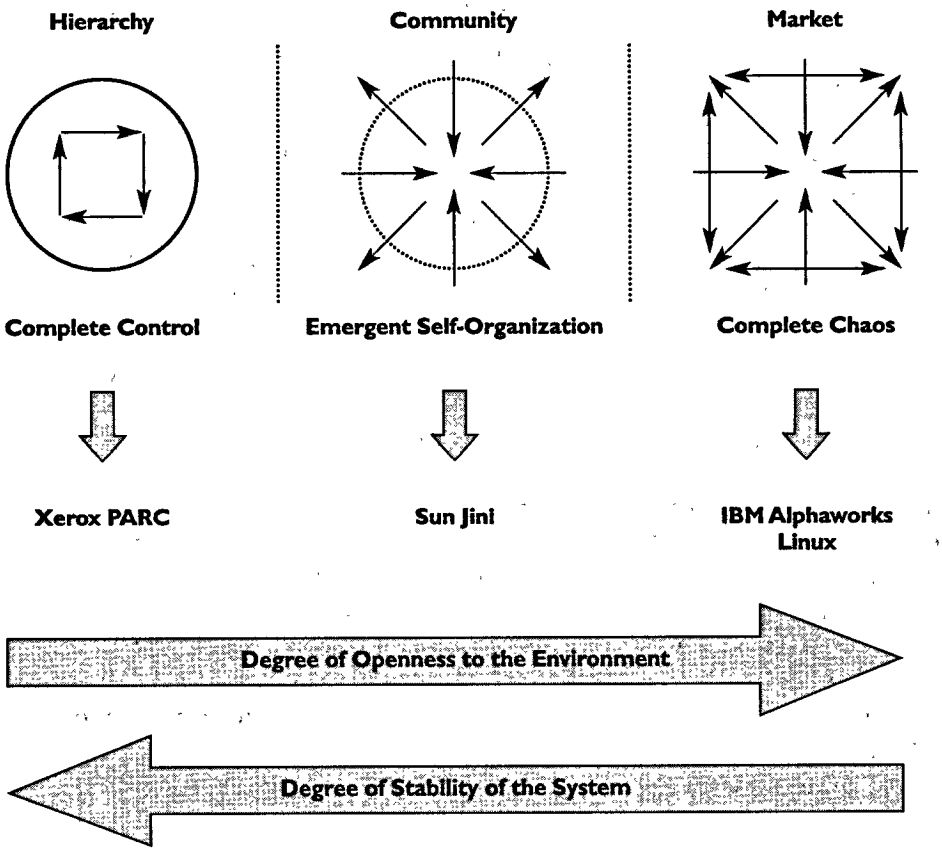
Agoric systems offer some interesting clues on how to manage this paradox. To motivate decentralized planning and division of labor, computer scientists have proposed the notion of "encapsulation of information" to manage intellectual property rights. Encapsulation relies on a separation of the internal state and implementation from external behavior, preventing one object from examining or tampering with the contents of another. Combined with communication of access, encapsulation ensures that communication rights are controlled and transferable only by mutual consent. In this way, the encapsulation mechanism provides a sphere within which an object may act with complete control and predictability, deeply investing in the production of new knowledge without fearing that the rewards for the creation of valuable code and information would be reduced or destroyed.[73]

Comparing Innovation Management Mechanisms: Case Studies from the Computer Industry

The computer industry is an excellent setting to understand the evolution (and revolution) in learning and innovation processes because the technologies that make distributed innovation possible originated in this industry. Within the computer industry, "exemplar" firms have adopted very different governance mechanisms for managing innovation. These extremes highlight the different approaches to knowledge creation and innovation (see Figure 3). There are three different models of innovation management in the computer industry.

The first model is exemplified by Xerox, which conducts all its Research and Development "in-house." This is a case of a closed, ordered, and structured approach to innovation, where the control of activities is strictly centralized. Next, we consider are two examples of a completely open market-based approach to innovation: the Alphaworks unit of IBM, whose role is to serve as IBM's "trading post" for technologies in Silicon Valley, and Linux, the well-known free operating system. Both function as unstructured systems, where new contributions to knowledge creation are "traded" on the market and the innovation process is not controlled by any single entity. Finally, the experience of the Jini group at Sun Microsystems provides an emerging example of community-centric development. The *Sun Community Source License* (SCSL) blends aspects of the proprietary licensing and the "Open Source" licensing models.

FIGURE 3. Three Models of Organizing for Innovation



Xerox PARC: The Closed "Hierarchy" Model

Ever since its beginnings as the Haloid Company, Xerox has invested a significant portion of its revenues in fundamental and applied research. Many of the technologies that form the basis of computing originated by Xerox. However, such innovations have always been developed directly inside its research laboratories and technology centers in the United States, Canada, Europe, and Japan. The most famous of such labs is the Xerox Palo Alto Research Center (PARC),[74] but it includes several others, like the Digital Imaging Technology Center and the Xrce. Together, they constitute the Xerox Corporate Research and Technology. The locus of innovation is distributed across these entities, but it always stays within the boundaries of the firm. As a consequence, even if this system is decentralized, it is still a closed system; control mechanisms still follow the hierarchical model of organization.

