THE RISE OF COLLECTIVE INTELLIGENCE
**Decentralized Co-Creation of Value
as a New Paradigm of Commerce and Culture**

By David Bollier

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The complicated dance between humans and computers appears to be moving to a new stage of development. As the Internet becomes a pervasive platform for commerce and culture, it is giving rise to radically new platforms for creating collective intelligence. Sometimes known as Web 2.0, this new generation of Web-based software has powerful capacities to help people share, collaborate and interact as social communities. The Web 2.0 universe is exemplified by such innovations as blogs, wikis, social networking Web sites and metadata tools for organizing information. By facilitating new types of social interaction and collaboration, the new platforms are gradually remaking many varieties of market behaviors, business strategy and organization, educational practices and modes of cultural expression.

Every year, the Information Technology Roundtable of the Aspen Institute Communications and Society Program examines a timely issue that is posing perplexing new challenges for business, culture and society. In 2007, the gathering met to explore the many ways in which network-based communities are becoming socially and economically significant. The phenomenon has been called "decentralized co-creation of value" — the process by which social communities and loose networks of people use Web 2.0 platforms to generate useful new types of collective intelligence.

Although the value that is created tends to be social in origin, it has far-reaching economic implications for business and nations. Online communities are often rich sources of innovative ideas, specialized knowledge, timely and sophisticated market intelligence and niche consumer demand. Moreover, because this decentralized value-creation is occurring online - and therefore is widely available — it is capable of diffusing rapidly and disrupting entrenched institutions and societal practices.

A memorandum by the consulting firm McKinsey & Company puts the matter starkly: "Value chains are breaking up and re-forming." Linear value chains are reconstituting themselves as loose social communities that, thanks to the Internet and Web 2.0 software, are creating value in innovative, decentralized ways.

To get a purchase on the issues at stake, the Aspen Institute invited twenty-seven technologists, entrepreneurs, computer industry executives, management consultants, venture capitalists and academics to meet in Aspen, Colorado, from July 31 to August 3, 2007. The discussions were moderated by Charles M. Firestone, Executive Director of the Communications and Society Program. This report is an interpretive synthesis of those discussions by rapporteur David Bollier.

I. THE RISE OF COLLECTIVE INTELLIGENCE

Collective intelligence has existed as long as humans have been around, in the form of families, companies, countries, armies and other institutions. But in recent years, said Thomas Malone, the Founding Director of the Center for Collective Intelligence at the Massachusetts Institute of Technology, the Internet has spawned a number of new paradigms of collective intelligence. Web-based software tools are enabling people to interact and collaborate in new ways.

The Google search engine represents one such innovation. Its PageRank system analyzes massive numbers of Web links, created by millions of people, to determine which Web pages are the most popular and thus most likely to be useful. Wikipedia also represents a new system of collective intelligence, said Malone. It has enlisted "thousands of volunteers around the world to collectively create a very large and amazingly high quality intellectual product, with very little centralized control," he said.

Other examples readily come to mind. Digg is a community-based website that uses social bookmarking, blogging and syndication to identify and showcase articles on technology and science that have popular appeal; Digg has been called "a form of non-hierarchical, democratic editorial control."[1] NASA Clickworkers is a project that uses tens of thousands of volunteers to classify the size of craters on the surface of Mars, saving NASA the expense of having to hire highly trained planetary scientists.

In his 2006 book, *The Wealth of Networks,* Yale Law School professor Yochai Benkler called this style of co-creation "a new modality of organizing production: radically decentralized, collaborative and nonproprietary, based on sharing resources and outputs among widely distributed, loosely connected individuals who cooperate with each other without relying on either market signals or managerial commands. This is what I call 'commons-based peer production.'"[2]

To give an idea of how collective intelligence may or may not work, Professor Malone gave four examples that yielded varied results:

Can fans manage a baseball team through online voting? In 2006, the Schaumberg (Illinois) Flyers, a minor-league baseball team, invited fans to vote over the Internet to make all the decisions that would ordinarily be made by team management — the batting order, pitching rotation, starting line-up, and so forth. "They had a disappointing season," said Malone, "and a lot of people thought the decisions made by the fans had actually made the season worse." The experiment may be "an instructive failure," he said: it showed that fans just didn't have the expertise or motivation to make the right decisions, while management probably did. Some observers even wondered if fans for opposing teams may have voted in order to sabotage the Flyers' chances of winning.

Can chess fans informed by expert advice collectively beat a world chess champion? In 1999, Gary Kasparov, then the world champion in chess, agreed to play a chess game against "the world," which would vote over the Internet about which moves to make. Each side was given twenty-four hours to decide which move to make. The thousands of chess fans who were collectively playing against Kasparov participated in extensive online discussions before voting. But significantly, they were guided by the commentary of five well-known chess experts who offered their analyses after each move by Kasparov. In the end Kasparov won, after sixty-two moves (and four months of play). But he conceded that it had been the hardest chess match of his career.

Can tens of thousands of volunteers write and compile an accurate encyclopedia? **In** only six years, Wikipedia has emerged as an improbable success in its ability to coordinate mass collaboration in writing an encyclopedia. With only an annual budget of less than $1 million and seven paid staff, Wikipedia has enlisted the help of tens of thousands of volunteers to produce an online reference Web site of more than 8.2 million entries in 253 languages. In a December 2005 assessment of Wikipedia's accuracy, *Nature* magazine found it roughly equivalent to *Encyclopedia Britannica.*[3]

Can thousands of volunteers successfully collaborate on a book? A joint product by the Sloan School of Business at M.I.T, Wharton Business School and Pearson Publishing sought to produce a book called *We Are Smarter Than Me.* Over 4,000 people registered to participate in the wiki-style project. In the end, only a few dozen people actually contributed material and deadlines were not being met, prompting the publisher to hire a team of professional writers to write most of the book.

As these examples suggest, the decentralized co-creation of value is not "magical," said Malone. It often does not work and, indeed, may often result in a kind of collective stupidity. Artificial intelligence pioneer Jaron Lanier, in fact, has railed against what he calls "Digital Maoism."[4] If anything resembling collective intelligence is going to emerge, Professor Malone warned, we have to consider three key questions:

- How can we collect the right people and computers?
- How can we connect them in the right ways?
- In what situations will these things actually work?

Professor Malone's presentation triggered a larger discussion about these very questions. What factors are necessary for the decentralized co-creation of value to succeed?

The first threshold of judgment must be "what are you trying to achieve?" A project that is attempting to brainstorm new ideas will have different design parameters and features than one that is trying to build open source software or manage a corporate wiki. In short, there is no single approach to online collaboration that can apply to all situations. Context matters. The particular online community matters. Having noted this fact, there was consensus that one of the most influential factors of successful online communities is the personal motivations of participants.

Why Collaborate and Share?

In his study of online collaboration, Professor Malone said that, "over and over again, the most important issue that I have seen is the whole question of motivation and incentives." A number of people shared the view of John Kunzweiler, a retired Senior Partner of Accenture: "I believe in voluntarism, but I also believe that everything needs to have an incentive structure. People are busy, and talented people are really busy, and what gets them to do this stuff? What are the incentives for people to apply their intelligence to someone else's project?"

Brad Johnson, Principal of McKinsey & Company, noted that "there is increasing evidence that contribution leads indirectly to financial remuneration." At the Web site TopCoder, which builds and sells software programs, "people who receive high ratings are likely to earn higher wages and get better jobs in the future," said Johnson. He worried that "if people's incentives are non-financial, and if they're not directly linked to your site, how do you prevent them from migrating away?" Fun, fame and entertainment may be a form of motivation for people to contribute to a project, but he after the "novelty effect" wears off, will anything persist?

Chad Hurley, Chief Executive Officer and Co-founder of YouTube, conceded that people upload videos to his company's Web site "because they want to be seen and they also want to have fun doing it. There is also the promise that they could potentially become famous." In catering to this motivation, YouTube enjoys the benefits of network effects, said Hurley. YouTube has attracted the largest audiences for user-generated videos, and so it is the site that is more likely to make an amateur videomaker famous.

But Hurley stressed that YouTube does not just cater to its video contributors, but also to its viewers. "A relatively small percentage of people are actually uploading," he said. "The larger majority of people are consuming, and there are two types of people who are consuming — the passive consumers, who view the site without using any of the features to mark their favorite videos, for example, and the engaged consumers."

Although user voting helps identify the most popular videos, Hurley said that YouTube is trying to find ways to "leverage people's collaboration just through their passive use of the site." The goal is to try to "create a better discovery experience.. ..The less we can ask of [users] to do specific actions, I think the more successful we will be."

To encourage continued participation on YouTube, Hurley said that the company has recently started compensating not just its top partners, but about "30 to 40 of our top users." "At first, we didn't want to create a community that was based on monetary rewards," he said, "but we feel that our community is large enough now that we can move in that direction."

