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ESTHER DYSON'S MONTHLY REPORT

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## INNOVATION AND LARGE COMPANIES

By Kevin Werbach

Welcome to the new millennium! As we turn over the calendar into the 21st century, it's as good a time as any to take a deep breath and a step back. So we diverge a bit from our normal pattern to consider a concept fundamental for the technology industry: innovation. All companies strive to be innovative, especially those in fast-moving sectors such as the Internet, computing and software. However, achieving that goal is more complex than it seems.

We examine innovation from two angles: First, we ask what innovation means in the Internet era, particularly to large organizations. As case studies, we look at how four well-known technology companies -- IBM, Cisco, HP and Intel -- address the innovation challenge. Second, we explore a particular area of disruptive innovation, Web-based productivity applications, and consider the implications for the marketplace.

We live in a time of unprecedented change and creativity...or so we're told. The Internet economy generates fortunes overnight and turns garage-bound entrepreneurs into publicly traded corporations almost as fast. Wide acclaim greets insurgents that leverage disruptive technologies to triumph over entrenched players. After all, AOL bought Time Warner and eBay bought Butterfield & Butterfield, not vice versa.

In all this hoopla, though, some simple questions rarely get asked: What is innovation? What precisely makes us believe the Internet industry is particularly innovative? Where does that innovation come from? Are small companies necessarily more innovative? If so, what should big corporations do?

These are not idle queries. In a recent global survey by Arthur D. Little, 84 percent of respondents strongly agreed that innovation is much more critical to business success today than it was five years ago. The ethos of the software and online world promotes constant innovation, but as the Net grows ==>

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and matures, innovation will be increasingly challenging. And if innovation happens primarily in small companies, what can those companies do to maintain their edge as they expand?

There are no magic answers. Small organizations, such as the startups developing new Web-based productivity applications (see page 15), are free from the operational, cultural and financial inertia that bogs down bigger competitors, but they also have limited experience and resources for turning their ideas into successful businesses. Bridging that gap involves many small decisions, practices, attitudes, behaviors, habits, anecdotes and observations, from which innovation emerges.

### **What is innovation?**

Innovation is surprisingly resistant to definition. Novelty and change are at the core of the term. However, innovation is something more than just new creations, or inventions. People and companies invent new things all the time, but only a fraction deserve the label of innovative. Or more precisely, only a fraction are useful or desirable innovations, the kinds that make money for companies and attract customers.

Definitions are in the eye of the beholder. (Remember the old Mel Brooks line -- "Tragedy is when I cut my finger. Comedy is when you fall down an open manhole cover and die.") But we can't talk coherently about innovation without a point of view. For purposes of this issue, innovations are those new ideas, technologies and products that can be developed and implemented in ways that create value.

### **It's not just the technology, stupid**

Often, technological breakthroughs are less important than the mechanisms companies develop to make use of them. Apple may have been more innovative than Dell in its technology, but Dell's innovations in manufacturing and marketing gave it a competitive edge in acquiring customers and generating profits. Cisco (see page 10) acquires many innovative technologies (and the innovators themselves) developed by small startups; these become Cisco innovations even though Cisco didn't originate them.

It would be nice if innovation were measurable, so companies could tune their efforts in the right direction. But alas, 'tis not to be. Most attempts, such as the "innovation index" developed by business school professors Michael Porter and Scott Stern, have a tenuous connection to what we really want to know. The innovation index primarily measures inputs such as government research and development (R&D) spending and outputs such as patents. But plenty of companies spend large sums on R&D or file significant numbers of patents, and still aren't innovative.<sup>1</sup> Or, as in the famous case of Xerox PARC in the 1970s and 80s, they create impressive innovations but don't themselves make use of them.

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<sup>1</sup> Even the positive correlation between patents and innovation is coming under attack from those who see Internet business model patents closing off opportunities to extend on broad approaches. Is Amazon.com's patent on one-click ordering a reward for a valuable idea, or a license to pre-empt competition around a common-sense practice? Walker Digital, which Esther mentions below (see page 6), poses this conflict most clearly.

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## IS BIGGER WORSE?

The current mania for Internet startups and IPOs suggests that innovation in the technology world primarily takes place in small companies. Reality is different. Most startups fail; generalizing from the success stories is dangerous. An innovation that adds a million dollars to the bottom line at IBM or AOL may be invisible, but the same boost at an early-stage company is a bonanza.

Having said that, though, there are serious, unique challenges large organizations face in turning inventions into innovations. It's intuitive that big corporations can become slow and bureaucratic, but how does that happen? And how have some players such as Microsoft and Cisco been able, so far, to avoid such a fate?

### Disruptions and dilemmas

Harvard Business school professor Clayton Christensen's 1997 book, **The Innovator's Dilemma**, describes how successful companies can be undermined by "disruptive technologies," usually championed by newer, smaller firms. When faced with disruptive technologies, as minicomputer vendors were by the PC, established companies tend to listen to their customers, who request incremental or "sustaining" innovations to existing products instead. The successful disruptive technologies initially appeal to a lower-end or innovative or fringe segment of the market, but they improve more quickly and eventually overwhelm the more-established competition.

We described such a looming shift in the telecom world several months ago (see **Release 1.0**, 5-99). Established telephone companies are focused on their existing voice and private branch exchange (PBX) businesses. They dismiss the value of voice over Internet protocol services and hardware because those technologies don't yet offer the quality and features of established products. But as products improve, and as hungry new entrants deploy new technology, these Net-based alternatives may swallow the traditional phone network.