For instance, through the Eureka Knowledge Sharing Process, Xerox favors the growing of community knowledge within its organization. The basic idea is that technical reps around the world have relevant insights. Entering such insights into a database creates documents and peers are able to review, validate, and warrant their content. Thus, the best insights can be used as new knowledge in the field. For example, at XFrance, Eureka deployment allowed for cost savings around 5-10% in parts, time savings around 5-10% on time spent at customer sites, and higher customer satisfaction and employee morale. After three years of using Eureka, Xerox France, historically one of the worst service organizations in Europe, is now considered a benchmark. However, it still does not include external partners and customers in its process of community knowledge creation.

When new partners are needed to develop new product opportunities, they rarely operate as autonomous agents. Most often, they are absorbed into the organization. In fact, to leverage emerging opportunities that do not align with any particular division's near-term strategy or even do not fit into the corporate structure, Xerox has established the "Xerox New Enterprise" (XNE) system. XNE operates much like a venture capital firm: organizations function like small start-ups, while maintaining the benefits of being part of a big company. They are set up for a specified period of time, during which Xerox explores the market to understand how the technology can best be exploited. At the end of this period, a decision is made whether to fold the company into Xerox as a part of a business division, to fold it in as a new unit, to find a strategic partner, or to sell off the company. Thus, the dominant tendency is to limit the autonomy of the participants in Xerox research activities in an effort to maintain centralized control.

This hierarchical system maximizes efficiency, minimizing "perturbations" and focusing innovation efforts toward a common purpose. The goal alignment is facilitated by processes for training and knowledge sharing across the Xerox field service organization and between service technicians and sales representatives. In addition, researchers frequently migrate between research and product operations, facilitating cross-pollination of knowledge within the company. Research teams also engage other divisions early in project development. This helps Xerox people to share their individual competencies and promotes the development of a common language and a strong culture. In fact, one of the most important aspects of Xerox Research is the tight coupling between Research and Corporate Strategy, which improves the alignment between what the Research Centers create and what Xerox is positioned to act on. However, this reduces the variety of potential contributions, as well as the ability of the system to self-organize to face uncertainty. In the long run, the absence of cooperation with external sources of knowledge and innovation could lead to partial stasis. Xerox also maintains a traditional, albeit very effective, approach toward its lead user clients. It studies them through innovative research methods, but it does not involve them in its new knowledge creation processes

directly. PARC's pioneering ethnographic research on work practice is well known, as are the firm's competencies in community-based computing, natural languages, physics, psychology, systems, and user interfaces. In all these cases, however, the customers' role tends to remain rather passive.

Finally, Xerox takes an aggressive stand on defending intellectual property, To protect technological capabilities that represent strategic advantages, it uses intellectual property as a form of currency to "barter" with other companies holding interesting patents. Beyond that, licensing of intellectual property to other organizations is considered a revenue stream. Thus, a proprietary-licensing model is the norm at Xerox, as well as in Bell Laboratories (now part of Lucent Technologies), in the Core Research Group of Microsoft Research, and in Hewlett-Packard Laboratories.

This hierarchical model has three main advantages: it provides protection for intellectual property; it guarantees structured innovation (innovation planned within a single responsible organization); and it allows a clear understanding of who owns what. However, it also has important drawbacks. It puts "innovation on a schedule," making its quality dependent solely on the owner organization. If the schedule is ill timed or if the owner organization does not correctly interpret user needs, frustration and lost opportunities can result. It also limits the creativity and the genetic diversity of the ideas, as well as the richness of the dialoguing process that is so important in creating knowledge.

IBM AlphaWorks and Linux: The Open "Market" Model

Both IBM, through its "AlphaWorks" team, and Linux, under the GNU General Public License, have developed an open approach to innovation, co-operating and trading with potential partners in an open "knowledge market." Technologies are promoted through online Web marketing initiatives including banner advertisements, newsgroup postings, and newsletters. In particular, AlphaWorks is chartered with the task of accelerating the transfer of technology out of IBM Research and into new product development, using the Web. The team works to bring IBM researchers and developers, product groups, and decision-makers together to learn more about the opportunities for commercial use of IBM's emerging technologies. When it makes business sense, AlphaWorks has been a vehicle for IBM support of the "Open Source" movement. The basic idea is simple: a piece of software will evolve more rapidly if programmers on the Internet can co-operate and freely modify its sources, adapting it and fixing possible bugs.