In thinking about co-creation, Donald Proctor, Senior Vice President of the Collaboration Software Group at Cisco Systems, stressed that the benefits must be shared by both consumers and contributors; the community must be seen as a "two-sided network." We need to think about the value that the consumer is getting from co-creation," said Proctor, "but we also need to think about what value the contributor is getting, whether that is commercial value, reputation-based value or other types of value."

The real issue is perhaps not one of *incentives,* said Max Mancini, Senior Director of Platform and Disruptive Innovation at eBay, so much as *motivation.* "We live in a world where we think about how to measure the value of your contribution, but co-creation is not that. Co-creation has its incentives elsewhere." Mancini suggested that those "incentives" are, in fact, deep personal motivations — the desire for personal expression, for social connection, for cooperating to advance shared ideals. By contrast, incentives are about easily measurable deliverables - specific, executable outputs that can be quantified.

Shona Brown, Senior Vice President for Business Operations at Google, said that her company has tried to foster a sense of personal motivation, a desire to collaborate and

community rather than focus on incentives. "We are a very informal, project-oriented, relatively loose organization," she said. "If you actually participate and collaborate with lots of others, you learn. You will become part of the 'densest node in the network,' which is a byproduct of collaboration. Second, if you participate in informal collaboration, where you help others, you're actually better at getting things done. Third, you're actually respected as someone who knows how to get something done." In these ways, Google tries to encourage community-building as a "way of being" rather than focus on specific job competencies.

The paradox of a community as a locus of value-creation is that it can be highly effective in performing certain tasks, but individual performance can be difficult to isolate and measure. It is the web of relationships, and their unpredictable synergies in a loosely controlled context, that generates value.

This may help explain why voting in online networks may be too crude a tool for generating collective intelligence. "Where integration [of judgment and ideas] is critical — choices about what goes in, what stays out — those can't be resolved through a basic voting mechanism," said John Hagel, Co-Chairman of the Deloitte & Touche Center of Innovation in San Jose.

Jacques Bughin, Director of McKinsey & Company, agreed: "If you vote, maybe it's right or wrong. But the question here is, *Who's* going to vote?" Just as the market can fail to deliver on its stated ideal, so voting can have skewed outcomes, said Bughin, who co-leads the McKinsey Technology Institute with James Manyika. He wondered whether "the average of the voting is the right metric" for determining the collective intelligence because, in voting or group recommendations, he said, people tend to be either overly negative or overly positive. This leads to a bi-modal distribution of votes, where the average is obviously not the right metric.

Dan E. Khoo, Vice President of Business Strategy and Transformation Unit at the Multimedia Development Corporation in Malaysia, noted that voting without consequences to the voters can make outcomes less reliable. "Sometimes if there are penalties involved, as in the market when you vote with your money, you can get better results. In those cases, if you don't vote well, you lose money."

In relying on voting systems, there is a fine line between "mob rule" and the "wisdom of crowds," said Robin Harper, Vice President of Marketing and Community Development at Linden Lab, the company that runs the immersive online environment, *Second Life.* "What's rising to the top, and is it really the best? Is it reflective of people's involvement in the content, or is it reflective of some other dynamic going on? It may have nothing to do with collective intelligence and everything to do with gaming the voting system," said Harper.

Attracting the "Right" People

In the quest to harness decentralized co-creation of value, a conundrum quickly arises: You want the right people to participate — but how do you know in advance who the right people are? This problem can be seen in *We Are Smarter Than Me,* the wiki-based book-writing experiment cited by Professor Malone. "How do you know who the right people are?" asked Padmasree Warrior, Executive Vice President and Chief Technology Officer for Motorola. "We have to be careful, when you say 'let's connect the right people,' to not change *collective* intelligence into *selective* intelligence. There's a danger in excluding different viewpoints."

One interesting way of dealing with this problem, said Professor Malone, is through self-selection. He cited the Web site InnoCentive, which allows "seekers" - often major multinational corporations — to anonymously post their research and development challenges on the site. "Solvers" can then come forward with their own proposed solutions. Over 100,000 people from around the world have used the Web site, which awards cash prizes ranging from $5,000 to $100,000 for problems solved.[5]

Malone explained: "Filtering is done by the potential problem-solvers — because thousands of people can look at a problem — but they have no real incentive to go to work on it unless they think they have some advantage in solving that problem. So there, you can let the vast community self-select those who are the right ones to be working on this particular project."

For certain type of collaboration, however, you need to structure in constraints in order to generate any collective intelligence. Arjun Gupta, Founder and Managing Partner of TeleSoft Partners, noted that "the new tools are making decentralized co-creation more unconstrained, so you're getting dramatically larger numbers of participants. This leads back to the familiar software development principle, the "mythical man-month" - the title of a 1975 book by Fred Brooks — which holds that assigning more programmers to a project will actually delay a software project, because adding more participants requires greater overhead and complexity to coordinate the work, while simultaneously producing more errors that then have to be corrected.

So any decentralized co-creation of value must consider the optimum size of the project and the system for coordinating and synthesizing work. "There must be some way for group norms to take root - where either overproducers start becoming 'experts' or non-producers start to be ejected, said Gupta. "At the end of the day, someone has to synthesize things into something real."

In this process, the absolute size of a community can matter. Jacques Bughin pointed out that "2 percent of the people who contribute material to YouTube contribute 90 percent of the content. So it is no wonder, if you have a corporate wiki in a company of 1,000 people, that there are so few contributors of content. With Wikipedia, which has a huge body of contributors, however, it works."

The unacknowledged reality of many communities of co-creation is that a handful of participants tend to have a disproportionate influence. Some contributions are more valuable than others, after all. So hosting a diversity of people means managing a diversity of social roles: the online bullies, the workhorses, the lurkers who may have a great deal to contribute.

This prompted Kris Hagerman, the Group President of Data Center Management at Symantec, to observe, "As we're building these different communities to create value, either within a corporate setting or outside of it, we need to think through how you set it up, what kinds of people you attract, what kinds of tools you put at their disposal, and then how you manage that, so you can stay in front of the extracurricular activity that is not really based on the merits."

Unlike a workplace, where people are assigned job responsibilities and roles, people who voluntarily join online communities self-select themselves to fill certain niches in the social ecology. "People tend to take on roles in that community," said Robin Harper of Linden Lab. "One of the challenges that we have, then, is how do we help people feel comfortable with those roles? How do we make sure that those roles stay relevant?"

Here is where leadership and governance structure play important roles. Collective intelligence requires a certain diversity of talents and perspectives — yet that diversity needs to be managed. Unconstrained diversity can end up being chaotic, unwieldy and dysfunctional if it is not coordinated to serve a shared goal.

Diversity may be largely irrelevant, said Professor Malone, "if you have a problem that is simple, in a certain sense. In some cases, diversity can even be counter-productive. People with very diverse viewpoints may find it hard to talk to each other, and that can actually slow things down, if you have too much of it where it's not needed."

More generally, however, diversity is likely to add value. John Seely Brown, Director Emeritus of Xerox Palo Alto Research Center, cited a recent book by University of Michigan professor Scott Page, *The Difference: How the 'Power of Diversity Creates better Groups, Firms, Schools, and Societies* (Princeton University Press). By diversity, Page does not mean the conventional sense of diversity as cultural acceptance of differences in ethnicity, gender and sexual orientation. Page's thesis is that a diversity of mindsets, expertise and personal styles

are critical to developing a collective intelligence — or in his words, "diverse people, working together and capitalizing on their individuality, out-perform groups of like-minded experts."

Brown elaborated on Page's themes, saying, "You want people with diverse perspectives; you want people with diverse heuristics; you want people with diverse interpretations within a given perspective, and also people who have diverse predictive models — 'How do you predict what's going to happen if we do x?'"

In Page's sense of the word, diversity is not just an enlightened cultural norm, it is a functional imperative. Diversity can be important in helping to solve "hard problems," said Brown — problems that require so much time that no one can solve them alone. "Such problems — exemplified by global climate change — are amenable to distributed parallel agents that show the kind of diversity that Scott Page talks about," said Brown. "That is actually how we're providing optimal solutions to problems that can't be solved through exhaustive thinking and research."

The online gaming community serves as a kind of living Petri dish for observing the power of diverse perspectives and talents. John Seely Brown noted how the single most important thing in the online game *Worlds of Warcraft is* building a guild. "And the success of the guild turns on how you get the right kind of diversity. Now, we all *say* this in the corporate world, but in the gaming world, they *know* this. And furthermore, they do it!"