### Organizational dynamics

There's another dimension to this, beyond company strategies or cultures. As Nobel laureate Ronald Coase explained more than 60 years ago, firms exist because the transaction costs of arm's-length relationships between independent actors in a market exceed the coordination costs of a hierarchically managed firm. The larger the firm, though, the higher the coordination costs, and the more bureaucratic the organization becomes.

Telecommunications analyst and consultant David Isenberg, who used to work at AT&T Labs, says the problem for large organizations goes beyond whether an innovation is disruptive. "A pyramid-shaped corporation suppresses ideas," he says. "For all the great ideas that people have in companies -- sustaining and disruptive -- a surprisingly small number of them actually see the light of day." The simple problem is that, in a large organizations, employees have jobs to do, and pursuing innovations often means putting those existing projects aside. Deciding to focus on something new often requires approvals through layers of management, with inertia creating a drag against the unfamiliar or unplanned.

Or, as venture capitalist Vinod Khosla of Kleiner Perkins puts it, "Escape velocity is hard to reach within the gravitational pull of the organization." In other words, a big company can get the high-level vision right (e.g. we need to do e-commerce) and can support teams exploring radical new directions, but the countless small decisions that refine the idea through implementation gradually pull it back toward conventional business models.

### No way out?

The dilemma about **The Innovator's Dilemma** is that it's easier to acknowledge this tension than to resolve it. In an interview last month in *Forbes*, Bill Gates observed that teams promoting new project proposals at Microsoft now invariably say they deserve funding because they are disruptive technologies facing the innovator's dilemma. Nothing has really changed...except the terminology used in the funding requests.

Christensen recommends that companies create independent units to exploit disruptive technologies, even when it means competing directly with the established business units. But exploring new technologies by ignoring your customers is hardly a guarantee of success. What you give up in terms of resources and relationships may be greater than the freedom you get, as HP's Rajiv Gupta concluded in keeping his e-speak project inside the company (see page 11). Steve Jobs was brilliant in ignoring his customers with the Macintosh, wrong with NeXT and brilliant again with the iMac -- the question is how to distinguish the winners and losers.

## PROMOTING INNOVATION

What can established companies do to remain innovative in the Internet era? Below, we describe initiatives to foster innovation at four well-known technology companies. These efforts share some general characteristics, which are worth highlighting.

Managing innovation means something different now than it used to. In previous decades, innovation was about staying ahead of the market. Market-leading companies had the luxury of funding operations such as Bell Labs and IBM Research. While others had to focus on the here-and-now, the largest companies could invest in basic research, or in the next technical breakthrough that would transform the industry. AT&T virtually cornered the market in developing advanced communications and switching technology, which went directly into its network.

Today, innovation increasingly means co-evolving with the market, being on the cutting edge but with one foot squarely in the mundane world. Time horizons are shorter than ever. No one can predict exactly how the market will evolve, so being able to change direction fast is more important than having a detailed ten-year blueprint.

Basic research can still create value. For example, IBM Research chief Paul Horn points to the fundamental materials science work that led to magnetoresistive head technology and the high-capacity microdrive, now a hot seller for IBM. But that research must be mapped to some reasonable belief about where the market will be in the future, so that it doesn't simply languish. Horn says IBM's large research operation was important

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to the company's turnaround, because IBM could fall back on the technologies in the labs once it recognized its existing products no longer fit the demands of the market.

### Outside connections

Even the largest companies must recognize they can't do everything themselves. Traditional industrial research groups were self-contained entities, situated awkwardly between the academic world and the corporate business. Companies themselves, such as HP and IBM, promoted their corporate cultures as unique and distinctive. But this inward focus gradually disconnected companies from the leading edge in the world at large. Listening to customers is only part of the puzzle, because customers often don't know what they want, or what they could have.

To avoid this problem, companies today encourage their employees to follow outside developments. Several are active acquirers of startups with complementary (or competing) technology, providing a constant infusion of new DNA. Almost all the major players have their own venture funds -- corporate funds totalled 16 percent of all venture capital investment last year. These investments serve several purposes, but one is to forge closer connections between the large company and the smaller innovators.

Going outside may also mean utilizing spaces designed to foster creativity. John Kao's Idea Factory in San Francisco is filled with toys, models, musical instruments, theater implements and more, all designed to create a fluid, dynamic environment. Kao holds consulting sessions for Fortune 500 companies there, and he emphasizes that the place itself is important to the success of his engagements. (For those who can't make it to San Francisco, he's working on scaled-down "portable Idea Factories.") This may be an extreme example, but space does matter. It's no accident that most Internet companies have open floorplans rather than the rigid divisions of traditional offices.

### Prototyping

A key element of innovation is flexibility. If internal processes are too rigid and slow, they will leave too small a space for innovative thinking. Michael Schrage, in his 1999 book **Serious Play**, looks at how employees behave around prototypes and models. Rapid prototyping, which allows new ideas to be explored and fed back into the development process, is a powerful tool for innovation. The Net fosters prototyping, making it easy to share and modify models.

The Net can break down the wall between companies and their customers. Everyone is on the same network -- a network designed for interactivity. As Schrage observes, "Your clients and customers now have the ability to be a collaborator with you in the design process." There are many ways to realize this notion of collaborative design, from IBM's willingness to share alpha products with customers (see page 8), to HP's open source licensing of its e-speak technology (see page 11).