This logic also informs Linux, the best expression of the Open Source Movement since 1991. Its General Public License is designed to make sure that everyone has the opportunity to distribute copies of free software, to receive source code, and to change the same software or to use pieces of it in new free programs. The recipients automatically receive a license from the original licensor to copy, distribute, or modify the Program, subject to the same terms of the original distributor. In this way individual developers have no warranties, but

assure themselves a unique opportunity to favor the greatest possible use of their software to the public. In particular, as a benefit to the source code for the Linux kernel being freely distributed, a number of companies have developed their own "distribution" of Linux.

As Linux's mission is to "evangelize the world," disseminating the most recent programs, AlphaWorks' mission is to provide early adopter developers direct access to IBM's emerging "alpha-code" technologies: IBM surfaces the latest software technologies, allowing its lead user clients to download and evaluate them. In this way, AlphaWorks has redefined the way IBM conducts new product development by offering to any innovative developer a chance to work directly with its researchers through discussion forums and to influence the earliest phases of new product development. The feedback generated by AlphaWorks' users is incorporated into IBM's technologies,[75] reducing development time.

AlphaWorks also provides a "venture capital" function for emerging technologies from IBM Research, attracting promising projects, and aiding IBM researchers by building a business case—the so-called "AlphaBrief"—around emerging technologies. Instead of actual funding, AlphaWorks invests information capital in an IBM Research project, using real-time application developer feedback to discover what the market thinks about the new technologies. This is a lean, flat organization, with low overhead and little infrastructure. It enables IBM to preserve its reputation for providing solid commercial code, while making available "alpha-level" technologies for evaluation and scrutiny by early adopters. This improves the flexibility and increases opportunities to experiment and co-develop innovations.

Both in AlphaWorks and Linux, lead-user clients (leading professional developers) can self-select and self-signal themselves as knowledge co-creators. Participation in the process is voluntary, and the process provides a means for researchers to gain visibility for new technology projects. In AlphaWorks, some product managers have even begun submitting "wish lists" of new technology features that would enhance their products.

Such an approach has a deep impact on intellectual property management: AlphaWorks and Linux place valuable intellectual property in the hands of early adopters at a point in time that can help shape subsequent product development. The major problem in this model is to create the incentives for developers to share their knowledge with the company. One approach IBM has adopted is to offer free commercial licenses to developers for products such as its XML Parser and the source code of its Jikes compiler for Java. In addition to content and commercial opportunity, AlphaWorks also provides Web developers with a community environment. Moderated bulletin boards offer a mechanism for sharing tips, debugging and identifying new uses for emerging technologies. In this way, AlphaWorks has made IBM more responsive to the marketplace. Similarly, Linux allows that if identifiable sections of the modified work are not derived from the original Program and can be reasonably considered inde-

pendent works in themselves, then the license does not apply to such sections when they are distributed as separate works. However, in both cases, the problem of motivating lead customers still represents a challenge for sustaining this co-operative process.

The second major problem arises in screening mechanisms for single contributions. IBM states a sort of "honor code," forbidding the transmission of material that is unlawful, vulgar, or defamatory. However, IBM does not take responsibility for the content of this Community Exchange. Similarly, Linux asks all the developers to clearly specify every change made in a file and the data of such changes, but it does not take direct responsibility for the quality of the output. If the program should prove defective, the user has to support all the costs for the necessary correction. The absence of a clear form of control and responsibility can potentially lead to fragmentation and chaos, introducing excessive perturbations into the system.

The main benefits of this open market-based approach are rapid innovation, flexibility in schedules and priorities, and self-organization. This approach recognizes that the primary value of a piece of software is the expertise represented by the people who developed it. This is the reason way Microsoft is now trying to determine which portions of its source code to release and whether the code should be licensed or available to everyone via the Internet.[76] This is also the reason that has pushed Sun Microsystems to move away from a closed system, to embrace the new, partially open model of innovation of the community of creation.

On the other hand, the drawbacks of the open system are the absence of clear control over compatibility and quality issues. This can provoke fragmentation and make progress chaotic and undirected. In addition, weak screening mechanisms can dilute the quality of the community and "vitiate" the atmosphere. Finally, this model does not adequately address the issue of incentives to assure the lasting participation of the best knowledge sources in the market. This is the reason why companies like Red Hat are trying to evolve the open system into a community model that can combine the best characteristics of the completely closed and the completely open innovation systems.

Sun's Jini Project: The Emergent, Dynamic and Self-Organizing "Community" Model

Sun Microsystems is attempting to combine the advantages of the closed hierarchy-based model and the open market-based model in commercializing its Jini technology. It has created a community of widely available software source code—the so-called "Community Source." The Community Source functions like the Open Source model, but with two significant differences:

- Compatibility among deployed versions of the software is required and enforced through testing, so that internal coherence and cohesion are assured.

- Proprietary modifications and extensions including performance improvements are allowed, granting for variations that catalyze innovation.