The governance of a guild, or any online community of co-creation, requires certain rules and norms. While the design principles for online communities have not been rigorously studied (the phenomena remains relatively new), some observers look to a literature on the commons that draws upon political science, sociology and anthropology. Scholars such as Elinor Ostrom have identified a number of important design principles for sustainable commons: clearly defined boundaries of community membership, rights of access and participation, conflict-resolution mechanisms, policing against free-riders, and graduated sanctions against miscreants.[6]

Such principles are apparently at work at Wikipedia. Joichi Ito, Co-founder and Board Member of Digital Garage, described how that community has a set of escalating governance models for dealing with conflict. "First you try to reach consensus," he said, "then you vote, and then it goes to the board, and then to the benevolent dictator" — which is Wikipedia's case, is co-founder Jimmy Wales. "The point is that you really have to look at these groups of people as communities rather than as markets or bundles of workers," said Ito.

Or, as Troy Pearsall, Executive Vice President of Technology Transfer for the intelligence community's strategic investment firm, In-Q-Tel, put it, "A lot of these business

models develop around stewardship of a community. The challenge is to steward a community in a way that creates value — while ensuring that the community doesn't revolt."

Varieties of Collective Wisdoms

If decentralized co-creation of value is so potent, and yet variable in how it manifests itself, there is an inevitable desire to find ways to judge the efficacy of a given instance of collective intelligence. "Can we find ways of measuring the ability of a group to perform well on a wide range of tasks in a sensible way?" asked Professor Malone. "Can we measure their flexibility or adaptability in the same way that general intelligence measures that sort of thing?"

The answer may hinge on what *type* of collective intelligence is being judged. There is no generally recognized taxonomy or typology for assessing such communities. However, as a thought experiment, Dan Khoo of Multimedia Development Corporation of Malaysia, proposed a framework for evaluating collective intelligence from a procedural perspective — input, throughput and output. The idea is that different metrics might be applied to the efficacy of an online community based on its process functions.

An *input model is* illustrated by YouTube, in which the key task is to gather material from contributors and post it on the Web site; this model contains very little "throughput" such as selection, editing, synthesis, and so forth. A *throughput mode is* exemplified by InnoCentive, the Web site that adds value by providing detailed analyses of R&D questions that are posed. Finally, a collective intelligence based on an *output mode is* exemplified by the Schaumberg Flyers example, in which fans voted on how the minor league baseball team would be managed. The "output" was the actual performance of the team.

Since the communities that generate collective intelligence vary so greatly, perhaps another way of judging them is to pit one model against another. "One of the strategies could be, How do you use collective wisdoms to beat collective wisdoms?" said Gilman Louie, Partner of the venture capital firm Alsop Louie Partners. Louie noted that most collective-intelligence models are based on sharing, while market-based economies are based on finding ways to exploit momentary advantages in the marketplace. So could an experiment be devised to see if people can use collective wisdom to exploit discontinuities in market performance? He cited a new company that is trying to use collective intelligence systems to try to beat the stock market.

This raises the provocative question, In what circumstances is decentralized co-creation better than a market-based model? Jacques Bughin believes the collective intelligence may play a powerful role in identifying "information asymmetries" in the market,

which can then be exploited by nimble entrepreneurs. Decentralized co-creation may also be able to generate new types of innovation more rapidly than the market. In economic terms, said Bughin, "If your demand side has demand externalities, maybe sharing part of the consumer surplus is a much better model than anything else."

This dynamic is well-illustrated by the work of Eric von Hippel, a professor of management and innovation at M.I.T. and author of *Democratizing Innovation.* Von Hippel had studied a variety of "innovation communities," of users, particularly in "extreme sports" such as extreme sailplaning (gliding) boardcross (a kind of snowboarding) and kitesailing. In these sports, it turns out, fanatical user communities are vital sources of new ideas that often have commercial value. These amateur-driven innovations bear a close resemblance to the kinds of innovation generated by open source software hackers.

The point is that an innovation commons can generate a demand-side surplus that can be shared by the community, yet still be plentiful enough for manufacturing firms to make proprietary products and profits.

Another example of "sharing the demand-side externalities" is the learning that occurs in "process networks" of hundreds of suppliers. John Seely Brown described how apparel maker Li & Fung in China has assembled a vast network of suppliers who cooperate and learn from each other (described in greater length below, on page 16.) "In Detroit," said Brown, "no one learns from each other. But if you look at the way process networks in China are working, it's just amazing the amount of learning that's actually happening between these guys. That is their motivation, as much as rent distribution [i.e., a larger share of market revenues]. We tend to think of rent-distribution as the sole goal, but the value of accelerating capability in learning is also important."

For all the excitement about using online communities as a base for profitable business models, Joi Ito cautioned that an online community is not a business model, and must be respected on its own terms. (Ito is Co-founder of Digital Garage, a Web solution provider and business incubator, and Chair of the Creative Commons.) "I run a lot of online communities," said Ito, "and we don't really use words like 'markets' or 'incentives'. Those words make the Internet sound like a thing that creates stuff that you access - but it's actually more like a place where communities share co-presence, where you go to hang out…. I hear the language of business being used to describe co-creation, but to me, co-creation is a byproduct of a successfully balanced, powerful community."

II. COLLECTIVE INTELLIGENCE IN BUSINESS

As the discussion of Part I suggests, the rise of decentralized co-creation of value has some profound implications for business. It is an alternative, non-market vehicle for generating useful information and innovation, one that does not necessarily conform to conventional economic theory and market practices. For individual firms, in particular, decentralized co-creation is posing perplexing challenges for business strategy, business organization and culture, and corporate branding.

Open Networks and Business Strategy

As open networks have empowered individuals and user communities, the very roles of "producer" and "consumer" have started to blur. Some business analysts have used the word "prosumer" and "prosumption" to describe - in the words of a McKinsey & Company briefing paper — "the increased involvement by customers and end users in various aspects of product design, development, marketing, selling and servicing. Just as technology allows businesses to interact more directly with their customers, the next logical step is the inclusion of customers directly into value-delivery systems."[7]

At a certain level, businesses recognize the need to incorporate the principles of decentralized co-creation of value into their business models, said Jacques Bughin of McKinsey & Company. Roughly one-third of all companies that McKinsey surveyed is trying to use collaborative technologies, and about 20 percent of these companies is trying to use collaborative tools to go beyond classical knowledge management within their companies, and go to the edge."[8]

This strategic reorientation is spurred by the shifting locus of value-creation — from business-to-business commerce to consumer-to-consumer intelligence, said Bughin. "The competitive advantage that companies had hoped to get is no longer with Web services. It's really about trying to harness collective intelligence on the demand side. At least, that's what they hope to do."

Brad Johnson, Principal of McKinsey & Company, offered a number of examples of companies that use consumer-to-consumer intelligence to develop "mass customization" strategies.

Adidas, the shoe maker, is now selling custom-designed shoes to ordinary consumers. "After measuring your foot, you can specify the level of padding you want, the type of padding you want, the aesthetics of the design, etc.," said Johnson. "Adidas takes your input and makes your shoe." This "mass customization" is also a tool for acquiring highly refined market intelligence, said Johnson: "By aggregating input from all the folks who are making their individual shoes, and understanding a little bit about their demographic background, Adidas gets a much better idea of lead-edge demand. That's what Adidas and other apparel manufacturers are starting to do."

Johnson also cited the innovations by Longine in using decentralized expertise in producing motorcycles. "This is physical manufacturing that is done in a distributive way. The lead manufacturer specifies a high-level architectural design, and then a network of co-creators compete to build, for example, an exhaust system or chassis or whatever. This system has enabled Longine to decrease its costs by 70 percent and make massive share gains in markets like Vietnam, which they entered."

The toymaker Lego is famous for inviting its customers and others to design and suggest specific Lego pieces the company should produce and market. "In 2005, the company actually created something called the Lego Factory," said Johnson. "You can go to the Web site, download basically a CAD [computer-aided design] package, and design your own Lego pieces, as well as the assemblage of those pieces, such as a castle, fire truck or whatever."

"What's interesting is that Lego holds an annual competition," Johnson continued. "They actually select designs from this huge pool of contributions to enter into their retail sales. The winners get 5 percent of whatever the cumulative retails sales of their designs are. So there is a clear potential economic value. Seventy-seven thousand models of Legos have been designed in this way. Lego is expecting two benefits, which are only partially realized now, because the experiment is new: 1) a 10 percent decrease in design and labor costs; and 2) a 10% increase in revenue."[9]

A final example offered by Johnson is the Open Prosthetics Project (www.openprosthetics.org), which uses distributive co-creation to develop customized prosthetics of amputees. The project "is a system by which people can contribute to both the design of a prosthetic limb and/or the specification of prosthetic limbs that ought to be designed — even if they don't know how to do it. This has come up with some pretty interesting things — like limbs that are specifically adapted for rock climbers and an arm designed for fishing.