A related concept to rapid prototyping is willingness to fail, and ability to fail fast. Cisco svp Howard Charney (see page 9) says ceo John Chambers would prefer eight successful acquisitions out of ten to five

## INNOVATION: BEYOND PRODUCTS

By Esther Dyson

Why is so much innovation on the Net so disruptive? One reason is that it concerns business processes and models as well as technology and cost. It interferes not just with individuals and machines, but with business relationships and power structures. A company such as Time Warner was competing not just with other new content on the Net, but with a new way for people to spend their time: Instead of just consuming content, they are becoming producers of it.

Perhaps the most innovative company around these days is Walker Digital, which understands well that it can't itself market most of its inventions, but must find third parties with established business processes to improve or established customer bases to serve. One exception was Priceline, established by Walker because it offered enough of a revolution to establish itself independently. It is competing with established air carriers not by means of faster airplanes or better service, but with a better way to price and allocate tickets and to reach previously out-of-reach customers. Another way to compete with established airlines may be not jumbo jets, but planes small enough to allow a restructuring of the industry into personal, on-demand flying, as opposed to mass transit. *(We look forward to hearing from Vern Raburn on this topic in March at PC Forum.)*

Companies are creating exchanges and markets where buyers and sellers can negotiate not just price but terms and conditions (see **Release 1.0**, 9-99), but many other new models. In Eastern Europe Keysystem (Disclosure: Esther Dyson is an investor) is creating a community of tour operators and holiday/tourist properties which will allow not just online transactions but cross-property yield management. (Hradec Kralove is full? Why not stay in Mlada Boleslav at another Keysystem partner hotel?) Payusback.com works as an agent for customers in tracking their packages and getting refunds for late packages from the likes of FedEx and UPS. (See the column on our Website.)

Likewise, grocery shopping on the Net isn't just about ordering online; it's also about subscription purchasing -- a year of toothpaste rather than so many tubes, and probably subscription shampoo and milk and cleaning supplies. Yes, you may set up the standing order over the Internet -- on the Web or by e-mail -- but it is not inherently a very "Internet" business. It will end up being quite local in terms of deliveries and logistics. The vendors may be large firms -- the equivalent of grocery chains except that they won't have stores; they'll have warehouses and trucks.

The new businesses on the Net even have to innovate in terms of what they sell and what they give away. Are you selling the use of software and continuing enhancements, perhaps with some data thrown in, instead of a license to a single version? (See page 16 on Web-based apps.) Are you giving away content to get an audience so you can sell advertising? Are you giving away software so you can sell service and support or custom development? Are you giving away products to gain registered users and sell stock? (That last one has been very successful, but unfortunately it is not sustainable.)

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out of five -- some risk of mistakes is better than no deal at all. And the willingness to take risks itself fosters outside-the-box thinking.

### **Managing scale**

Big companies need to understand those areas where size helps, and those where it hurts. For manufacturing, marketing and sales, large organizations benefit from economies of scope or scale, or from existing relationships. But tasks that require rapid decision-making and willingness to change your business model on a dime tend to be most effectively carried out in smaller, less mature companies.

There's a virtue, therefore, in managing scale. This is the human analogue to the management of growth in the Internet's core infrastructure that we described last month (see **Release 1.0**, 12-99). All the well-documented techniques of small, cross-functional teams, flat management structures, incentivizing employees and so on come into play here, but today even more radical approaches are called for. Khosla of Kleiner Perkins argues for an "organized chaos" model, "where plans are directionally 'herded' like a flock of sheep with enough room for experimentation, with individual sheep occasionally going in random directions... but with the herd going in a general direction."

Managing conflict, rather than squelching it, is a key here. Large organizations dull contrarian points of view and compartmentalize disciplines, when it's only the clash of truly different viewpoints -- the market economy in microcosm -- that can yank companies out of complacency and instill the passion and paranoia that feed innovation.

### **Innovators everywhere**

Large technology companies often seek to foster innovation through research labs or skunkworks projects. Though these groups can develop brilliant new technologies free from the strictures of corporate bureaucracy, they can easily fail in their broader mission. The danger of having a designated innovation group is that everyone else (in other words, those developing, managing and selling actual products) will get the message they aren't a source of innovation. And the skunkworks may be too far removed from the expertise elsewhere in the company in turning ideas into marketable products.

To avoid these difficulties, companies must find ways to integrate their forward-looking research with the rest of the organization, without overly constraining the small group's freedom. For example, Novell established a new group a year ago to explore ideas beyond its existing product lines. Rather than staffing the group with dedicated researchers, however, Novell allows engineers and other employees from anywhere in the company to join by submitting proposals. If the concept is selected for "the pipe," a small team prototypes and validates the idea with potential customers and partners; that same team transitions into the production product group if the decision is made to go forward.

This approach attempts to capture some of the benefits of research labs without the downsides. "It has broken down the glass house picture of a research group," says Novell vp of new product initiatives Kent Erickson.

The greatest challenge, he notes, is convincing engineers used to focusing on existing products to think outside the box: "We have to encourage our employees to want to come in and take the risk."

#### CASE STUDIES: HOW BIG COMPANIES RESPOND

Innovation lies between the realms of strategy (visions that are straightforward to articulate but difficult to realize) and tactics (the blocking and tackling that makes all the difference, but only if the environment is fertile enough). Companies cultivate it through their practices, but it emerges through their values and stories. Here we offer a few such stories, culled from four prominent technology companies -- IBM, Cisco, Hewlett Packard and Intel.