These differences make the Community Source a hybrid of the hierarchical proprietary-licensing model favored by Xerox and the open source technology-licensing model implemented by IBM and Linux. According to Sun, the Sun Community Source License (SCSL) is designed to balance the organizations' needs to innovate rapidly in order to grow, with their needs to leverage a community's expertise while maintaining proprietary advantages. Sun recognizes that it is difficult for a single company to house all the expertise it needs to succeed, especially when it wishes to build infrastructure on which other business depend. At the same time, it is aware that a completely open system, working like a pure free market, lacks the coordination mechanisms needed to make the process effective as well as efficient.

As complexity theory suggests, systems that are too static and too chaotic are both likely to adapt poorly to a turbulent business context. The SCSL addresses this problem by creating a new way to distribute and share cognitive work involved in innovation. The main "attractor" is a common interest. The community is architected around this common interest. Such a community is neither a market nor a network. A market consists of spot transactions; its players are not obligated to participate in long-term relationships. Only if there are adequate incentives will such a mechanism sustain itself. As soon as payoffs are considered unfair, trading will tend to grind to a halt. A network, in contrast, consists of strategic alliances that persist over time, but its internal cohesion is generally weak: individuals and institutions are participants, not members. Networks tend to lack a deep common interest, a shared culture, and a legitimized identity.[77]

The community model strikes a balance by creating a distributed system of innovation within a group of individuals and/or organizations centered on an infrastructure provided by the so-called "developing organization," like Sun for Jini. Sun invented and built the initial Jini technology infrastructure. Jini is a network-based technology that allows computers and devices like televisions and printers to federate into a single distributed system.[78] Such a network, however, can work only if the underlying protocols and infrastructure become pervasive through a strong community of participants and partners. The SCSL is the mechanism to build such a community around Jini technology. Within this community, Sun is opening the source code for Jini software to the Jini technology licensees, who are free to use, extend, improve, and repair it.

It is important to note that this is a "gated community." It is not open to the general public. On the contrary, it consists only those who have agreed to the license and have signed the SCSL contract. This contract clearly defines the ground rules for the co-operation, as well as the members' rights and responsibilities. As a consequence, there is no need to create strong screening mechanisms for filtering misleading contributions, as in the case of IBM and Linux.

The Sun CSL envisages an emergent structure, which is neither closed nor open. It is closed outside the gated community, and open inside it. This structure grants SCSL high flexibility without excessive disorder. Sun can screen for the best partners on the market, at the same time allowing for enough variations to favor innovation. Several benefits can derive from such an innovation model. First, outside developers are likely to evolve the technology for their products and markets more rapidly than the original developers would ordinarily be able to do using a proprietary licensing approach. Thus, a new marketplace based on such an infrastructure is created more rapidly than would otherwise be the case. Second, a "short loop" for learning by errors can develop, allowing the firm to internalize mistakes before registering a negative performance on the broader market.[79]

Such a balance between being closed and open—i.e., structured and unstructured organizational forms—has important implications for intellectual property management as well. In particular, because the members of the community are bound by a common license, intellectual property is maintained and there is no requirement to share openly everything developed for the infrastructure. Thus, while error corrections to the licensed technology must be given back to the community, other modifications can remain proprietary at the discretion of the participating organizations that created them; the only requirement is that interfaces must be published for other community members in order to preserve the community openness. As a consequence, in such a cooperative environment, there is a place for both incremental improvements and rewards for invention.

By combining benefits of the proprietary licensing model and the open source model, the community model allows the co-participation of community members to self-maintain over time. The developing organization is responsible for the original code base and the community for the contributed portions, so that intellectual property is protected and structured innovation is granted. Therefore, even if the platform is open, and has published and specified interfaces, it is clear "who knows what" and control over compatibility is ensured, as would be the case in a hierarchical proprietary model. Further, more developers working on the common source code make for higher quality and more rapid innovation: each participant can determine appropriate quality levels and work toward them by himself or with other participants. In other words, the community pulls organizations and developers into a circle of shared concerns, allowing them to self-organize, with only a little assistance from the developing organization.

While there is a schedule for the developing organization's structured innovation, the SCSL provides each participant with freedom and the authority to move forward independently. This helps the company to avoid "alignment gaps"[80] that arise when priorities the owner company assigns to technology development are not aligned with customer priorities. With SCSL, the community members share common source code and can set their own priorities,

TABLE 1. Key Features of Models for Technology Development and Licensing

	Proprietary Licensing	Community Source Licensing	Open Source Licensing
Governance	Hierarchy	Community	Market
Closed/Open	Closed System	Emergent System	Open System
Degree of Structure	Basically Structured	Self-Organizing	Basically Unstructured
Degree of Order	Order	Creative Tension	Disorder
Degree of Change	Stasis	Emergent Self-Organization	Chaos
Example	Xerox	Sun	IBM Linux

working on the code as, when, and how much they wish. There is a force that tends to keep the infrastructure stable because all the participants depend on it, but innovation can take place anywhere in the technology base. This is the main idea at the basis of knowledge co-creation and diffuse innovation processes: the *locus* of innovation is no longer in the firm; the locus of innovation is the *community*. To paraphrase Sun, "the network is the innovator."