The real power of these models is their capacity to amass dispersed and specialized consumer preferences, and then to use the knowledge as the basis for innovative new

business models. Jacques Bughin cited the fascinating case of insurance sites in Germany that are using the Web as a new "infomediary" model, whereby people provide additional information for risk underwriting in a way that is as effective as local independent brokers. By using this information, the brokers are able to pass along savings on insurance to consumers while making a greater profit themselves. Having acquired 3-4 percent of the market in Germany, the brokers are now proposing to underwrite the insurance premiums of major insurers on a commission basis.

Startup companies that are so immersed in the collective intelligence of their customers — in an ongoing, responsive, evolving way — are "beta-forever companies," said Gilman Louie. "It turns out that customers are much more loyal to companies that respond almost immediately to the wiki-blogs about the product than those companies that do not," he said. "We've watched companies with inferior products gain market share and eventually bypass the superior product because they're willing to iterate every day. There is a relationship between the customer and the people building the product."

Chad Hurley of YouTube said that this is precisely what his company strives to do: "It's about listening and adapting — and getting your organization into a place that can move at that speed. When Steve [Chen] and I developed the site, we were pushing out changes to the site every day. Now there are more people involved, and more development, and we have a push every five weeks. That's still rather quick in terms of turning things around. You just can't wait an entire quarter, or an entire year, to make a change. When you receive feedback, you have to take that feedback and figure out how to make changes as you go along."

The demands for real-time feedback and innovation are getting exponentially more difficult, it seems, as the Generation X demographic goes mobile, with cell phones personal digital assistants, text-messaging and other mobile devices. Web pages and Wikipedia may not be the model for collective intelligence-gathering for the mobile generation, predicted venture capitalist Gilman Louie. "The next generation doesn't care about Web pages because they're mobile. They've got a screen about *this big"* he said, holding his thumb and forefinger together. "And they don't really care about brand. They care about instantaneous information. From a corporate strategy point of view, the question is, How do you turn that real estate into something of value? It really comes down to the time-value of information. It isn't who owns the information, or who owns the customer, but who can integrate that information and provide that market intelligence quicker than the next guy."

The time-value of information is intensified by the growing use of mobile communications and computing. The presentation of content is no longer confined to the computer screen; it has become far more fluid because people can "place-shift" and "screen-

shift" their content to different appliances so readily. So the Web is not the sole venue on which decentralized co-creation of value will occur.

Building an Organization and Culture
That Can Leverage Decentralized Co-Creation

The rise of decentralized co-creation as a new value-proposition has daunting implications for business organization and culture. Existing systems are not likely to enable the rapid learning, adaptation, innovation and mindsets needed to compete in a networked environment.

As Bughin put it, "Currently, management is hierarchical, competence is considered a matter of job function, and contributions are made by job description. We need to move toward more modular co-creation and 'edge competence' in order to capture the kinds of innovation that occur at the grassroots." The familiar conflicts between marketing and R&D departments, he said, are mostly an artifact of existing organizational forms. A system of decentralized co-creation shows how they can be integrated more seamlessly.

Similarly, the supply chain (production) and demand side (consumption) should not be regarded as separate entities, said Bughin. The two sides need to become more integrated, modular and cooperative, he said, citing Google and eBay as platforms that sit astride both consumer contributions (recommendations, reviews, reputation systems) and sales. These companies are exemplary in sitting in the middle of consumer-to-consumer intelligence, he said.

In light of these emerging trends, Bughin offered the hypothesis "that your organizational model has to change drastically. It's probably a bad system because systems are usually very structured. And guest what? Knowledge management has failed badly simply because it's too structured. The reason is because most information is *not* structured, and will never be captured in knowledge management systems." The most natural, accessible form of knowledge, he said is "conversation."

Online games provide some clues for how knowledge platforms ought to be designed, Bughin said. The best ones — like *SimCity* and *Second Life* — provide a platform on which collective intelligence can emerge. No contract can design the proper incentives for this to occur, but the design platform itself can incentivize people to share useful information, he said.

Companies face some formidable challenges, however, in moving from old organizational structures to new ones that can leverage decentralized co-creation. Brad Johnson enumerated some of the key issues: control over intellectual property, quality control, liability, operational risks and branding. Shona Brown of Google pointed out

another reason why large companies have trouble revamping their organizational structures. They are invested in the old business models and have not yet figured out the risks of the new models. They may see genuine opportunities, but those opportunities entail new content formats, risk factors and revenue models. So it can be quite difficult to relinquish the old and embrace the new.

"The only way to get large companies to deal with such issues," said John Hagel of the Deloitte & Touche Center of Innovation, "is to figure out pragmatic migration paths. How can they start to participate in decentralized co-creation of value in small ways, consistent with their current market assumptions?"

Bughin agreed that making the transition from a legacy system is very difficult. But he wonders if it is even worth trying to revamp legacy systems in a piecemeal fashion: An effective path migration is "not about doing it step-by-step, and saying, 'I've changed my organization to be more flexible.. .or simpler.. .or more relationship-based,' and all that," said Bughin. "No, actually, you need to change everything.. ...It's about dynamic capabilities. It's about transparency. It's about loose control."

When innovation is so fast-paced and driven by mobile customers, it is tempting to believe that you have solved your organizational problems by installing a new wiki Web page, for example. This idea is laughably inadequate, said GiJman Louie: "We know things are bad when the intelligence community stands up and says, 'Our solution to bad intelligence is to create a wiki.' I mean, that *is* the strategy they are using. But it doesn't work if the fundamental culture hasn't changed in the first place."

John Hagel believes that even the InnoCentive Web page (discussed earlier) is something of a half-way measure: "There is not a lot of distributed collaboration around that. It's more transactional. There are no long-term relationships built through that kind of mechanism."

For large public companies, finding an effective migration path can be blocked by their own attitudes toward control and trust. In a milieu of decentralized co-creation, innovation requires *less control* and *greater social trust* — yet public companies are used to exercising a great deal of control in order to deliver predictable results to Wall Street.

John Seely Brown described the conundrum: "Large companies get predictability by having extreme control. When you have extreme control, you actually *lose* trust. So basically, you might say that they have high-control environments because they don't trust, or conversely, because they assert control, they don't have trust. It's not clear which comes first; it is chicken-and-egg. But the point is that there is a very deep relationship between being unwilling to trust and wanting total control."

Brown suggests that there are some attractive alternatives to strict corporate control. He described the "Creation Networks" that the Chinese apparel maker Li & Fung has developed as a way to orchestrate diverse design and manufacturing capabilities. As described in Brown's book, *The Only Sustainable Edge* (co-authored with John Hagel), Li & Fung has few assets, but a global supply network of more than 10,000 companies.[10]

"If you join the Li & Fung network," said Brown, "it will guarantee buying at least 30 percent of your goods, but never more than 70 percent. So, if you are a supplier, you are encouraged to develop other relationships. The system is a very interesting accelerant of trust and also an accelerant of learning." Suppliers have a keen incentive to learn from each other, collaborate with and trust each other, and collectively innovate. An important reason for the company's 30-50 percent return on investment and $5 billion in revenues is its institutional ethic of "low control and high trust."

Max Mancini of eBay echoed and elaborated on Brown's conclusion: "When you're trying to create a co-creation model centered around community, it is our instinct to try to control it, because that creates predictability. The reality of a community" is you cannot control it; the community controls you. Ultimately, the community directs you and takes you in directions you may not have otherwise understood — and ultimately creates value that you probably wouldn't have otherwise understood."

These trends are putting enormous pressure on today's chief information officers (CIOs), said Terry Waters, Senior Vice President and Chief Marketing Officer of Garner. It is getting harder for companies to keep pace with Web 2.0 innovations and the impact on IT budgets that are increasingly only 3-4 percent per year, essentially keeping pace with inflation — while decentralized business leaders are driving the consumerization of IT across their enterprises. "IT leaders are absolutely being pressed to more with less — reduce costs, reduce staff, improve productivity," said Waters. "At the same time, CIOs are being asked to innovate and leverage these new IT capabilities. They're being asked to move faster. They're being asked to leverage their technology infrastructure in new and different ways. They are being asked to help the company grow."

As technology moves toward Web-based services and consumerized services, it "fundamentally changes how CIOs and business leaders architect IT systems to be able to deliver value across the enterprise as well as to suppliers, customers and business partners," said Waters. "The key question that I have is: Do CIOs have the imagination, the vision and/or the time to lead this effort, in a world that's very short-term focused?"

Perhaps the most formidable barrier to embracing decentralized co-creation models, then, may be mental. "At the end of the day," said John Hagel, "the key roadblock has to do

with assumptions. It goes back to the zero-sum-game versus positive-sum mindset. If you come to this challenge with a zero-sum mindset, it's going to be very hard to adopt new organizational and business model requirements. Yet large companies, for a variety of reasons, tend to have a zero-sum mindset."

There may also be a generational difference in how you look at these questions, pointed out John Kunzweiler, formerly of Accenture. "In my business world, we care a lot about intellectual property, defending the brand, quality control and so on. But with the newer business models, the things I cared about might simply reflect an old guy's view of the world."