##### IBM's Internet Division: small blue

"The most important contributions that we've made to the company were things that nobody asked us to do," says John Patrick, vp for Internet technology of IBM's Internet Division (and longtime Release 1.0 subscriber). Patrick, who urged IBM to take advantage of the Internet in a 1993 paper titled "Get Connected," heads an IBM skunkworks called WebAhead in Southbury, NY.

Patrick says that to be innovative, employees have to live externally, devoting time and energy to the world outside the company. "Most of the people in the world don't work for IBM," he notes. Encouraging people to engage with outside colleagues, conferences, publications and Websites helps information flow in both directions: IBM can incorporate outside innovations and user demands, and internal projects can be tested for market responses.

Patrick deliberately eschews all-encompassing plans and requirements analysis, which can put a damper on projects that may produce unexpected benefits. IBM still has its formal product development process, but in parallel it allows novel Internet-related concepts to develop in their own way. Concepts move from individual conception to a small group of two or three, who quickly develop a working prototype. That prototype goes up on the IBM intranet, where anyone in the company can try it out and send feedback. Patrick also established a parallel program, called Alphaworks, that makes IBM technologies with uncertain commercial value available on an external Website so that outside users can identify possible applications.

Explains Patrick, "Our philosophy is: Don't control it. Make it available and let people try it. If you control it, you might not get the right people to test it. It becomes too rigid." Prototypes that garner sufficient interest and support are eventually funded and turned into mainstream products.

Ubique's instant messaging and collaboration software is a good example. The company developed the technology in the early days of the Web, and Patrick's group installed a copy on its internal Website. Ubique itself was acquired by Netscape, then spun back out and later acquired by IBM subsidiary Lotus. During that time, the Ubique VP Buddy software gradually became a mission-critical tool within IBM, and now boasts over



200,000 users there. IBM has enhanced the basic instant messaging functionality with "buddy bots" that perform additional functions such as corporate directory lookups based on the buddy list.

Patrick takes issue with the argument that the Net favors startups that can take advantage of disruptive innovations. "The Net doesn't favor small companies. The Net favors good ideas," he argues. Some technologies (Patrick points to the scanning tunneling microscope as an example) require scale for development. What really matters for innovation is not size but speed, and Patrick believes big companies can move quickly if they believe they can. "If you think you're slow, you're going to be slow," he notes. This means evangelizing internally, and also focusing on hiring and retaining the right people.

#### **Cisco: giving customers what they want...or should want**

If there's a poster child for the post-modern company, it's Cisco Systems. With nearly 25,000 employees and a dominant share of the data networking market, Cisco's market capitalization ranks third only to Microsoft and General Electric among US companies. Not bad for a company that shipped its first product in 1986, competing in the cutthroat data networking industry. So what's the secret?

Cisco svp Howard Charney sums up the company's view of innovation succinctly: "Innovation is doing something that your customer values." Rather than focusing on research for its own sake, Cisco works to understand what its customers are looking for, and then develops the new technologies to meet those needs. Charney, who worked at IBM early in his career (he also co-founded 3Com and Fast Ethernet vendor Grand Junction Networks), says IBM's introduction of the PC was a more important innovation than any number of uncommercialized technical breakthroughs at IBM Research, because it dramatically changed the marketplace.

Of course, listening *too* hard to your customers can get you into trouble. Customers may not know what they want, or they may want more of the old familiar thing when they would actually prefer something new if it were offered (see page 3). Charney says the answer is to stay close to customers...but also have a strong view of the trajectory of technology and the marketplace. "We need to develop on a trajectory which will be of value to our customers, but they don't know it yet," he explains. In practical terms, this boils down to the nuts and bolts of execution, not sexy but ultimately more critical than the occasional flashes of inspiration. For example, a more powerful technology at a price customers are unwilling to pay is hardly a useful innovation.

Regarding the relationship of company size to innovation, Charney makes an interesting point. It's not that smaller companies are more innovative, only that their innovation is more visible to the world. "What small really means is that I don't have any customers," he explains. "I have a simple life because I have no support issues. I'm working on something and I'm single-mindedly focused." Bigger companies, by contrast, must devote resources to customer support, follow-on products and so forth, which divert resources but don't eliminate the fundamental innovation that still takes place. "Every one of those startups would trade their lives to have the economics that Cisco has," he argues.

Two particular areas in which Cisco is recognized as a model are its skill in acquiring companies and its internal use of Internet technologies to enhance its business. Cisco still generates a majority of its innovation internally, but it has acquired over 40 companies -- Granite Systems, NetSpeed, Weblin, Stratacom, Selsius, GeoTel, Monterey and Cerent, to name but a few -- because it recognizes that many great ideas (and people) reside outside Cisco.

Charney, who himself came to Cisco through a 1995 acquisition, says the company's success derives from both clear strategy and effective execution. Acquired companies are integrated immediately through templates for rapid switchover of human resources, finance and other functions. "Cisco purposefully engenders a pain spike upon acquisition so that immediately thereafter we can begin the healing process," explains Charney, arguing that tight integration is essential to realizing operating synergies from the acquisition.

Cisco's internal use of Internet technology is one of its hallmarks. "I can't even imagine what it would be like not to have the Net here," says Charney. "It would be like trying to do business without a telephone or a lamp at my desk." The Net has even caused a shift in Cisco's acquisition strategy. Early on, Charney says, Cisco acquired only companies physically close to its San Jose headquarters, but thanks to the ease of online communications it has been able to broaden its sights and successfully integrate companies around the country and the world.