Table 1 provides a summary of the main features of the different innovation models. The Proprietary Licensing model by Xerox is a hierarchical model that is closed and structured. This allows for order, but it might lead to a partial stasis. At the opposite end of the continuum, IBM AlphaWorks and Linux Open Source model resemble a free "knowledge market," completely open and unstructured. This model tends to lack coordination and screening mechanisms and could easily degenerate into disorder and chaos. In the middle of the continuum, the Sun Community Source Licensing offers an early example of an "emergent self-organization," where it is closed outside of the community combined with being open inside of it. Within this community of creation, the diversity of the peripheral sources' contributions can enact a creative tension, favoring continuous and diffused innovation while at the same time preserving internal cohesion and intellectual property rights. Although it is too early to comment on the eventual success of Sun's community-centric model—and several implementation hurdles still remain—there are still important insights to be gleaned from this experiment.

Lessons for Managers

A key challenge for managers in the network economy is to set up the rules of the new competitive game, where organizations have continuously to evolve into higher levels of order, both more complex and more stable, to increase innovation without losing internal cohesion. Using the computer industry as the canvas, we have painted a picture of a new approach to innovation,

TABLE 2. Managing a Community of Creation: Key Questions and Lessons

Key Questions	Lessons for Managers
What level of control should the sponsor company maintain?	• It has to "give the rhythm" to the developers' community: it pulls individual organizations and developers into a circle of shared concerns, then allows them to self-organize. • It coordinates individual schedules and priorities, at the same time allowing for emergent modifications. • It helps establish responsibilities to ensure compatibility
How can property rights be managed?	• Intellectual property has to be maintained and there is no requirement to share openly everything developed for the infrastructure. • Rights have to be directly proportional to responsibilities.
What incentives favor a direct involvement in the long run?	• The sponsor has to provide a business model that encourages and rewards individual invention. • By creating a gated community that is not completely public, quality of innovation within the community is protected.
How can the community evolve?	• Preserving and renewing the balance between continuous innovation and internal cohesion, between openness and closeness. • The community has to be conceived as self-referential: tolerance for diversity has to co-exist with redundancy to favor innovation. • The sponsor firm has to fund support for the entire community of licensees as well as for further development.
Should the sponsor firm also provide physical support? Can the community remain only virtual?	• A community can not self-maintain during time if physical support is not granted. • The sponsor has to offer different services, depending on the intensity of the individual members' involvement. • At the most advanced level, the company has to make available capital for personalized assistance and co-marketing activities.

where the *locus* of innovation shifts from the firm to a community. This community is open on the inside, but closed on the outside. It has specific rules for membership. It also needs a sponsor and property rights to prevent it from lapsing into chaos. However, there are several open questions that managers need to consider before they can implement the community of creation model. Table 2 summarizes the questions and their answers.

The first important question is: What level of control should the sponsor company maintain? The community of creation requires a sponsor that plays the role of the developing organization. This organization offers a body of intellectual property rights to a community of developers. Ideally, the sponsor should provide the rhythm, but then leave the singers free to play their song. The sponsor also needs to establish rules for ensuring compatibility: everybody can improvise, but nobody can be out of tune. Finally, the sponsor needs to provide

a business model that rewards innovation and invention by allowing licensees to create proprietary enhancements.

There are rules for membership as well as rules for protecting and recognizing intellectual property rights. The community functions like a democracy—rights are granted, but responsibilities also have to be stated. First, by getting access to intellectual property, members can help each other to refine and improve knowledge far more efficiently than in a closed system. Second, by sharing responsibilities, members are assured their efforts will align with others in the community. Finally, by providing a means to appropriate some specific modifications and establishing a business model tailored for specific needs, the community model encourages and rewards invention.

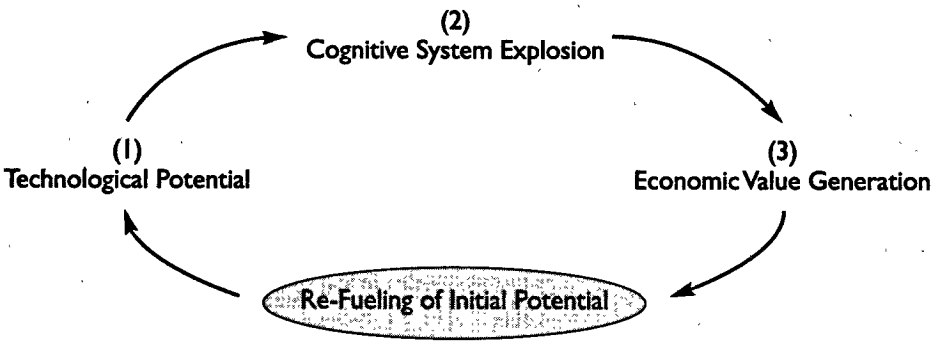
With respect to the question of how such a community of creation can evolve, the secret is to achieve and preserve a balance between intellectual property rights and responsibilities. If this balance is maintained, the system can combine continuous innovation with internal cohesion, disorder with structure. Such a community can become self-organizing and continue to evolve even in the face of a turbulent environment. For example, Sun's CSL may function like a complex adaptive system by spawning emergent and self-organizing communities that coalesce into interest groups supporting different services. Sub-communities may arise within the SCSL, favoring rapid and effective innovation. These sub-communities can function as resilient organizations, adapting quickly to changes. Individual users can enter and exit, but the communities keep on living. Thus, they are open structures that maintain self-referentiality, preserving their internal cohesion and carefully balancing tolerance for diversity and redundancy to favor innovation.

