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Sustaining the Ecology of Knowledge by John Seely Brown

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ECONOMIC and social wealth in the New Economy increasingly depend on rapid knowledge creation. Organizations that create value through new products, services, and ideas will prosper. Those that fail to build the intellectual capacity and personal engagement of their members will stagnate. The generation of new knowledge, largely based on digital technology, is driving three fundamental shifts in the economy, each of which poses strategic challenges for leaders.

From conglomeration to demassification. Most products and services -- as well as markets and entire societies -- are breaking into smaller, more specialized units. In the realm of products, Moore's Law -- which says that the power of integrated circuits doubles every 18 months -- now applies to goods in all fields. Because integrated circuits are omnipresent, the distinction between low-tech and high-tech products is fuzzy at best. The performance of almost all products, including cars (which today may need an occasional software tune-up), medical equipment, home appliances, industrial goods, is improving at breakneck speed -- far faster than those products have traditionally evolved. And despite the recent wave of merger-mania, demassification also applies to organizations, which are outsourcing more and more of their work and which increasingly must tailor their products and services to individual tastes. Likewise, in families, schools, and communities, for better or for worse, fragmentation is becoming the norm. Power in the New Economy is shifting to the smallest possible unit.

From simply making products and services to making sense. Increasingly, leaders are becoming



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This article appears as "Sustaining the Ecology of Knowledge" (Chapter 8) in *On Creativity, Innovation and Renewal*. [Read more.](#)

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- [Table of Contents](#)
- [From the Editors](#)
- [Resources](#)

sensemakers, whether for customers, employees, or investors. How do you interpret the market? How do you sort out the forces reshaping the competitive landscape? Where might we be at risk as the world and the marketplace change? How do we respond to change? How do we build a marketing plan around latent needs, how do we engage the talents and energies of an often diverse and independent workforce? And perhaps most important for leaders, how do we design a truly agile organization?



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As leaders move from making products to making sense, we must focus on the shared sense of place -- whether physical work space, online networks, or organizational community -- that increasingly defines the quality of work life. In the process of creating these physical and virtual work spaces, we must find ways to foster intellectual capital that becomes inextricably bound to a sense of personal meaning.

From established rules of engagement to self-determined rules. Organizations in every field are seizing opportunities to create new business models. Consider the latest wrinkle in DVD, or digital video disc, technology. Rather than renting a video cassette or standard DVD, which must be returned to the store after one or two nights, the new Divx discs allow you to watch a video and keep it. But, typically, two days after your first showing, your Divx player must get a new password from a central computer and bill you for additional viewings. The future of this technology is far from certain, but it represents nonetheless a dramatic bid to change the behavior of a market. Such changes are evident in every industry, creating a new imperative for organizations to see more clearly, make sense faster, and learn faster than their competitors.



Turning Ideas into Knowledge

THESE trends may not provide a specific plan of action, but they make clear that the only winning strategy is to engage the full force of the firm in creating new knowledge (see [A New Law Of Knowledge](#)). Essential to the process of knowledge creation is the adoption of shared beliefs. Any new idea requiring a change of thought or practice must be justified in the eyes of colleagues, customers, and critical stakeholders before those constituents will be willing to act on it. This process is largely social; it depends on the credibility and standing of an idea's champions, the evidence that supports their case, and the way others in the organization or the marketplace respond.

Several years ago, for instance, banks lost a fortune trying to convince consumers to do simple financial transactions online. Today, as technology has improved and our acceptance of it increased, millions of people track and trade their stocks, shop for mortgages, and buy cars online. Such changes do not happen simply because a new technology or "better idea" exists; new technology and good ideas often fail. They happen when an idea is compelling enough to change personal and group beliefs. Any successful innovation must earn the warranted belief -- the authority -- of others in the community before people will embrace it. It is the willingness to act on belief that matters.

An organization is a knowledge ecology; it is fundamentally dynamic and gains robustness

through diversity. But ecologies cannot be designed; they can only be nurtured. The key to nurturing these ecologies is finding the balance between spontaneity and structure. People need both the latitude to improvise and the business processes to apply their knowledge. Thus, creative leaders must learn to be bold yet profoundly grounded. It's easy to be conservative and grounded, or to be radical and impulsive. It's hard to be both grounded and radical (and the literal meaning of the word -- "going to the root" -- suggests exactly the right approach). That is the discipline of knowledge creation.

My own experiences at Xerox PARC suggest ways to handle the creative tensions inherent in knowledge ecologies. Hundreds of people a year visit PARC and ask, "How do you manage creativity?" The answer is simple: you can't. You can manage innovation. But you cannot manage creativity, only foster milieus that promote it. You let the world do more of the work of creativity for you. That means, for one thing, giving people the freedom to fail and then reflect, because we learn far more from failures than from successes. In the athletic arena, for example, it is inconceivable that anyone who is afraid to fall could become an expert skier.

