

# The Evolution of Innovation

## An Interview with John Seely Brown

*John Seely Brown talks with James Euchner about where innovation management has been and where it is headed.*

**John Seely Brown with Jim Euchner**

John Seely Brown has been at the center of many of the most profound shifts in R&D management over the past three decades. As Chief Scientist at Xerox Corporation and director of PARC, co-chair of the Center for the Edge, Silicon Valley board member, and prolific author, he has helped frame leading-edge thinking about the effective management of research and innovation. In this interview, he speaks about a wide range of topics, from the generative environment at PARC to its contributions to Xerox; from the emergence of sociotechnical approaches to technology design to the increasing importance of social media; from innovation at the edges of companies to the growing emergence of innovation ecosystems across corporations.

**JIM EUCHNER [JE]:** I thought that it would be interesting to talk about how R&D and innovation have changed over the last couple of decades. You were part of Xerox PARC when it developed the technologies that reinvented the office. Then you helped to broaden both PARC's approach and the way others think about technology by increasing our focus on the

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**John Seely Brown** is the independent co-chair of Deloitte's Center for the Edge and a visiting scholar and advisor to the provost at University of Southern California. Prior to that he was the chief scientist at Xerox Corporation and the director of its Palo Alto Research Center (PARC), a position he held for nearly two decades. While head of PARC, Brown expanded the role of corporate research to include such topics as the management of radical innovation, organizational learning, complex adaptive systems, and nanotechnologies. He was a cofounder of the Institute for Research on Learning (IRL). He is a member of the American Academy of Arts and Sciences and the National Academy of Education, a Fellow of the American Association for Artificial Intelligence and of AAAS, and a Trustee of the MacArthur Foundation. John's personal research interests include digital youth culture, digital media, and institutional innovation. He has published over 100 papers and several books, most recently *The New Culture of Learning*, coauthored with Doug Thomas. Brown was awarded IRI's Holland Award in 1999, for "Seeing Differently: A Role for Pioneering Research" in *RTM* 41(3). He was the IRI Medalist that same year. [jsb@johnseelybrown.com](mailto:jsb@johnseelybrown.com)

**Jim Euchner** is editor-in-chief of *Research-Technology Management* and vice president of global innovation at Goodyear. He previously held senior management positions in the leadership of innovation at Pitney Bowes and Bell Atlantic. He holds BS and MS degrees in mechanical and aerospace engineering from Cornell and Princeton Universities, respectively, and an MBA from Southern Methodist University. [euchner@iriweb.org](mailto:euchner@iriweb.org)

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social systems in which technology is embedded. And now you are studying how innovation ecosystems are growing as a result of increasing social interconnectedness and declining barriers to innovation. It's a lot to cover, but I would like to start with PARC. What made it so generative?

**JOHN SEELY BROWN [JSB]:** PARC was a unique place at a unique time, and I think we have to locate it in what was happening around the world and in our markets at that time.

In the early '70s, we were at an amazing moment in which the digital world was being born. At PARC, we were given the freedom to invent what we wanted and build whatever we needed in order to make possible whatever we dreamed. We had a simple mantra: "Build what you need; use what you build." This gave us a tremendous grounding for many of the things that we invented.

Curiously, we may now be in another even more amazing moment, one that I like to call a Cambrian moment where ways of working, learning, organizing, innovating, and governing are being reconceived. Old institutions are stumbling; old, even digital, technologies seem like abacuses; old modes of innovating seem a bit archaic. But let's go back to the old moment (mid-1970s), which I think was also extremely fertile and underdefined. I'd like to say that PARC was so creative because of our brilliance, but I think we have to calibrate those beliefs relative to what was happening at that moment in the technological world. One factor was that computers and very large-scale integration (VLSI) were just coming of age, creating a gigantic sandbox to explore. Another factor that enabled us to do amazing things was that we were given an incredibly broad charter to become "the architects of information." That charter was a broad narrative that oriented us, but didn't overconstrain us.

A third factor that was critical in enabling PARC to be so great stemmed from Xerox having four other research centers, plus major development centers all over the world. These centers were doing the more predictable stuff, which gave PARC the freedom to be unpredictable and gave us freedom to fail, fail, fail, and then periodically come up with some truly great ideas. If we hadn't had these other, more incrementally oriented research centers,

we would never have been given the freedom to pursue the wild.