For such a mechanism to work effectively, the experience of Sun suggests that the sponsor may need to provide physical support as well. For example, Sun offers a full spectrum of developer support, sustaining different levels of co-operation, depending on the levels of partners' involvement. "Level A Services" are available for anyone in the community. They include technical and advisory support programs, from white papers to a listing in Sun's online catalog. "Level B Services" can be chosen *a la carte*. They include education and training services, as well as custom-tailored professional services, concerning design, development, and implementation of pilot projects employing Jini technology. Finally, for the community members who want maximum support, Sun offers "Level C Services," granting personalized assistance with co-operative advertising and participation in the Jini technology marketing advisory program. With this layered approach to physical support, Sun eliminates any barriers related to support from affecting the community's potential for distributed innovation.

Theoretical and Managerial Issues

The different models of innovation pursued within the computer industry represent new ways to distribute not only physical, but also cognitive work.

FIGURE 4. The Virtuous Cycle of Knowledge Creation in the Network Economy



Social relationship extension is needed to reduce knowledge generation costs and risks and to increase the intrinsic value of knowledge. To survive in an increasingly uncertain and complex environment, the firm has to transform its "organizational intelligence" into a new "relational intelligence," enacting an open communication process with its stakeholders.[81] The implications for knowledge creation are evident: the hierarchical structure is no longer the best organizational architecture because it is designed to centralize the organizational intelligence, not to maximize it. Social and cumulative learning processes require new ways of organizing for innovation, even if this means greater chaos and uncertainty. In the network economy, it is much more valuable to play in an orchestra than to be an outstanding soloist. Value creation is the output of a process that encourages creativity and diversity, yet does not allow the players to go out of tune completely.

While these processes are not completely new, the ubiquity of the Internet allows the scale of these processes to be greatly enlarged. The Internet explodes the cognitive capabilities of society. New knowledge and competencies develop, and the intensive deployment of these capabilities catalyzes value generation. Such an increased value can in turn be reinvested in new knowledge creation, leading to a virtuous circle of knowledge creation (see Figure 4). This virtuous mechanism has important consequences in finding new ways of managing the tradeoff between leveraging existing knowledge and creating new knowledge. Thanks to knowledge socialization within the "networked digital environment,"[82] tradeoffs such as "isolated-connected," "concentrated-distributed," "de-contextualized-re-contextualized," which characterized the diffusion of knowledge in the industrial economic society, will be mitigated in post-industrial society.

As the potential for organizational connectivity increases, so do the possibilities for developing knowledge socialization and communities of creation.[83] These communities benefit all participants. On the supply side

technical solutions to problems in product development or customer service can be socialized; on the demand side, word-of-mouth can increase, modifying product evaluation processes and customer satisfaction.[84] However, the greatest benefits accrue to the developing organization to the extent that it is able to transform itself into a "relational intelligence," evolving from the "physical transformation of products" to the "cognitive transformation of ideas." The community paradigm promotes learning *with* suppliers, instead than *from* them, as well as creating value *with* customers instead than *for* them. This is a radical shift in perspective, from the Learning Company to a new Learning Society, where the boundaries of the firm, its suppliers, and its customers begin to overlap. This overlapping creates more effective, concurrent learning that shortens innovation cycle time, lessens risk, and cuts costs."[85]