Nurturing creativity also means understanding the mind-sets of those most involved in the creative process -- and walking a tightrope between two fundamentally different creative motivations. A healthy knowledge ecology needs two types of contributors, characterized metaphorically as the serious scientist (analytical, focused, consistent) and the hungry artist (playful, transcending boundaries, unpredictable). How we bring together different cognitive styles largely determines the success of our strategic capabilities.

The key is to insist that both types be equally grounded in the mission of the organization. That is the essence of sensemaking. With shared understanding of purpose we can ask that people lash themselves to a problem. We must live the problem -- connecting with others, listening, and eliciting the cross-currents of doubt, debate, and exploration that surround any new idea. That is how to build a research or a marketing strategy, and how to build a knowing community.

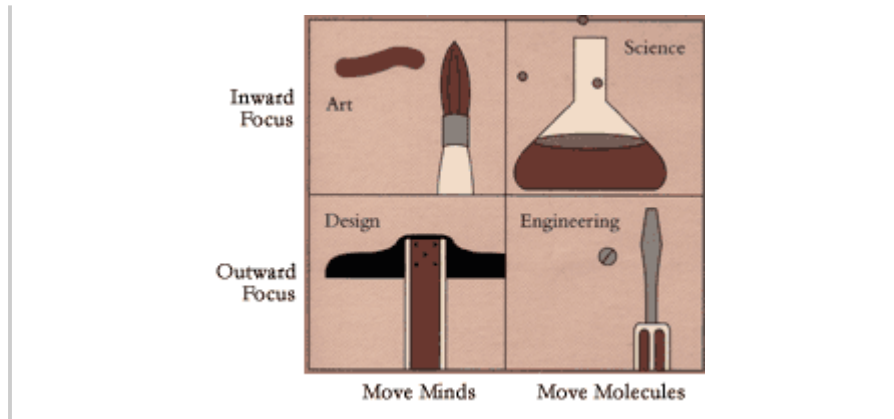


The Sociology of Science

IN sponsoring a knowledge ecology, Xerox PARC brought together physicists, sociologists, psychologists, anthropologists, designers, and artists. And in the process, a surprising thing happened. We had always held the traditional view that artists and designers are natural collaborators, as are scientists and engineers. We thought the barriers were between the soft disciplines of art and design on one hand, and, on the other, the hard disciplines of science and engineering (see figure). Artists and designers, after all, are trained to move minds; scientists and engineers are trained to move molecules. We were wrong.

Managing Mind-Sets

The perceived barriers between scientists (who move molecules) and artists (who move minds) are not significant in the experience of Xerox PARC. In fact, scientists and artists, who tend to be more inward looking, are highly compatible, as are designers and engineers, who are outward looking. Innovative organizations learn to be all four dimensions together.



It turns out that artists and scientists collaborate naturally, as do designers and engineers. Why? Both scientists and artists are concerned with looking inward. They're pursuing inner truth, self-expression. Can you imagine Picasso conducting a customer survey? Absurd. On the other side of the coin, no designer or engineer can succeed without thinking about the outer world of user needs and desires. The challenge is to devise dynamic structures that bridge these worlds. That is a leader's own creative contribution.

A powerful and largely self-governing structure for connecting people emerges from communities of practice -- the entities that actually do the work of the enterprise. Communities of practice are the working fellowships, both within organizations and across common disciplines, bound by shared interests and tasks. For instance, marketing, design, or accounting represent communities of practice that exist in every organization, and often such communities are the source of new knowledge. One mechanism that Xerox has developed enables us to apply the learning of a vital community of practice. The company has nearly 20,000 technical representatives, people who repair our customers' machines in the field, and every day some of them make discoveries. Because machines age differently in different settings, they develop unique histories and unique problems, not all of which can be predicted. So we tried to create a mechanism that tracks these discoveries, combines them in useful ways, and contributes to the company's knowledge.

We created a Web site where tech reps can post their tips or insights and get quick feedback from their peers. This is far more powerful than simply entering information in a database; it is a way to test new ideas, collect evidence, and mediate discussions electronically. If the peer review team cannot quickly validate or refine the idea, an expert is called who acts as referee, exploring the idea with others and ultimately accepting, improving, or rejecting submissions. Tips that are validated by this vetting process become sufficiently credible that other tech reps can act on them, and are posted for worldwide distribution.

One aspect of this feedback structure was decisive. Every posting carries the tech rep's name, along with the names of those who refine the idea. Because it is a relatively closed community, people who consistently contribute the best ideas become more central members of their community of practice. In every field, professionals draw much of their identity from their standing in their community of practice.

This process has afforded us an unexpected opportunity to see how social capital is created simultaneously with intellectual capital -- and demonstrates the necessity of respecting both. For example, when our managers first began to recognize the value of the tech reps' ideas, their first response was, "This is great, let's reward these postings with cash bonuses." But

the tech rep community said, 'No, we're doing this because it is important to us.' It was the intrinsic rewards that were driving people to share, debate, review, and then make their insights public.

Thus leaders must build systems that support the interplay of social and intellectual capital. It is impossible to do that without the help of the users of the systems. Our process, for instance, was codesigned with tech reps themselves. The key was simply to implement in a corporate setting the social dynamics and values that make science work. These dynamics grow out of the power of the peer review process, the ways ideas gain credibility, and a respect for authorship and reputation.