Charney emphasizes that a key element in all of this is setting expectations high. "My direct experience tells me that you manage innovation because you ask for it," he says. "You set a culture for moving the line far ahead, then you accept nothing less than moving the line far ahead."

#### **HP: e-speaking up**

Hewlett Packard, perhaps Silicon Valley's oldest and proudest company, is in the midst of a company-wide shakeup, spearheaded by new ceo Carly Fiorina. HP realizes it must adapt to the Internet world and become more effective at creating value from its resources and vast store of technical inventions. A major focus of that effort is a push beyond HP's traditional hardware base into services, and a key element of HP's e-services initiative is a project called e-speak.<sup>2</sup>

E-speak is an abstraction layer allowing any resource such as hardware, applications and content to be represented as an Internet-accessible service. The e-speak API can also support distributed online marketplaces based on open protocols such as XML.

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<sup>2</sup> *E-speak is one of several non-traditional, semi-autonomous projects HP is developing as part of its reinvention efforts. Another is Deep Canyon, which sells electronic documents such as research reports to marketers. Deep Canyon grew out of the LaserJet division in Boise, ID. "We thought we had already sold all the LaserJet printers anyone in the world would need," says Deep Canyon's Thad Webster, so the group developed a plan that leveraged HP's customer base and expertise in document production, but with a services business model.*

Rajiv Gupta, HP's cto for e-services and gm of e-speak, has been working on the project since 1995. The original notion was to create "PCs on demand," enabling network-connected machines to function as either a traditional PC or a server-controlled network computer based on the application. Among the first things the e-speak group, then part of HP Labs, did was to build a demonstration prototype to show to HP managers. "Once you build it, you understand what's required, whether you've done it wrong or right," explains Gupta. "Then you build it right."

Reaction to the prototype was mixed. Some HP managers responsible for selling PCs and servers were concerned that the new technology would threaten their revenues by allowing low-end machines to serve as terminals for powerful network-based applications. Gupta's response was that e-speak would allow HP to sell other things, including services, that built on top of the technology, and ultimately come out ahead.

Gupta says he used several techniques, including internal champions and pressure from customers, to convince HP executives to support e-speak. In the end, though, he says, "it's an issue of credibility." Gupta himself had developed a reputation leading HP's work with Intel on the IA-64 microprocessor, which made others in the company more willing to take a chance on his new effort. Having Fiorina publicly make the technology a centerpiece of her message doesn't hurt either.

"Most of the disruptive technologies we have today came from places of research," says Gupta, pointing to the Internet, the Web and Java as examples. Startups simply don't have the resources, or the ability, to gestate non-revenue-bearing projects for several years that research labs allow. Startups also don't have channels and customer relationships, which can allow a large company such as HP to market new products and services effectively. Instead, Gupta observes, "what the startups are telling us today is that it takes more than technology to be disruptive. It takes business models."

HP is putting that approach to work with e-speak, by giving away the underlying technology as open source code. Gupta is convinced that HP will benefit from building a critical mass of support around e-speak, which it can capitalize on to generate revenue. "A company like HP has other things to sell," he says. "It has other needs for mindshare that it can milk out of giving things away."

For now, the e-speak group remains within HP, though the company professes a commitment to true open-source distribution, and hopes competitors will adopt the technology as well. When e-speak moved out of HP Labs, Gupta got a written commitment from the company that the project could be spun out within a year as an independent company. However, he says, he now sees HP's channel and other assets, including people, as more valuable than the benefits of going independent.

### Open source: non-innovative innovation?

Open-source software development (see **Release 1.0**, 11-98) is clearly something different from the predominant software-development model, but does it necessary foster innovation?

The open-source model isn't new -- projects such as GNU and sendmail trace their lineage back over a decade. What's new is the number of open-source projects, their scale and the level of interest in the general consumer and business world. The Net has made it much easier for open-source development communities to form, communicate, maintain projects and incorporate new features. Open-source projects turn out to be perfectly suited to the capabilities the Net provides, but their use of the Net isn't necessarily innovative because of it.

What about the projects themselves? Many open-source projects offer benefits not found in their commercial counterparts, but these seldom fall into the category of innovations. Linux, for example, may be more reliable, flexible and affordable than Windows NT. All of these are important to users. But the basic structure and features of Linux are derived from Unix, an operating system available for more than 20 years. The OS may be more open to tinkering than its commercial competition, but that's not the same as disruptive innovation, which would require the leaders of a project -- or a splinter group that forks off -- to make a decisive break with the past.

Saying that open-source projects may not be innovative doesn't mean they aren't good, even better than the commercial alternatives. The reason open-source products may not focus on innovation is that they are so tightly coupled with user demands. Open-source developers customize software to meet their own preferences as users, or to address specific requirements or solve problems. The software is therefore often more valuable for its intended purpose, but that's something different from the landscape changes that come from deep innovation.

Innovation in the open source world often arises in areas other than the projects themselves. Companies such as Collab.net, LinuxCare and VA Linux Systems are creating novel business models that meld open-source development efforts with commercial offerings. The end result may be to change the way many companies and developers think about software. As Esther notes above (see box, page 6), it's innovation in business and revenues models, not just products.

### Intel: corporation as venture capitalist

Intel has long been able to remain on top of the semiconductor business, despite attacks from many directions. Outside investments are its secret weapon. Svp Les Vadasz, one of the company's first employees (and a speaker at last year's PC Forum, see **Release 1.0**, 3-99), is among other things responsible for Intel's investment portfolio.