The mental barriers plaguing the "old" generation of business executives may stem from a misunderstanding about the decentralized co-creation model: It is not a zero-sum game, as Hagel pointed out, but a regime that tends to make the "pie" grow larger. Tapping into collective intelligence is about generating a plethora of positive externalities and expanding a market sector, which innovative first-movers are then strategically positioned to dominate. Hagel concedes that one cannot always know in advance which scenarios are positive-sum and which are zero-sum situations. But the recurrent story of decentralized co-creation is one of using collective intelligence to unleash exponential growth, transforming a sector into something quite new.

Branding as a Corporate/Community Conversation

In companies that have developed symbiotic relationships with online communities, what then becomes of branding? Do brands still matter? And how should branding be conceived and protected in an environment of decentralized co-creation?

There was broad consensus that brands will continue to exist and be important, but that they will function in different ways. The role of brands as an indicator of quality is likely to diminish, said Professor Thomas Malone of M.I.T.; instead they will increasingly serve as indicators of one's experience with a product. In the open, transparent environment of the Web, search and discovery about products is much easier. People can do comparison shopping, make instant purchases, and browse and buy from mobile devices. In this environment, brand reputations are not as "sticky."

Jacques Bughin agreed: "We are seeing 50 percent of products becoming totally commoditized. That's because you can search the Web site for products to find the lowest prices for the same features. If your brand is about product attributes, and that's the way you earn your market share, you are in big trouble. On the other hand, if your brand can work on more intangible drivers, opportunities to engage people on those drivers are

multiplied many times. Sixty percent of people we surveyed on Second Life are willing to co-design and participate in brand products and service, for instance."

The more important shift may be in the user community's increasing control over the meaning of a brand. "The importance of brands is not decreasing," insists Aedhmar Hynes, the Chief Executive Officer of Text 100 International, a public relations firm. "But *who promotes* the brand is changing. Increasingly, *communities* are promoting a brand."

John Hagel agreed: I think we are seeing a shift from what I call Vendor-centric' brand promises to what I call 'customer-centric' brand promises. The brand is not a promise about the product or my company, but a promise that I know you, as an individual customer, better than anybody else, and you can trust me to configure the right products and sendees to meet your needs." He added that "distributed co-creation is hugely important in building on this kind of brand promise" because it opens up new conversations between the corporation and the community about the meaning of the brand.

Thus, the brand owner must pay due respect to his customers. "You can't get away with trading on a brand," said Giknan Louie. "In fact, there are penalties for BS because you get instant customer feedback. Brand mangers have a higher requirement to maintain a brand because of the risk of overnight reprisals. You can lose customer loyalty the moment you become inauthentic."

Joi Ito of Digital Garage compares brands to a popular nightclub: "The arrogant owner thinks he's the one who's made the place so hip, but in fact it's the crowd that makes your place cool, not you." Brand is not a thing with fixed identity, he said, but a "hangout for like-minded people." It's an evolving socially created value. So the responsibility of the brand owner is to assure that the brand is a place where people want to hang out. Ito cites his own experiences in helping to lead two "community-operated brands" - the open-source Firefox browser and the Creative Commons licenses. In 2004, the developers and users of Firefox collectively contributed enough money to buy two full-page ads in the *New York Times* announcing the release of the free browser.

III. DECENTRALIZED CO-CREATION IN MEDIA AND EDUCATION

The Explosion of Amateur Video

Perhaps the most visible manifestation of decentralized co-creation is in video. User-generated video content is soaring, helping to spawn new genres of expression: short amateur videos on YouTube, video mashups, machinema, amateur pornography, and hybrid

schemes that combine user videos posted online with conventional broadcast and cable television.

Chad Hurley, Chief Executive Officer and Co-Founder of YouTube, noted that the ratings and audience share of television, newspapers and DVDs are declining, largely because people have many more choices of how to spend their time. They use the Web, play online games, and use cell phones and other mobile devices. "So while there is a greater fragmentation of media, there is also a greater consumption of media," Hurley said.

The real challenge facing the new media, especially those based on decentralized co-creation, is to develop sustainable business models. This may entail new types of subscription or sponsorship models, or perhaps partnerships of the sort shown when YouTube joined with Cable News Network to host a debate of Democratic presidential candidates. Traditional media may have trouble embracing the online media, Hurley predicted, because their business universe is based on scarcity and dominance of distribution — but in the Internet world, of course, everyone enjoys open access to distribution and plentiful supplies of content.

Max Mancini of eBay explained why user-generated video is proliferating. At the most basic level, it is becoming cheap and easy for ordinary people to produce video. In additional, people have become comfortable with online reputation systems, which are a useful tool for sorting huge quantities of uploaded video. Structurally, the Internet provides open access to anyone and the computing power of a basic PC continues to grow. While professional content "is not going to go away," said Mancini, the supplies of user-generated video are going to increase.

John Seely Brown gave a quick survey of some of the more robust types of decentralized co-created video. One of the most popular genres is "machinema," a production technique that blends filmmaking with online games to produce computer-generated imagery. "Basically, you can take *Second Life* or *Worlds of "Warcraft* and have a set of avatars run by people all over the world, that come together and create their own movie, and then you can 'YouTube' the movie," said Brown. Machinema emerged from the underground gaming community, and has become a hugely popular genre of decentralized video co-creation.

There are other social practices emerging that may ripen into genres. The practice of communicating through short videos — from one platform to another, and among large groups of people - may soon emerge as people discover the compatibility of YouTube videos and cell phone screens. Brown also noted that rise of "distributed co-watching" that occurs on *Second Life.* "People from all over the world are sitting together watching a

simulcast. It sounds kind of bizarre, but it is kind of like watching a movie with a crowd, but people know you are really sitting in your living room."

These platforms are likely to give rise to new types of storytelling as people discover the special properties of the medium. Just as film was initially a re-creation of theatrical plays, until directors discovered cut-aways and collage and so forth, so the video clip may become the basis for new types of storytelling.

One form of user-generated videos may well become the feedstock for a television program in 2008. Arturo Artom, President and Chief Executive of *Your Truman Show,* plans to showcase people's blogging and self-created video profiles, and invite Internet users to "rate the life" of other people using scales of "calm/exciting" and "drama/comedy." Reviewers themselves will also be rated and ranked, and can attract their own fan base. The winners of various categories — best documentary, best blogger, best entertainer — will then be featured on a weekly television show.

The show is another example of how decentralized co-creation of media is becoming hybridized with conventional media. The 2006 elections saw the case of an amateur video showing Virginia senatorial candidate George Allen uttering the slur "macacca," which in turn was picked up by the mainstream news media and given wide coverage. More recently, YouTube and CNN joined forces to host a presidential debate, resulting in an intriguing clash of styles — the solemn formality of network television with the puckish amateurism of ordinary citizens.

It is too early to know how the new social practices will shake out; some will be transient novelties, others may become enduring genres, as blogging has. But consider this range of innovations that leverage ordinary people's participation and creativity:

- Justin TV (www.justin.tv) is a free platform for broadcasting and viewing live video. Some people are using it to create 24/7 "lifecasts"; others have used it to broadcast live from Baghdad, showing war-related events.

- Yahoo and Reuters have teamed up to invite millions of people with digital cameras and camera phones to become photojournalists, submitting their eyewitness photos of news events.[11]

- One World TV (http://tv.oneworld.net) is a social activist Web site for people in Third World nations, which enables them to use storyboards to construct video stories about situations in their community. The videos can then be uploaded to the Web for viewing.

- Onmynews.org in South Korea uses 36,000 citizen-journalists to write up to 200 online stories a day. The publication is considered the sixth most influential media outlet in Korea, based on a national magazine poll.

Despite the power and range of these sorts of innovations, "the advertising industry is struggling to adjust," said Aedhmar Hynes of Text100 International. "Advertisers are used to speaking at larger audiences of coerced listeners rather than communicating with small communities of vocal individuals. However, the new media is moving us from "prime time" shows aiming for big brand awareness to "my time" conversations of people sharing their little brand experiences. As long as the advertising industry doesn't find an appropriate response to this new setting," said Hynes, "it is in crisis."

A number of conference participants affirmed this view. Robin Harper of Linden Lab, host *of Second Life,* reports that advertisers frequently come to her and ask, "What's your cost-per-thousand?" — the standard advertising term for the cost of reaching 1,000 people. She laughs: "I tell them I know what that is, but I don't think we have one." The point of online communities is not reaching a certain number of eyeballs with a certain efficiency ratio (CPMs, or cost-per-thousand), but about deepening consumer engagement with the brand.

Jacques Bughin said that a recent McKinsey survey also confirmed the limited knowledge of advertising agencies and advertisers. Although about one-third of companies surveyed are trying new ad vehicles such as blogs, virtual worlds, podcasts and social networks, this activity remains very experimental, said Bughin. One of the key reasons that companies cited for *not* using these new ad vehicles is the absence of such skills internally, but also the fact that advertising intermediaries are not "on top of those techniques."