The Promise of Community

KNOWLEDGE creation is not an activity that can or should be confined to the work organization. Indeed, the transfer of knowledge not only within but also between institutions is the subject of debate in both academic and corporate circles. Some organizational researchers, for instance, characterize knowledge as *sticky* (subject to hoarding and difficult to move); others describe it as *leaky* (inherently mobile and difficult to confine). But Xerox itself has shown that knowledge can be both. The first personal computer and first graphical user interface (GUI) that led to the Apple Macintosh -- and later to Windows -- were both invented at Xerox PARC. These inventions did not move beyond our research lab, yet found their way to Apple and others who developed and marketed breakthrough personal computer products.

However, this famous "fumble of the future" was not the result of a grand miscalculation or obvious oversight (not obvious, at least, at the time). It was a failure of divergent communities of practice to turn ideas into knowledge that others could act on. Few people in 1978 understood the commercial potential of the personal computer. And PARC's small, eccentric community of researchers were as uncommunicative with outsiders (including engineers from down the hall) as we were inventive. Likewise, most others in the company (whom we as researchers derided as "toner heads") focused narrowly on what they knew best -- commercial copiers. It took a then tiny community of practice outside the firm -- personal computer designers -- to recognize the potential of the personal computer.

Yet even an uncommon ability to coordinate diverse communities of practice is not enough to move from invention to innovation.

Organizations play two key roles in that process. The first was

articulated by economist Kenneth Arrow 25 years ago: "innovation by firms is in many cases simply a question of putting an item on its

agenda before other firms do." And setting an agenda that reflects the skills, capacities, and mission of the organization means recognizing that what is right for one organization may not be right for another. The second task of organizations, of course, is to execute their agenda. Here again, leaders must attend to social patterns and practices, not just to strategy and technology.

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Community Beyond the Walls

COMMUNITIES of practice, so essential to knowledge creation within the organization, also sustain and are sustained by the broader community. The personal identity that emerges through community membership is seldom limited to one's place of employment. We all hold diverse and overlapping affiliations -- to our profession, avocation, neighborhood or region, political cause, or faith. And all enterprises rely not just on their own employees and suppliers but on many social resources -- colleges and universities, school systems, public and nonprofit institutions -- for the expertise and infrastructure to operate.

What makes Silicon Valley, Hollywood, New York's financial district, or London's theater district so dominant in their fields are the porous relationships among myriad communities. The flow of knowledge among organizations is as important as the flow within. Partners and competitors live in complex symbiosis; the boundaries between organizations are fluid, and ultimately everyone benefits from the movement of people, goods, and ideas. These centers of expertise are the result of *regional* knowledge ecologies. The dense overlap of shared interests and varied affiliations is what makes these regions so vibrant.

Sometimes regional ecologies spawn conscious collaborations, such as Joint Venture: Silicon Valley, a nonprofit partnership of businesses, government agencies, labor, professional organizations, and foundations. Its conferences and demonstration projects address economic, environmental, educational, and quality of life issues affecting four counties and 2 million people.

Whether or not they develop such formal efforts, all regional ecologies create their own social architecture -- structures and cultures that allow members to both construct and consume knowledge. One of the most powerful of these structures is the Internet. No other vehicle provides the reach and reciprocity needed for knowledge sharing across geographical, organizational, and professional boundaries. The Internet augments rather than replaces the kind of shared space and work practices inherent in a region and essential to a knowledge ecology.

Just as no one manages the Internet, no one can manage a knowledge ecology. But we can understand the working principles of our communities, adapt our roles to be more effective, and improve the tools that support creativity. In the knowledge economy, therefore, management gives way to mission. It is people's commitment to the continuous generation of knowledge that gives life to the communities on which we all depend.



A New Law of Knowledge

Volumes have been written on the nature of the New Economy. At the risk of both hopelessly complicating and oversimplifying the picture, I propose a Newtonian-like "law" to describe the competitive dynamics of the knowledge economy.

The formula given here represents a straightforward proposition: if knowledge equals a belief leading to action, learning is simply the increase of knowledge over time. Sustainable competitive edge, then, can be seen as the differential rate of learning. It's a function of the number of people in the firm who learn differentially faster than competitors. In other words, in a time when both the rate of change and the growth of knowledge keep accelerating, the more people you have who can learn more in a shorter time, the more competitive you will be. I illustrate these forces as follows:

- Knowledge (warranted belief leading to action) = K
- Learning (the rate of change of knowledge over time) = $L = dK/dt$
- Sustainable competitive advantage, or force of the firm (the differential rate of learning) = $F = dL/dt = md^2K/dt^2$ (where m = size of firm)

Such is a metaphoric description of knowledge economy. The real formula for success is less mechanistic; it requires the creative energies of everyone associated with an organization, as well as careful stewardship of an organization's shared purpose and practices.

Created with the help of Sandy Campbell, vice president, special programs, corporate research and technology, Xerox Corporation

[Return to reference](#)

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