Vadasz acknowledges that small companies may be able to move more quickly, because they aren't encumbered by the need to coordinate large numbers of people. But he is quick to add that speed is only part of inno-

vation. "A small company can move with an idea very fast and develop a small business," he says. "But as soon as you want to develop a big business, some of the other impediments get in the way."

Intel has several parallel mechanisms to remain innovative. It funds over 200 university research projects, with an Intel researcher assigned to each in order to strengthen connections with the outside world. Instead of a central R&D lab, Intel has research operations associated with each business unit, so the research subjects are more-closely tied to business imperatives. The company also provides seed funding for experimental internal projects.

Most prominent, however, is Intel's investment portfolio, now among the largest in Silicon Valley. Intel generally takes minority interests in startups that it sees as strategic and complementary to its own products. Vadasz says Intel has had an excellent success record with its investments, because unlike professional venture capitalists it has deep expertise in technology development and marketing. Though Intel isn't investing solely to make a return on its money, its 350-company portfolio would make most VCs proud; last quarter, for example, it realized \$327 million in profits solely from its investments.

Though Intel's original investment focus was on promoting "MIPS-sucking apps" that created demand for processors, the company today takes a much broader view of what will be in its strategic interests. The Internet is particularly important to Intel's thinking, Vadasz says: "The first question you ask is, 'what can I do to assure that the next generation Internet infrastructure develops in a way that is rapid and advantageous to our business interests?'" The answer varies from country to country; in the US broadband access to the home is the next frontier, while in India availability of phone lines is still a serious constraint.

Intel now generates a billion dollars of sales per month on the Web, and Vadasz credits Intel's investments in online business-to-business technology vendors for helping the company's internal Internet people "realize what can be done."

## THE TECHNOLOGY CONTEXT

There's no sense discussing innovation in the technology industry without acknowledging the current context, otherwise known as the Net.

Internally, the Net can be a huge boon to innovation in large organizations. Cisco is probably the best example. Cisco's public Internet site, through which flow over 80 percent of its sales, may be better known, but its intranet is the heart of the company. This behind-the-scenes resource allows Cisco to waste less time and money on non-productive activities such as processing purchase orders, enables more sophisticated financial modeling because the company can close its books in an hour and provides a wealth of information to employees and partners, all of which fosters innovation.

At the same time, the Net magnifies the challenges large organizations face. Startups can develop and deploy new services without building their own networks, because the Net is the universal platform. Entry

barriers fall, which levels the playing field between small and large organizations. The fact that the Net is a new environment also means that everyone starts at square zero; resources in a related space may be useful but they don't guarantee success. Moreover, venture investors, following the phenomenal success of upstarts such as Yahoo!, Amazon.com and eBay, are pouring money into tiny operations so they can compete with bigger players.

Furthermore, as Schrage points out, "The Web takes away the luxury of the median." Large organizations aim for the middle of the bell curve, satisfying most of the customers most of the time to generate the substantial revenues they require. Big companies are effective at bundling products, generating value (and margins) from scope economies and their ability to integrate pieces. But the Net is a disaggregating force, allowing each piece to become a separate business while the relationships between the pieces follow standardized open interfaces. Cross subsidies are hard to justify when your competition is unencumbered by them.

In general, though, and primarily for small companies, the Net is fundamentally a positive force for innovation. "The Net makes it possible for a really good idea anywhere to link up with a really good use for that idea anywhere," says IBM's John Patrick. Because of its layered, end-to-end architecture (see **Release 1.0**, 5-99 on IPv6), the Net provides tremendous freedom for experimentation. Anyone can play with and deploy a new service over the network without getting approval from the network owners, and without reaching universal agreement on standards. Internet protocols define only the baseline requirements for connectivity, allowing anything compatible to plug into the network.

#### **Hardware and software dialectics**

The rapid obsolescence of hardware reflected in Moore's Law means there's always room for something new to make use of additional processor capacity. As costs plummet over time, it becomes possible -- even rational -- to waste virtually free cycles on seemingly non-essential uses. For example, streaming media via the Net doesn't work on 1980s-vintage PCs, because they don't have the excess processing power. Recognition that more powerful CPUs opened facilitated software innovation, which in turn sold new machines, motivated Intel's early foray into venture investing (though its aims are now broader, as discussed on page 13).

On the other hand, necessity is the mother of invention...and of innovation as well. Some innovations happen because underlying technologies *don't* evolve fast enough. To take streaming media again, the compression algorithms that eat up all those cycles wouldn't be necessary in a world of gigabit bandwidth to the home. Akamai and Inktomi's content-delivery networks (see **Release 1.0**, 12-99) respond to bottlenecks in end-to-end Web performance, and wouldn't have happened without those bottlenecks.

#### **The maturation effect**

As successful technologies develop, they tend to mature rather than constantly reinvent their basic structure. Within any particular category, customers become comfortable with existing arrangements, and there's simply less room for dramatic change. This also means that products become

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more packaged and “easy to use.” Easy-to-use interfaces may be innovative, but they limit innovation at other levels.

Just as few people now work on their own cars, hardly any consumer today looks under the hood of the operating system or applications they run. The last radical innovation in PC operating systems was the desktop graphical user interface, developed two decades ago at Xerox PARC and introduced in largely its current form with the Apple Macintosh in 1984. Sure, more recent implementations such as Windows 98 include valuable new features, better performance, and many changes that could be called innovative, but these pale beside the desktop metaphor itself and the all-powerful WIMP (windows, icons, menus, pointer) design.