Shona Brown suggested that businesses still focus on advertising because it remains the primary "engine of monetization." But, she added, "It's clear to me that we have to evolve a broader definition of the monetization opportunity. Voting on the preferred ending of a movie; listening to people's input; asking people to rate different versions of a new product — we used to call such activities 'market research,' but they are actually *engagement* with your product or service." The online environment offers different and better opportunities for such engagement than traditional advertising, said Brown, because "you can create *experiences* with your product or service that are much more meaningful than a billboard or a targeted text ad."

It is important to keep in mind, Chad Hurley of YouTube added, that "all of these new formats don't just necessarily drive toward revenue. They provide new opportunities to engage an audience, drive them to different formats and develop partnerships." He cited YouTube's partnership with CBS, which involved putting CBS shows on its site. This

exposure resulted in ratings increases of 5 to 7 percent, but the revenue opportunity was indirect.

Learning Platforms that Enable Tinkering and Sharing

John Seely Brown of Xerox PARC, a student of "open learning" and how it is changing educational practices, made a presentation about "tinkering as a learning platform." He noted that the rise of the Internet, and especially the World Wide Web in the mid-1990s, has inaugurated a powerful surge of "tinkering" and sharing among ordinary people as an enjoyable social activity. For the "bom-digital generation," tinkering takes many forms: open source software, amateur videos posted online, immersive online environments such as Second Life, simulation games like Civilization, amateur anime cartoons, and "game moding" (user-created derivatives of commercial software games).

In this participatory culture, consuming and producing are not separate activities, but a seamless cycle of yin and yang. "The assumption is that anything I produce will be built on by others," said Brown," making for a remix, open source, blogging culture." People build their identities from participating in communities of sharing and rebuilding, he said. The Web 2.0 environment differs from the mass media and Web 1.0 environment in precisely these ways. Professionals dominate creativity in the latter culture, while amateurs *(amator-* Latin for "lover") are the dominant creators in the participatory media of Web 2.0.

Some fairly sophisticated types of information and creativity are emerging as the professional and amateur classes find each other, and begin to collaborate. Brown noted how amateur astronomers armed with Dobsonian telescopes and digital sensors (as in digital cameras) are sharing their discoveries and discussions on blogs, Yahoo! groups, online forums and even collectively managed databases.

This culture of amateur sharing via open platforms is starting to spread to education at all levels, said Brown. It arguably got its start in 2001 when M.I.T. President Charles Vest asked his faculty how the Internet should be used in higher education. His proposal: "Use it to provide access to the primary materials for virtually all our courses - for students, faculty and other learners, anywhere in the world, at any time, for free." The first project begun under Vest's vision was M.I.T.'s pioneering OpenCourseWare (OCW) Project, which put all primary materials for virtually all of the university's courses on the Web, for free. The OCW Project has caught on, and now scores of college and universities in more than a dozen nations participate in an OCW Consortium.

Meanwhile, the culture of open sharing and participating has spawned a wide variety of educational resources - free textbooks, open repositories for scholarly work, open-access scholarly journals, open-curriculum development, peer-to-peer platforms for collaborative

learning, and much more. The level of activity is so great that, in a major report to the Hewlett Foundation, Brown and two co-authors declared in 2007, "The conditions now exist, we believe, to consolidate understanding, technology and incentive from multiple threads of activity in an open participatory learning infrastructure." There is, in fact a new international "open educational resources" (OER) movement of many dimensions that is now organizing itself.

Just as the Long Tail has made niche markets viable in many businesses, so the Long Tail is creating a new social ecology in education in which "virtual niche learning" is feasible. People who are passionate about a niche topic can have the opportunities to truly engage in the topic and learn more, in collaboration with other passionate learners. One such example is "The Valley of the Shadows, 1859-1870," a Web site on Civil War history that features primary documents from two communities of the North and South. Another is the virtual three-dimensional classrooms that can be hosted on Second Life — "a platform for a world-wide class discussion, which in turn can be augmented with a social network for virtual study groups," said Brown.

As open education models proliferate, Brown foresees some major transformations in fundamental processes of education. The new models will be based on "demand-pull by passionate niche communities and individuals," said Brown. Since a number of developments are now converging - the OER movement, new initiatives in eScience and eHumanities, and the ongoing growth of the Web 2.0 environment - Brown predicts a "perfect storm of opportunity" that could reinvent education in ways that foster participation and collaboration on a global scale.[12]

The group found Brown's vision of open education inspiring and encouraging, but also noted the hard realities of moving existing educational systems to higher ground. John Kunzweiler of Accenture is a volunteer helping a San Francisco Bay Area high school with an economically troubled student body. High school teachers are forced to "teach to the standardized tests," and have increasingly limited freedom in how they can innovate in the classroom, he said. As a result, many teachers actively resist the idea of open education.

The challenge, it seems, is to find a way to let students get enthusiastic through a participatory project. Brown said that some kids make video mashups after school, and the projects evolved to become vehicles for general learning. If the learning can be situated in a "real world" context - music, video, computers - then the pedagogy that normally occurs in the classroom can be integrated into participatory learning.

Citing his own youth, Joi Ito of Digital Garage noted how traditional education can encourage the development of smart conformists, but often discourages critical thinking and risk-taking. By contrast, niche-based learning in an open environment can elicit the passions

that are latent in most young people. Ito noted how many Wikipedians are "outcasts from traditional education," but in the context of the Wikipedia project, have become "bookworms for the common good."

IV. THE NEW FRONTIER: CLOUD COMPUTING

As if the epochal trends sketched in the preceding sections are not enough, William Coleman, the entrepreneur who started BEA Systems and recently started the Cassatt Corporation, made a bracing presentation about the changing economics and capabilities of the information technology industry over the next thirty years. Coleman's Big Picture scenario has sweeping consequences for virtually all parts of society. The changes would stem from the transformation of the Internet from set of independent computers and networks into a global utility upon which services, collaborations and interactions are dynamically produced in response to the demands of the "ends," be they individuals, groups, corporations or governments.

This "cloud" can be viewed as the computational equivalent of the network of telecommunication service providers today, which provide wired and wireless, audio and digital communications services. The new cloud for computing "will dramatically lower the cost of services while enabling mind-numbing increases in interactive collaboration, content creation and intelligence augmentation.

Coleman suggested a simple example of how The Cloud might work. Imagine a tourist with a PDA [personal digital assistant] who accesses The Cloud as she wanders through the Louvre. Knowing her interests, history and education, the system guides her to the objects of most interest, connects them to her own history and brings them alive just by tapping into The Cloud. Perhaps this experience triggers a desire to share the experience with two old friends whom she hasn't seen in years, but by reaching out, the linkage is accepted and the friends re-live a shared experience in the moment. This is a simple example.

The path to the Cloud must be seen in the context of the history of computing. Coleman started by identifying five distinct cycles in this history, each of which took about ten to twelve years to play itself out. The first was the invention of semiconductors in the 1960s, which was followed by the commercialization of computers, the development of computer networks, and finally in the 1990s, the growth of the Internet and World Wide Web. At each of these successive levels, said Coleman, there is a period of invention followed by a boom and then a bust; followed by a broader build-out of the innovation and

a consolidation of the companies in the sector; and finally, the commoditization of the technology.

At each cycle, investors use the technology to add a new class of users by "extending the ends." For example, semiconductors were first placed in mini-computers, and then put in the workplace and the lab, and then on every desktop. When the Internet arrived, the semiconductor revolution was extended to individuals and localities everywhere on the globe.

"The key point here," said Coleman, "is that we've reached the final end. There are no more ends to which we can extend the technology. Now everyone can participate in the 'conversation.' We can go end-to-end to everything and everywhere now. So that actually turns the equation upside down."

By that, Coleman means that large numbers of disaggregated users can be leveraged for business gain in new ways. There is a "new value proposition." The first instances of this new dynamic was Dell Computer's innovation of taking customers' orders and money before Dell had even actually ordered the parts to build the computers. By this ingenious scheme, said Coleman, "Dell leveraged the ends and dramatically lowered its costs, so the cost of its capital was *negative* — so now capital is no longer an expense, and Dell became the first corporation to enter the Information Age."

The larger point, said Coleman, is that commerce is moving "from a push, mass-consumer, mass-marketing world to a pull/micro world. This is the killer application — *the ends* are in charge." Decentralized co-creation of value is a major example of how "the ends" are asserting their capacity to manifest collective intelligence and innovate. This represents a profound challenge to conventional business notions of how value is created. In Coleman's words, "Pull is the 'killer application' of servicing the ends." It does so by both leveraging network effects and the Long Tail at the same time.