That was reasonable back then. It may be reasonable again, but in a different way.

**JE:** There were so many innovations that emerged from PARC, but Xerox only capitalized on them in more narrow ways. They invented the technology but didn't create the markets. Why was that hard?

**JSB:** I think that's a complicated story and a long story, but it's often misunderstood. It's a whole interview in its own right. I'm just going to say two or three brief things on that.

It may be a bit brash or macho of me, but I am fond of saying, "We didn't invent products; our game was to invent industries." It's not surprising, if you're going after inventing an industry, that you would invent many components of that industry and wait for the market to gel. That just kind of happened, quite honestly, because we wanted to build an imagined world for ourselves. Using the technologies that we built ourselves kept us grounded when there was no clear market yet established for much of what we did. So the mouse, GUIs, the bitmap display, the laser printer, the Ethernet, distributed computing, the document protocols defining Interpress, Smalltalk—all these are complements to each other that enabled us to implement a new kind of knowledge workscape that stemmed from a unifying version of how groups of knowledge workers might want to work.

That's why I was saying we were given the chance to create an imagined world. It was a world that we'd imagined by ourselves and, to some extent, for ourselves, because we considered ourselves leading-edge knowledge workers: if we invented tools for ourselves, we assumed that there would be, eventually, a market there when the rest of the world was ready to focus on knowledge work rather than on just business processes. If you see it from that point of view, many things that we invented were all part of an imagined ecosystem, and they would play together sometimes in unexpected ways.

Another thing that put PARC ahead was that we often went to the root of a problem; we didn't just pick off the easiest solutions. When you go to the root of a problem, you often solve tough problems that have secondary consequences. These often turn out to have more value than the idea you were pursuing in the first place.

A simple example of that is printer technology. PARC had to invent new technologies in order to drive our printers in faster and more economic ways, and that led to a lot of work around a class of solid-state lasers, moving thus from the gas-based lasers that had been used to solid-state lasers. These lasers—I was not part of that team—later were dramatically enhanced and became part of a spin-out that eventually got sold for \$41.5 billion.

So, when people say things didn't pay off at PARC, they are looking at only part of the story. If you talk to the CEO of Xerox, that was never a comment he made or a feeling he had. What was true—and this ties into Clayton Christensen's



**John Seely Brown**, codirector of the Center for the Edge, believes that the next phase of technology development must emerge from a fundamental understanding of how work gets done.

disruptive innovation—is that we invented a lot of things that did not fit the big business and big sales force delivery mechanisms of Xerox or the three-year customer guarantee that had that become part of our brand. Little personal desktop printers/copiers/scanners or personal computers would sell for a couple of thousand dollars and don't usually last for three years. You can't easily put products like that through the kind of worldwide sales force Xerox had. There was a complete mismatch between Xerox's sales channels and many of the individual technologies that we were creating inside Xerox PARC.

There was another factor that was important. In the early '80s, Xerox was being challenged from Japan, Inc. In a relatively short period, we dropped 30 to 40 percent of market share—and that's almost a "going out of business" sign. East Coast Xerox came to PARC and said, "Please help us reinvent our light-lens copier business and push back against the stream of products coming in from Japan." And we did, and that's, in part, why Xerox exists today. In fact, one of the high-end copiers Xerox developed at that time had three levels of Ethernet networking inside the machine, 30 processors, a fantastic bitmap display, a very sophisticated feedback process control system, and even an AI engine for predicting failures, enabling a total recalibration of the machine every six pages. The end result was a new level of consistently high image quality that enabled Xerox to stop the erosion of our market. And soon thereafter Xerox took back its market share.

So that's what was happening in the background.

**"We didn't invent products; our game was to invent industries."**

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This leads to another big misunderstanding about PARC. The CEO and the leadership of PARC did have the wisdom to recognize that many of PARC's ideas could not easily be channeled through the normal Xerox business for all the reasons given above—a total mismatch between selling expensive, big iron and even stunningly beautiful personal workstations. They said, “Look, we're not going to be successful with the home or hobby market; let's find the best of the best in that market.”

And the best in the home market turned out to be an interesting, long-haired guy down the street named Steve Jobs. He had built this great, little company, and we, Xerox, said, “Let's do a deal.” Let's let Steve come into PARC to look around, and in return we get the right to a small percentage of Apple. So when Steve came in, Xerox owned a significant share of Apple. That story never seems to get told, though.