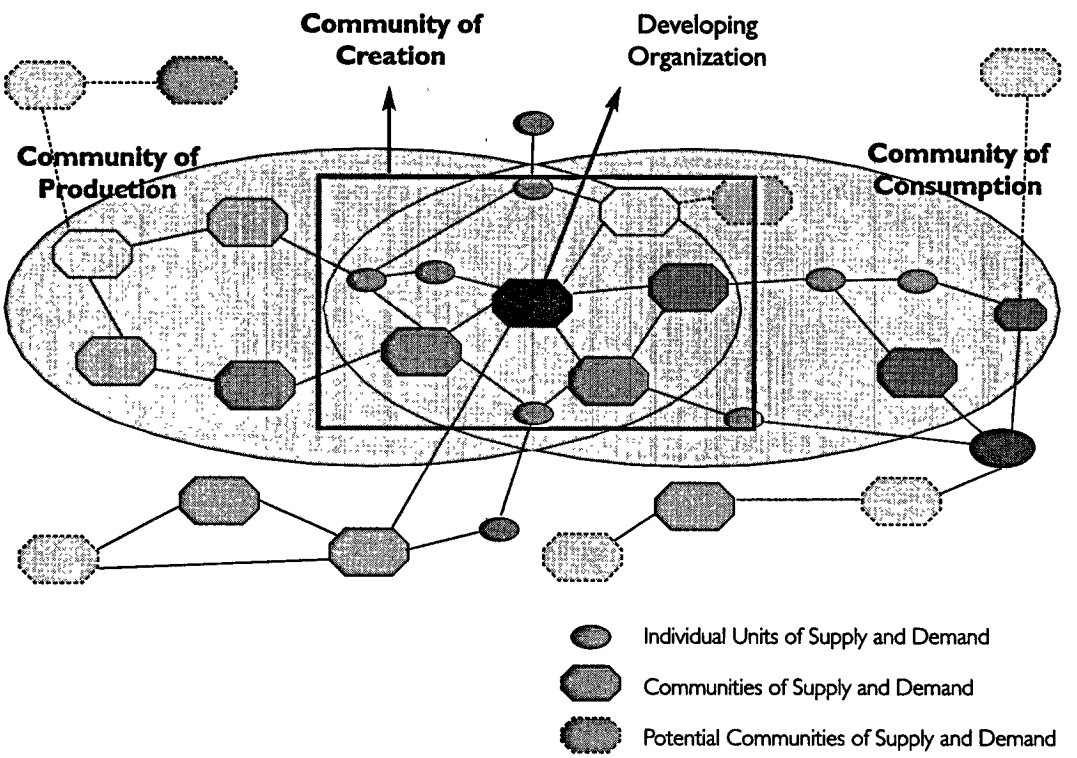
Within this society, the firm can evolve into a community where knowledge co-creation is the mechanism through which it self-reproduces over time, coordinating co-operative efforts and redistributing benefits among all the participants. The boundaries of the firm broaden and change over time, becoming highly permeable to differentiated external knowledge contributions (see Figure 5). Firms conceived as "communities of creation" can function as complex organic systems whose "extension" and "shape" are defined by the co-operative and co-evolving relationships they enact with their partners.

As a consequence, strategic compatibility between single economic actors is no longer enough. "Cognitive compatibility" is needed as well. This has implications for organizational and knowledge management theories. While knowledge production within the company emphasizes internal assets or the purchase of know-how from the market, the knowledge co-creation process eliminates the dichotomy between "make" and buy," and what is "inside" and "outside" the firm.

On the supply side, these ideas are finding use in firms like Caterpillar Inc., where an Extranet[86] network has been implemented to favor joint experimentation of new product solutions, promoting co-operation between the company technicians and experts from other organizations. The objective is to reduce turnaround time on product design by inviting experts to collaborate within exclusive "virtual spaces" where they can exchange files and CAD/CAM applications in real-time. Similarly, the Italian car producer Fiat has since 1990 been working on projects to integrate knowledge held by several institutions and firms outside Fiat. In addition, individual business units co-operate in co-design activities with suppliers of components, progressively increasing the autonomy of such partners in suggesting innovation.[87]

Co-operation in knowledge creation is increasing on the demand side, as well. Fashion Box, the Italian producer of the label "Replay," allowed its customer to design T-shirts online in a project called E-Play. The Internet Underground Music Archive (IUMA) invites customers to take part in virtual auditions, interact among themselves, and jointly decide which artistes to promote.[88] Similarly, Adobe, one of the world's largest software companies,

FIGURE 5. The Community of Creation as an Overlap between a Community of Production and a Community of Consumption



considers the buying experience as part of a direct and ongoing dialogue with the company and other customers via the Web.

The community of creation model overcomes the rigid and centralized control mechanisms that are typical of hierarchical structures and emphasizes the role of peripheral knowledge contributors. At the same time, however, it preserves the coordination mechanisms that promote "encounters" between strategic assets that are often too dispersed to "meet" on the free market. Self-organization is the hallmark of communities where participants tend to self-signal and self-segment, like in an ideal *ba* that acts as a platform to concentrate distributed knowledge assets and intellectualizing capabilities within a common knowledge creation process. At the same time, implicit and explicit sanction mechanisms and the assignment of individual responsibilities assure that community participation is limited to those who are really interested in knowledge sharing. This regulation of access assures the quality of the joint innovation process.

However, this is still a definition of the community of creation model in terms of, and in relation to, alternative models for managing innovation. There

are conditions that are necessary, albeit not sufficient, to define the Community of Creation as a new, distinct organizational architecture. Specifically, the development of a Community of Creation requires:

- a common interest,
- a sense of belonging,
- an explicit economic purpose,
- a sponsor,
- a shared language,
- ground rules for participation,
- mechanisms to manage intellectual property rights,
- physical support of the sponsor, and
- co-operation as a key success factor.