Coleman sees three structural drivers of this process: *straight-through processing, transparency* throughout the commercial/cultural field, and commercial *reach* to micro-niche levels. This bears some further explanation.

> *Transparency,* according to Coleman, is the ability of a business venture to "see the customer, the suppliers and everybody else at once. Companies can compare vendors and products from one market segment to the next; keep track of consumer behavior in the marketplace, and monitor new developments as they occur.

Straight-through processing is the ability - enabled by transparency — to change business activity in the middle of the process, in real time, in order to adapt to what's happening in the marketplace. "There could be a shortage of wide-screen TVs the day before Christmas, or a pricing dislocation that enables a company to charge a premium in one location on a given day," said Coleman.

Reach is the ability to effectively leverage the Long Tail and network effects to market one's product and services to micro-niche markets.

Coleman sees three companies whose business models are based on these three principles: Amazon, eBay and Google. They all leverage community information — whether it is through creating lists of recommendations or reputation systems —which in turn enables them to exploit network effects and the Long Tail, and so market effectively to very small market niches and, indeed, to individuals. If Dell was the first to leverage "the ends," Amazon, eBay and Google have used transparency, straight-through processing and reach to take this capability to whole new levels, said Coleman.

So which cycle are we in now? Coleman sees us coming to the end of Cycle 4, the Internet journey, a period of 1990 to 2020. The first phase of invention, boom and bust occurred from 1990 to 2001, in which the World Wide Web was invented and the tech sector boomed and then crashed. From 2001 to 2010, we are in the build-out and consolidation era, in which broadband, wireless, search, online communities and applications will consolidate and then start to be commoditized, a process that will last until 2020. This process is, in effect, the end of the information technology industry as we know it, said Coleman.

But in the meantime, Cycle 5, the Pull Revolution, is also underway. It began in 2000 when "cloud computing" started to emerge. We know cloud computing by its earliest precursor, Web 2.0. This is the period of the invention of new models of decentralized co-creation of value. Coleman's analysis:

> This period resembles the eight blind men trying to describe the elephant —
> because, except for Google, eBay and Amazon, we don't know how it's
> actually going to evolve for all the other industries. But by the end of this
> decade, those models will begin to emerge. It will take the whole next decade
> to build out those models, and then they will transform the Web-builds on top
> of them. And I posit that, meanwhile, the technology will disintegrate and
> turn into "The Cloud." That is what this is all about. I think Cycle 5 is going
> to be based on the technology of data and identity being able to become
> transparent and ubiquitous, and the individual will control their identity any
> time, any place.

By the time that The Cloud emerges, said Coleman, the "triple convergence" of voice, data and video will have been consummated. In an Internet protocol-based world, all forms of content will be digitized and flowing through the networks. As this happens, most of the applications and data storage that now resides on PCs will migrate to The Cloud, and computing will become a utility service. Vendors will supply capacity on-demand.

This will have many profound implications, said Coleman. First, software applications will become a commodity, effectively ending that industry. "Open source software — what I call the 'good enough syndrome' — will evolve to the point that it is good enough for all the generic applications that you need," said Coleman. "But they will be loosely coupled enough that people can still add value to them, and customize them. Computing will be a utility service, and generic open-source software applications will be a set of services that are assembled appropriately - by professionals and amateurs who do 'mashups' — for whatever computing domain or market that you are in."

As for the utility computing industry, Coleman predicts:

The incremental cost of generating more capacity will start to approach zero as time goes forward — just as we are seeing in the cellular industry today. As that happens, the service provider winners will be those that can invest capital as quickly as possible to gain more scale — and take the risk for convergence. What that will do is destroy the telephone service industry, the cable industry, the Internet service provider industry, and part of what is the portal industry today. So the survivors will be — I call them the "Google-rizons" — the ones that have both the access to a huge amount of capital and the willingness to take risk in this converged world.

This, then, is The Cloud — the "creative destruction" of the IT industry as we know it today. Coleman believes the computer hardware industry will shrink to a fraction of itself as hardware and software alike become interchangeable commodities, just as the telecommunications equipment industry is today. Only a handful of companies will survive, and their products will be, for the most part, be generic commodities. Application software as we know it today will be gone — integrated into loosely coupled services that will be part of the generic Cloud infrastructure. A small number of utility service providers — combining telecommunications, cable, Internet service providers and portals — will control 80 percent of the global market by 2020. [

Before Cycle 5 can truly get underway, however, Coleman believes that some key issues must be solved. Because there will be huge amounts of data flowing into The Cloud, new ways of marking data files — with metadata — will need to be invented. The Semantic

Web, which has tried for years to accomplish this, will need to mature into Semantic Web 2.0. By this, Coleman means an environment in which "all data is self-describing and can therefore be manipulated in ways that you can't possibly think of beforehand. We need a lot more knowledge and understanding of data and data services, which I believe is what all of the next decade's invention will be all about." The point will be to devise new ways to automate the interaction of data.

The other major issue that must be solved, said Coleman, is the issue of digital identity. "We have to create an identity system in which human beings can control their identity, to some degree.... We don't have a concept of [digital] identity yet; we have a concept of security and passwords, but they're all one-to-one links." To Coleman, identity is about what information constitutes a digital identity and how much of it must be exposed, and in what circumstances. The ideal, he said, would be for people to be able to set their identities to be expressed automatically in role-dependent and context-dependent ways. So, for example, certain information will be expressed in a healthcare context, with stipulated exclusions and sharing of information.

The technical challenge in constructing digital identity, said Coleman, is finding a way to "separate identity from authentication and authorization, so that I get to control my own identity." The government will necessarily have to play a role in helping facilitate policies and systems for constructing digital identities, he said.

Some Implications of Cloud Computing

Although The Cloud as sketched by Coleman seems to be a visionary scenario with many open variables, conference participants generally agreed that, based on existing trends, The Cloud is likely to materialize. It is a general framework for imagining the future of computing, telecommunications, software and all the activities that flow from them - that is, nearly everything. However, as a general scenario, all sorts of secondary technological and economic factors will affect what The Cloud will in fact come to be. This section looks at some of the large, novel challenges that will have to be surmounted. The next section explores some potential "speed bumps" that could modify, delay or derail The Cloud.

However compelling the macro-economic and technology trends, The Cloud raises some deep, unprecedented issues in computer science. "We in computer science have no understanding of what will occur when massive amounts of data intersect with massive amounts of computing," said John Seely Brown. There is an incredible noise-to-signal ratio that would need to be addressed. He predicted that computer science will nonetheless invent some fundamentally new types of data-mining techniques. While this may sound daunting, the truth of data-mining is that "you only have to 'lift' data a little bit to be able to identify brand new patterns."

The metadata problem is also a huge issue. "You need to be able to get through all the crap that's out there, to find what's meaningful to you," said Max Mancini of eBay. "This is the biggest challenge that we all face." While several participants expressed little confidence that the Semantic Web will solve the metadata problem, Coleman said that that term may be the wrong one. "What we're talking about is being able to assimilate and get as much signal out of the noise of an increasing amount of data, without having to manually manipulate it," he said.

Some participants expressed excitement at the new set of technical challenges in The Cloud: "When data begins to understand its relationship to other pieces of data that are out there, you have a markedly different kind of world," said Gilman Louie of Alsop Louie Partners. One of the biggest changes would be the arrival of "dumb" client appliances on a mass level, he said.

"For the first time, the experience of the client service relationship that we've been talking about for the last forty years is finally coming true for the mass market," he said. "And that means that the client — the device for delivering things — doesn't really matter any more. You will have browser-less browsing. You will have real utility computing. You will have computation powers on demand. Finding the data will be free. That is a whole different world." Although there will be some very large providers of commoditized services, said Louie, there will also be many opportunities for newcomers because of the "huge fragmentation" of products and services for specialized niche needs.

What Could Thwart The Cloud?

Since The Cloud will not take place in a social or political vacuum, it is likely to provoke resistance, many people agreed. James Manyika, Director of McKinsey & Company pointed out that previous cycles of the semiconductor/computer/networking/internet revolution were compatible with existing institutional and governmental frameworks. They did not threaten the powers of nation-states, government, intellectual property, and so forth. But The Cloud is going to test the limits of all of these structures, said Manyika.

The key issue now, Manyika elaborated, is that the technological capabilities have far outstripped our institutional arrangements, which were set up in a time when most things were not digital and transaction costs were high. One only has to look at how we think about issues like identity, intellectual property, location-independence and so forth, to appreciate this increasing gap. Without the emergence of frameworks for the era we are entering, we are likely to see responses by threatened governments, institutions and businesses to limit or thwart The Cloud, he said.