**JE:** I didn't know that. I can't believe I didn't know that.

**JSB:** It's a wonderful story that's been stunningly overlooked, and it's never gotten any real publicity, perhaps because it didn't fit the simplistic narrative of fumbling the future or what it takes to invent an industry.

**JE:** It sounds like there were clear paybacks in the core business using all these technologies in copiers and printers and in networks of those devices. Xerox also made money from the spin-outs. And the big criticism that Xerox didn't grasp the potential of the personal computer market wasn't really true, either.

**JSB:** Absolutely. Now it also turns out that if you looked at the financials of the printer business, and the business model

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based on the annuity streams inherent in printing, the printer business is a *better* business than the PC business.

You really have to understand how to live in a moment in time. Of course, a lot of things that we now look back on were clear mistakes; our intuitions were not perfect. But they were not as far off as the folklore would have it. Nevertheless, let me definitively say that both PARC and East Coast Xerox business folks could have done a heck of a lot better. Brilliant ideation is not the same as brilliant innovation. Radical innovation involves marketing genius as much as technological genius.

**JE:** After this phase at Xerox, in the early '90s, you published “Research that Reinvents the Corporation” in *HBR*. Can you discuss the shift in thinking that that represented?

**JSB:** Sure. In the late '80s, we began to move from just being an ultra high-tech research center to also looking at what it takes to actually get technology used along with how people can appropriate these technologies in the workplace. This led us to expand the notion of user interfaces, to what you might call social interfaces, which led us to bring in a bunch of world-class social scientists: anthropologists, sociologists, social psychologists.

There was a movement at PARC from a pure techno point of view to a sociotechnical point of view. That led to the second major wave of things happening there involving transforming the ethnographic study techniques that anthropologists use to study tribal cultures to use them in studying office work practices and the tribes therein. I think this movement was so important because it recognized that the real value gets created by enabling and enacting new kinds of work practices. Again, this is the challenge we're facing now, as we move to worldwide networks of loosely coupled distributed work. Knowledge is fundamentally changing from being contained within a corporation to being contained within ecosystems of partners, which sets the stage for the third phase—a knowledge infrastructure for a global networker.

Ethnography is now more common. Places like IDEO use it a lot. They tend to do very quick ethnographic sketches, while we tended to go much deeper, to try to understand core principles underlying how work really works or where the real value gets added. Researchers like Lucy Suchman, a brilliant ethnographer and thinker, would sometimes spend nine months or more studying a site.

With some of those insights, we developed fundamental understandings about how work gets coordinated and about how things like signaling and coordinating in the context of the work really happen, often beneath the surface. We came to understand that if you mess with the context, you mess with the signaling, and suddenly nothing is apt to work quite as well—even though it might look more efficient on the surface.

I think that that message is still not fully understood, although the importance of looking at least at the surface structure of how work gets done is increasingly acknowledged.

I would argue that we will need to go a level deeper, as Lucy did in some of her pioneering work, in order to understand more of the deep structural dynamics as opposed to just the surface dynamics. In a curious sort of way, we haven't yet realized that the workplace itself is a miniature ecosystem, which means you can't take it apart piece by piece. An ecosystem is fundamentally situated in a particular contextual setting, and the technology itself must be embedded in that context, which impacts the tacit flow of knowledge.

That context has its own dynamics. It's just like a garden. You can't pick up a set of plants and just move them without understanding how the chemistry could be different, how the sun shining on the garden could be different. The whole notion of portability of best practices has been a major setback for understanding how situated technologies must be and how it is the content coming together with the context, and the interaction between the thing and the context, that produces value.

We have to understand the dynamics of that much better. We may want to think about how we actually *shape* that context in order to bring the full power of a technology to the fore. Today, we just tend to drop stuff in and expect everything to be better when, in fact, you miss something big if you don't understand how we, as humans, in a very collaborative manner, use the properties of the context to help us do our work.