As existing products mature, innovation must come from new categories splitting off or rising up from elsewhere. An important element for such innovation to occur is under-specification. Innovation occurs most in the white spaces where there aren’t existing patterns -- in evolutionary terms the unoccupied ecological niches.

The PC is an excellent platform for innovation because it’s a multi-function device that does many things, but none of them especially well. There’s room to improve on any of these functions, such as entertainment, information retrieval and communication. The Net has similar characteristics. Designed primarily for scientific and military applications in its early days, the Net arrived in its commercial form with only the services valuable to researchers. To make it useful in commercial and business contexts required many new applications, connections to legacy systems, performance enhancements and so forth. That blank slate encouraged startups to fill in the gaps, producing a burst of innovation.

Though the PC is the dominant platform for computing and online communications today, that may change in the future. Information appliances and Internet-connected wireless devices (see **Release 1.0**, 4-99) are rapidly growing in popularity, and may eventually surpass the PC in sales and installed base. Such innovative new products will catalyze further innovation at the application level (as did the Palm), so long as they are not coupled too tightly with a single function or business model. And all the companies that have worked so hard to innovate around the PC will have to reinvent themselves yet again.

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## A DISRUPTIVE INNOVATION: WEB-BASED APPS COME OF AGE

*We've been talking generally about disruptive technologies and their effects on companies. It's also instructive to look at one specific development that has the potential to disrupt established companies and markets: Web-based productivity applications. Fortunately, it's a development that is interesting in its own right.*

### Unmet expectations

So far, the Web has had little effect on sales of desktop applications. Despite predictions of its downfall, Microsoft Office remains a tremendous cash cow, and few users have given up their Windows or Mac software for Web-based alternatives. If anything, things have moved the other way, as Microsoft has integrated Hotmail into its Outlook groupware suite, and plans to do the same for the Jump calendaring service it bought last year (despite security risks and other complications).

Let's face it. Mature desktop packages are hard to replace. Users become familiar with the interfaces and features of their preferred package, and store their data in proprietary application-specific formats. Other than WordPerfect, Lotus 1-2-3 and dBase, all beaten in wars of attrition by Microsoft, is there another example of a prominent desktop productivity application with a commanding majority of the market that was overtaken by a competitor? (OK, VisiCalc, which lost out to 1-2-3, but that was before most of today's Internet ceos were born.)

The Web was supposed to change all that, but it hasn't. Web-based e-mail has proven phenomenally popular, but mostly as a supplement to desktop e-mail clients rather than a replacement, especially in corporations.

### The new generation

So with some trepidation we suggest, humbly, that over the next several years things may shift. In the past six months we've seen a number of impressive Web-based applications that finally give their desktop counterparts a run for their money. What happens next depends on how the startups developing these products play their cards.

What has changed to raise the quality of Web-based apps? Internet penetration has continued to grow. More specifically, the building blocks for Web-based services have improved, with plain HTML giving way to dynamic HTML and Javascript on the front end, along with Java and XML on the back end. These newer technologies, now relatively mature in terms of browser implementations, development tools, and so forth, make it possible to deliver sophisticated interfaces in a browser that rival those of desktop clients (see Release 1.0, 9-98).

The business model of delivering software as a service, and the business and technical infrastructure for hosted applications, have also come into their own over the past two years (see Release 1.0, 12-94, 1-96, 6-99). Startups, such as those discussed below, see innovative ways to deliver functionality that established desktop software vendors can't match, while those established vendors are responding, creating an arms race that puts a premium on innovation. The final piece of the puzzle, reliable always-on broadband connectivity, is finally coming into play in the



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US, though still a fraction of the market (see **Release 1.0**, 2-99). With broadband, Web-based apps can approximate or even match the responsiveness of their desktop counterparts, and can leverage the always-available network connection for a range of new capabilities.

Though it's easy to cast these developments as challenges to Microsoft, that's misleading. Microsoft itself has announced plans to deliver Office as a hosted application over the Web. Moreover, the new Web-based apps need not prevail in head-to-head purchasing comparisons against established desktop applications. These services extend and change the meaning of an application, and they will be delivered in a range of situations beyond the reach of shrink-wrapped software.

For example, a dynamic client-side internal rate of return calculator for your portfolio on a stock-trading site isn't an alternative to Excel, it's an expansion of spreadsheet functionality to other contexts. Over time, as an increasing share of user activity migrates to these Web-based environments, sales of the analogous desktop applications may tail off, but that's almost beside the point.

### Getting better all the time

There are several reasons to think Web-based productivity apps will gain traction with users, and may eventually eclipse the shrink-wrapped software model we've known and loved for so long. Because these applications run from a server and are delivered to a thin client, they are far more easily modified. Vendors can rapidly incorporate not just bug fixes and security upgrades but entire new features into the product, without having roll them out through physical distribution and user installation. The speed of improvements for Web-based apps should therefore be greater.

As with simple Web-based services such as free e-mail, Web-based productivity apps will also benefit from ubiquitous access. Users can get to their data wherever they have an Internet connection, including public kiosks and wireless devices, rather than being tethered to their PC. Moreover, because the Web-based apps are already running on high-performance servers in monitored data centers, there's reason to believe they will be more scalable and reliable than applications running locally (assuming reliable connectivity, of course).