William Perry, Senior Fellow at the Hoover Institution at Stanford University and the former Defense Secretary under President Clinton, agreed: "When the government realizes that its roles and its laws are made more and more irrelevant by this happening [The Cloud], government will resist it — and it will have the power to resist it." Bill Coleman agreed that governments around the world will resist, but such resistance will have consequences that may be unpalatable: 'When China has virtually free computing power accessible everywhere and the U.S. doesn't we will become a Second World country in a matter of a few decades. So you're just going to have to let economics work that one out," he said, conceding that that is not a full answer. At the very least, government regulation will shape the character of The Cloud.

Some "speed bumps" will results from The Cloud's very scale and complexity. Distributed global innovation is only going to grow, but that will result in greater fragmentation of technologies. How will those be standardized and made interoperable? Padmasree Warrior of Motorola said: "I would argue that the view that Bill [Coleman] has presented does not take into account the global nature of innovation that has to happen, which has pros and cons. The good part is that innovation will be more distributed; the bad part is that it's going to be much more fragmented. But a company or nation can't just set a standard and say, We're getting the whole world to follow that.'"

William Perry predicts that "this whole system is highly vulnerable to breakdowns of various sorts — either accidental breakdowns or deliberate breakdowns when people attack it (a topic that he discusses in the next section). Coleman is more sanguine on this point, however, arguing that the whole technical infrastructure of The Cloud will be "self-configuring, self-healing and self-optimizing." He added, "I'm not worried about that side of it. We do have to figure out how to beat any attack. But we have to figure that out in any case, even without utility computing."

Still, this is an enormous technical challenge that may or may not be solved. John Hagel said, "Essentially, you're talking about long-lived, loosely coupled, asynchronous transactions that occur across very heterogeneous, diverse participants on a global scale. Today there is very little IT that actually provides that kind of support — and it's an architectural issue versus the components and platforms that are coming into play."

So how will that new architecture be imagined and built? Hagel pointed out a paradox embedded in The Cloud computing concept — that massive, centralized, scale-intensive facilities will be necessary to facilitate decentralized co-creation of value at "multiple levels and layers."

And who will have the capital to finance it? The risk factors for building The Cloud are huge because of the technical, economic and policy complications. Brad Johnson of McKinsey & Company sees two approaches. Under one scenario, he said, the triple convergence of audio, video and text would occur, and the computer hardware industry would actually help build it, even though investors would likely suffer as their products become low-profit commodities (as it has in all previous technological cycles described by Coleman). Under another scenario, investors would learn from the past and be dubious about the value they would reap from The Cloud, and decline to invest in it.

National Security, Privacy and Other Obstacles to The Cloud

William Perry, Senior Fellow at the Hoover Institute, raised a new series of potential disruptions that could prevent the IT infrastructure of The Cloud from emerging. Global climate change and energy disruptions could radically change commerce and everyday life, he said. So could a major war or an act of catastrophic terrorism. As mentioned earlier, nation-states may also feel profoundly threatened by the redistributions of power that The Cloud entails, especially its erosions of national sovereignty and power.

At least in democracies like the United States, individual privacy concerns could also impede development of The Cloud, said Perry. The government will continue to have legitimate national security interests in preventing future acts of terrorism, much of which is now coordinated through decentralized communications networks. At the same time, new data-mining techniques will make it potentially possible to identify terrorist threats — but such surveillance could result in privacy abuses of ordinary citizens.

Perry is convinced that "we cannot simply walk away from data-mining because the prospects of a catastrophic nuclear or biological terror attacks are quite real. Yet they are also quite preventable." Interception and analysis of cell phone traffic could be effective, he said. Data-mining of Internet traffic would be very difficult and would necessarily be intrusive. An example of such data-mining, he said, might be development of databases that compile information about all passengers who had flown from Beijing to Peyong Yang over the last three years; all passengers who had flown into New York City and Washington over the last three months; all persons who had rented vans or trucks at the airport; and all persons who had made short-term rentals of buildings in those cities.

"This data-mining probably does not find the needle in the haystack," said Perry, "but it certainly makes the haystack quite a bit smaller. This, combined with other efforts by police and intelligence analysts, give us a shot at preempting that second attack. So this is an argument, I believe, to undertake a serious R&D program in data-mining."

"Can data-mining be both effective *and* protect privacy?" Perry asked:

It is conceivable but not demonstrated. But if the executive branch of government does design a data-mining system, it will be a powerful tool that could easily be abused. Thus, the proper use of this tool will depend on establishing and enforcing good practices in carrying out the data-mining. Such practices will necessarily encumber the executive branch and probably diminish its effectiveness. History argues that we cannot depend on the executive branch always enforcing such good practices, in the absence of strong oversight.

Perry believes that such oversight should consist of two components: some form of prior approval from the judicial branch, similar to the so-called FISA approach [Foreign Intelligence Surveillance Act], and some form of auditing by the legislative branch, similar to legislative oversight of covert intelligence operations now done by the select Intelligence Committees of Congress.

Participants worried that a powerful data-mining system could open the door to some troubling new practices and norms. Brad Johnson of McKinsey & Company said that "as we gain the ability to do more and more sophisticated pattern recognition, we will have to punish *potential* crimes in order to prevent terrorism. Once you embrace that philosophy, it extends to other things. For example, if I googled how to dispose of a body and where can I buy lime, and how do I dig a six-foot trench? Do I get punished for that?"

Joi Ito pointed to the troubling abuses of systemic profiling in Japan, where people whose parents or grandparents once subscribed to left-wing publications are tracked across generations, on the presumption that they pose a higher national security risk. "Profiling has a higher probability of causing a chilling effect on speech and association," said Ito, because parents in Japan make sure that their children never read or subscribe to those things, check those books out of the library or hang out with certain people. For somebody with left-wing political views, it is still very difficult to get a visa to get into the United States. Even though you're not committing crimes, these cross-generational relationships alone are exceedingly important in determining who you get married to, what companies will hire you and what universities you get into."

Gilman Louie, who participated on a Markle Foundation panel studying these issues several years ago, said that the basic conundrum about national security and privacy is that you cannot have one without the other: "If you push too hard on national security at the expense of privacy, then the data-mining program gets shut down, and you don't have national security. But if you go too far in protecting privacy, a bomb goes off— and you end up having no privacy. We've just got to understand the context of coming to that world."

One potential tool to ameliorate the tension between privacy and national security is to "anonymize the data," said Louie. By this, he means putting "large parts of computational problems up into The Cloud" and letting computers automatically sift and sort the raw data, without exposing it to human beings. This would help minimize the potential abuses of privacy. New R&D would be required to develop data-mining techniques that could do this, but Louie believes such systems could be created.

While there may be value in analyzing vast quantities of information, John Seely Brown suggests that intelligence analysts may need to spend more time considering unconventional sources of open information. Changes in the types of graffiti found on public walls may be revealing predictors of bomb attacks in the London subways, for example. Not all useful information consists of conventional data, such as flight manifests and truck-rental information.

Striking a balance between national security and privacy is fundamentally a problem of trust, said John Kunzweiler. "It does come down to the trust we have in the [surveillance] institutions and what they're going to do with this information. If their practices are trusted and transparent, I think it's less of a concern. It comes back to checks and balances, and our trust in the institutions behind them."

However the data-mining debate proceeds, Perry stressed that the most important priority should be "keeping the damn materials out of the country in the first place. There are a whole set of programs that could do that with high probability, but we're not doing it." The United States needs to pay the utmost attention to this problem, Perry urged, not just to prevent the damage and panic that another 9/11-type attack would entail, but to prevent "government overreactions that would trample on civil liberties in ways that would seem minor compared to what's going on today."

Conclusion

The emergence of decentralized co-creation of value is not entirely new or surprising; open source software and Web collaboration have flourished for many years. But as this conference made clear, the types of online communities that are emerging today are both more varied and powerful. Not only is the technical infrastructure maturing to host more sophisticated kinds of sharing and collaboration, Internet users themselves are becoming more accustomed to, and enthusiastic about, active participation in online communities. The innovations underway are as much social as technological.

But as they play out, the innovations are assuredly economic as well. Although decentralized co-creation springs from deep personal and social impulses, it has proven to be a potent platform for generating valuable information and creative works. As such, online

communities are irresistibly attractive to businesses seeking to capitalize on new sources of value-creation. But businesses — at least those that are conventionally organized and run - face many special challenges in harnessing the power of decentralized co-creation. Social communities frequently have different values and priorities than those of the market, and may or may not welcome attempts to monetize or sell their collective intelligence. A great deal of attention is being paid, therefore, to how new business models can work with collective-intelligence communities in sustainable, respectful ways.

It seems likely that Web 2.0 innovations are merely a prelude for a giant leap into The Cloud, a far more capacious, versatile infrastructure for social computing than the Internet as we know it today. While technologists are understandably excited about the prospects opened up by cloud computing, the forces of resistance — among governments, social groups and individuals — could be intense. It could be that the vision of The Cloud itself may have to pass muster with the world's collective intelligence, however imperfectly configured, before it can be actualized: a paradoxically appropriate condition for moving forward.

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