The whole point is that these insights didn't emerge from a quick and dirty study. You have to spend time to really understand sociotechnical phenomena. This deeper research is like fundamental work in materials science; in this case, the deeper anthropological work provides us with new eyeglasses, a new way to see. I want to make a distinction between research in work practices and the application of that knowledge. The work we did in research was to create new eyeglasses through which to make sense of the invisible assets being used in getting work done. But once you understand how to make visible the invisible, once you have new conceptual lenses to understand the world, then quick and dirty analyses can be okay.

**JE:** This kind of work is still in its infancy. Are you hopeful about these ideas eventually making their way into our technology development?

**JSB:** In some senses, I am. I'm very optimistic that design thinking on the one hand and increasing attention to "business as social" on the other will lead to a lot of advances in the next two or three or four years. But I think we must extend design thinking to what my colleague Ann Pendleton-Jullian and I call ecosystemic design, which shifts our focus to the deep interactions between content and context.

There's another thing accelerating innovation in this space, which is cloud computing. Cloud computing is already bringing together thousands of small entrepreneurial firms that are reinventing ways to do innovation on the cheap and very fast. The new dynamic made possible by cloud computing means that a ten-person garage start-up

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does not have to take any of its money to build infrastructure in the classical sense. It can use the cloud to pay by the bite to do its computing work, but it can also get access to all kinds of other resources on the network, including very complex scientific instrumentation, for example. Firms can start using those types of distributed resources rather than spending millions of dollars to get off the ground. In addition, you also have a new way to reach the global market.

The game is fundamentally changing in terms of the pace of innovation that's possible because of these tools. The changes suggest we rethink the edge, so let me cycle back to the very beginning of our interview. Xerox PARC was an edge operation within Xerox, where what we produced on the edge had to push into the core. And the core was an incredibly efficient immune system that would gobble up and basically destroy many of the ideas coming in from the edge.

But we're now capable of doing two things we couldn't do back then, and as a result, we're capable of empowering the edge. The new PARC is a tiny example of this. We can now empower the edge not only to develop the deep ideas, but to use the cloud to build prototypes in brand new, much more efficient ways than used to be possible. Then we can actually try them out by distributing them through the cloud or through the fulfillment centers at Amazon, for example, around the world.

We can now build these small, lightweight, fast-moving businesses from the edge. What that does, for those enlightened large-scale firms, is to convert the excitement on the edge into a dynamic attractor for the folks in the core. More of the passionate folks in the core will tend to migrate to the edge to build real businesses, not just new technologies. And now, these edge operations can also use social media to better connect with the core, spreading both their learning and their excitement. And of course these edges also become fantastic incubators of talent development. This edge-core dynamic may well hold the key to how big elephants learn to dance again.

And there's a second dynamic that happens when edges start connecting to edges, including those of other companies. People start to build networks across the edges that create a new kind of ecosystem, not just among small companies, but among big companies that are engaging the ecosystem from their edges.

These new dynamics are something that the Center for the Edge, which John Hagel and I co-chair, is trying to unpack. That's why we get so excited today. We see new tools



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for how to play on the edge, so to speak. I think that this is going to be world changing—in fact, another Cambrian moment.

**JE:** Do you think the large entities are a stable component of that world, or that industries will fragment into components of the ecosystem? Do you still see companies like Xerox existing as large central production engines, or does their transformation actually lead to their disintegration?

**JSB:** Well, it's too early to tell. There's no reason why the large-scale companies that get it, get it in their gut in a deep way, can't survive. They will have to invent brand new work and innovation practices to be able to take advantage of this new tool set to do things simply unthinkable a few years ago. So I think that there's going to be a role for some large-scale companies that operate fundamentally differently than they currently do, and I think that they will become, yet again, complementary assets in a broader ecosystem that will also get unique value from some of the small-scale companies.

There's yet another component to this story that doesn't get talked about much in the press, and that's what massive amounts of scientific computing now enables us to do. We have had three orders of magnitude—maybe four orders of magnitude—of capability improvement. This is not just because of hardware advances, but because of a deeper understanding of the algorithms behind basic simulation, so we can now start modeling very complex phenomenon from first principles. We can start exploring spaces more computationally rather than just through experiments and prototypes.

I think that the next wave of some of the more fundamental types of innovation is going to come from finding ways to use this massive new computing capability to simulate the way materials really work as well as the process we might use to make these new materials. This will speed up the time from ideation to commercialization. It's going to happen. And this is going to change the cost effectiveness of doing fundamental research in the large-scale companies as well as the payoffs.