The community of creation begins with a reconfiguration of cognitive labor through information technology. It results in the transformation of the firm into a "res cogitans,"[89] a relational intelligence that leverages existing knowledge and builds new knowledge through processes of socialization.

The managerial challenge in developing communities of creation is to balance order and disorder, stasis and chaos, intellectual property rights and individual responsibilities, common priorities and flexibility, and tolerance for diversity and redundancy. Only if firms can continuously feed and renew this creative tension will they be able to catalyze innovation in a complex environment, maintaining high variety and variability, without degenerating into chaos.

Notes

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4. I. Nonaka and N. Konno, "The Concept of 'Ba': Building a Foundation for Knowledge Creation," *California Management Review*, 40/3 (Spring 1998): 40-54.
5. For more on theory of chaos, see A. Van de Vliet, "Order from Chaos," *Management Today* (November 1994), pp. 62-65; S. Kauffman, *At Home in the Universe: The Search for Laws of Self Organization and Complexity* (New York, NY: Oxford University Press, 1995); Beinhocker, op. cit., pp. 46-53; Youngblood, op. cit.; P. Cilliers, *Complexity and Postmodernism: Understanding Complex Systems* (London: Routledge, 1998).
6. Kauffman, op. cit.

7. K. Eisenhardt and S.L. Brown, "Competing on the Edge: Strategy as Structured Chaos," *Long Range Planning*, 5 (1998): 786-789.
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12. From an interview to Daniel Burrus, available at www.asaenet.org/publications/Amjun97/6norris.htm, p. 2.
13. See F.F. Schmitt, ed., *Socializing Epistemology—The Social Dimensions of Knowledge* (Boston, MA: Rowman & Littlefield, 1994); G. von Krogh and J. Roos, *Organizational Epistemology* (New York, NY: St. Martin's Press, 1995).
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17. The origins of knowledge as a social construction can be ascribed to Durkheim. He was the first to note that, by sharing knowledge, groups can develop and stock knowledge in ways that go beyond every individual cognitive capacities.
18. M. Boisot, *Information Space: A Framework for Analyzing Learning in Organizations, Institutions and Cultures* (New York, NY: Routledge, 1995a); Böhme, op. cit.
19. Nonaka and Takeuchi, op. cit.
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74. Xerox PARC is a research center divided into five major laboratories, several smaller research groups, and an operational support department. These include Eletronic Materials Laboratories, Computer Science Laboratory, Document Hardware Laboratory, Information Science and Technologies Laboratory, Systems & Practices Laboratory, an Office of the Chief Technologist and the RED, Research in Experimental Documents.
75. During the past two years, thirty percent of the technologies posted to AlphaWorks have been incorporated into IBM products or licensed to third party developers. By comparison, typical venture capital firms boast a 10% success rate for new technologies.
76. Microsoft President Steve Ballmer argues: "We do have a team out thinking through what kind of strategy is appropriate to make our source code, or parts of it, more available to customers so they can be more effective in what they do. . . . I don't call that a full embrace of the open source model...On the other hand, we're trying to understand what it is that really brings the benefit." Diederich, 1999 [Note to author: Need full reference for Diederich].
77. For a discussion on the relevance of a recognized identity as the basis for the emergence of strong communities, see Lave and Wenger, op. cit.; Wenger, op. cit.
78. For instance, connecting home appliances allows for controlling them centrally, connecting office equipment allows for people to share resources, and so on.
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80. For the notion of the "alignment gap," see E. Valdani, B. Busacca and M. Costabile, *La soddisfazione del cliente. Un'indagine empirica sulle imprese italiane* (Milano:

Egea, 1994); M. Sawhney and E. Prandelli, "Beyond Customer Knowledge Management: Customers as Knowledge Co-creators," in J. Malhotra, ed., *Knowledge Management and Virtual Organization*, (2000).

81. E. Rullani, "Prefazione," in *Reti di marketing. Dal marketing delle merci al marketing delle relazioni*, (Milano: Etaslibri, 1993).
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84. Adobe states that its online customer community, known as user-to-user forums, provides a virtual place where customers with common personal and professional interests can congregate, trade industry gossip and practical product tips, share ideas, and create a buzz around Adobe products. As this online community solidifies and expands, Adobe believes customers will become better spokespeople for Adobe than Adobe itself. From Gartner Group's Business Technology Journal: http://btj.gartner.com
85. Miller, op. cit., p. 24
86. The Extranet represents the bridge between the public Internet and the private corporate Intranet, connecting multiple organizations on-line behind virtual firewalls, where those who share in trusted circles can network and co-ordinate their value-activities in order to achieve common business objectives. This definition is from "The Extranet Solution: The Business Software Application for the 21st Century," published within the Web site by OneSoft Corporation.
87. B. Auteri, "Nuove basi organizzative per l'impresa eccellente," *L'Impresa*, 1 (1994); L. Falduto and M. Palitto, "Un modello manageriale per l'organizzazione che apprende," *L'impresa*, 7 (1996).
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