**JE:** Who would you say is a model of what this future company might look like? Is Amazon an example? It seems to be doing a lot at its own edges and then finding aggressive ways to move into those spaces and establish leadership roles.

**JSB:** It's a very successful model and it's a fair characterization of what they're doing. Jeff [Bezos] has a very unusual way of structuring the internal operations of Amazon that makes it happen in a way that is quite natural. Another company, in a more classical realm, is Corning, which is doing all kinds of amazing materials science.

In places like Corning, one factor for success is that process research happens shoulder to shoulder with product research. In their fundamental sciences, they are building up a complex mathematical model for how their chemical reactors work. They are instrumenting and modeling their manufacturing processes to the extreme in order to know how best to scale them up. In essence, they understand the interplay between inventing new types of materials and manufacturing them at scale. Hardcore research and hardcore manufacturing must honor each other in a very profound way.

I bring that up because I have to say what worries me a great deal in America is the outsourcing of manufacturing. That means we have decoupled the manufacturing processes from the design, ideation, and fundamental research work. I think that some of our best ideas and our best advances will come from driving a closer coupling. If we want to restore manufacturing in the U.S., we need to bring certain parts of the manufacturing process back home and have it sit in the same space as the fundamental research.

**JE:** That's a very, very interesting point. Parts of the ecosystem need to be tightly, not loosely, coupled.

As the world of R&D moves towards this ecosystem model, what do managers need to know in order to take advantage of the trend in their own companies?

**JSB:** I think they have to ask a different question than that. The purpose of the firm in the twentieth century was to find ways to minimize transaction costs. That's why the firm came into existence in the first place; it's the idea that Ronald Coase got a Nobel Prize for.

But John Hagel and I are beginning to think that maybe the purpose of the firm [in this new paradigm] is to accelerate talent development or capability development, not minimize transaction costs. One's competitive edge in the future will come from being able to build deeply innovative, new talent pools faster than anybody else.

You get a sense of this when you look at either Facebook or Google. Why do kids go to Google today? It's not to make fast money. In some sense, the big rise of the stock has already happened, but people go there because it is where you pick up new skills better than nearly anywhere else in the country. They have great computational environments. They have thousands of emergent groups that have access to infinite amounts of computational power, like we did in a different way inside PARC in the '70s. There they can think the unthinkable. For example, the autonomous car.

People want to go there because, actually, they can be exposed to more radical thinking than even in many of our universities. Universities are governed by the peer-review

systems of NSF and NIH, where it is safest to propose projects that are incremental and easily understood. But some of these newer companies, like Google, are pushing the boundaries of the unthinkable. And, again, that's made possible by having access to nearly infinite amounts of computing power and the tools to build complex models from first principles.

**JE:** All these things are interrelated.

**JSB:** Yes. Suddenly we have tools that really extend the mind in powerful ways. That's why this research game is now more effervescent, in my view, than ever: because we can explore questions we couldn't have before. We now actually have the tools to explore some of these hopelessly complex, even wicked, ecosystemic questions.

**JE:** All of these things—the huge computing capability, the lower barriers to innovation—they change the game in a technical sense. How do you relate that back to the need to understand work and social systems more deeply? How do we avoid getting caught up in all the technology and misunderstand the impacts of technology on the way people really work?

**JSB:** Perhaps we have to find ways to get companies out of their comfort zones and to recognize just how much the game has changed—both in terms of innovation and in marketing. The leaders have to spend a little bit of time on the edge themselves. I believe we're going to have to invent a form of what I'm going to call "reverse mentorship," where the youngsters coming into these companies have a lot to teach us graybeards.

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Now, we still have plenty to teach them, so I think it's a question of how you make mentorship and reverse mentorship work together seamlessly. How do you get core management willing to get out of its comfort zone and spend some amount of their time going to conferences that make little sense to them, being willing to sit and listen to things that seem absurd at first and start to make sense only once they start to participate in conversation?

There is a lot of work in understanding how we amplify what I might call serendipity. That's what we call "the power of pull." How do you expose yourself to the power of pull? How do you create the right kinds of beacons that let other people detect what you're now willing to talk about?

**JE:** That's wonderful. We've covered a huge amount of ground.

**JSB:** Well, these are exciting times, the most I have ever experienced.

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