The final, killer advantage of Web-based apps is flexibility/modularity. Desktop productivity applications are monoliths. It doesn't make sense to market separate versions for each cluster of users, so vendors sell all-encompassing packages that accrete more and more features over time. Modular Web-based services can offer just the functions each user wants. Users can customize their toolset on the fly, both in features and interface, far more readily than a mass-market desktop package.

This flexibility extends to business models (see box, page 6). Rather than traditional licenses and upgrade fees, Web-based app vendors can mix and match one-time fees, monthly fees, advertising revenues, up-sell and transaction commissions, or other revenue sources. The apps can even be thrown in for "free" with the purchase of data services or memberships.

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**THE NEW CROP**

The number of startups offering Web-based productivity apps is growing rapidly. Below we provide brief overviews of several that have poked their heads out, roughly organized by increasing divergence from the status quo. At this year's PC Forum we'll be showing off the work of several of these companies; look for more details in the March 2000 issue.

**Suites**

The desktop world went from single-function applications such as VisiCalc to packages, led by Lotus 1-2-3, that offered a bundle of related functions. Attempts at further integration into a single application resulted in unwieldy hybrids (remember Jazz? Symphony? Framework? Javelin?), but Microsoft's Office bundle of several popular and full-featured productivity applications has become a perennial best-seller.

One disruptive aspect of delivering applications through the Web is that the boundaries between them are less clear. It's easier to build integrated collections of applications that share interface elements and back-end data stores, because that's the way the Web works anyway. So it makes sense that the current generation of Web-based productivity apps includes both standalone offerings and comprehensive suites.

Star Office, a German product which Sun purchased last year and released for free under its community source license, is the most incremental evolution from desktop applications. The Java-based suite can run either locally or remotely over the Net, and it offers the standard productivity applications including a word processor, spreadsheet, and presentation software. Most of the components look like stripped-down versions of their analogues in Microsoft Office, providing the most commonly used features and offering file-format compatibility with Office.

Star Office may have been the first entry in this space, but others have quickly joined it. ThinkFree, launching in February, is another startup that has developed a free Java-based Office lookalike, with a built-in Windows-like file system. NuoMedia, based in Brooklyn, NY has released a beta version of its own Web-based office suite, which similarly covers the major desktop productivity functions and reads Microsoft Office files, but delivers the applications in a more Web-like browser interface. Nuomedia plans to offer the basic suite free, but to charge for value-added services such as additional file storage as well as licensing the suite to other sites.

Another player in Web-based productivity suites is CoreByte, which focuses on the groupware functions such as e-mail, scheduling, instant messaging, contacts and bookmark management. CoreByte offers a far more rich and customizable feature set than the leading Web-based e-mail services such as Hotmail and Yahoo! Mail, along with Web-based administrative tools that allow organizations to manage multiple domains on the same server. Corebyte has been licensed by several customers in its beta form, and the company is now signing up additional companies and service providers. The startup was acquired last July by communications systems integrator Datapoint, but it operates as an independent subsidiary.

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**Databases: Flashbase, Bitlocker and Activespace**

Many specialized applications are built around databases, as are most non-static services offered over the Web. But far fewer users create their own personalized databases than avail themselves of other productivity applications such as word processors. Desktop database packages are often overkill for managing a wine list or keeping track of job candidate interviews. There may be specialized applications, templates or Web-based services for the kind of database you want to create, but these will usually have limited customizability or require time-consuming database development.

Three companies -- Flashbase, Bitlocker and Activespace -- have announced Web-based services that allow users to create their own simple database-centered applications on the Web. Data are stored on the server, with the browser used as a front-end interface to define fields and to configure views and queries. All three companies offer customizable templates for a wide variety of situations.

Flashbase, started by ceo Andrew Ehrlichson (previously with Silicon Graphics and BlackRock Financial Management) and Cornell University electrical engineering professor Mark Heinrich, launched in September. The company, based in New York City, has \$1 million in funding from Wit Capital's Dawntreader fund. Bitlocker, which launched earlier this month, was started by ceo Eric Krugler, an ex-Apple technologist, and cto Andrew Voelker, who has been involved with several companies including Tumbleweed, Apple, Creative Labs and T/Maker. Bitlocker sees its ability to grab data from external sites and automatically incorporate it into hosted databases as a differentiator. The third player, Activespace, based in San Francisco, plans to launch in the first quarter of 2000.

**Halfbrain: from spreadsheets to components**

Halfbrain's BrainMatter spreadsheet, now available in public beta, shows how feature-rich a purely Web-based productivity app could be. Written entirely in dynamic HTML (DHTML), BrainMatter doesn't require any plug-ins or Java. After a brief component download, all the presentation takes place on the client side, rather than requiring a server call and page refresh. This makes BrainMatter almost as responsive as a local application, and the spreadsheet includes most of the commonly-used functions in commercial spreadsheets such as Excel.

The well-designed interface, featuring cells, drop-down menus and clickable icons, is familiar to any Windows or MacOS user, but it also incorporates uniquely Web-enabled features such as e-mailing a spreadsheet.

Co-founder and ceo Steve Guttman, formerly a product manager at Adobe, sees Web pages evolving from static text to applications, but says that transition requires new tools to deliver application functionality in a usable manner. Halfbrain has built an authoring environment to create DHTML-based applications, with BrainMatter as only the first example. Guttman believes that the native information-sharing capacity of the Web will allow Web-based applications to do things desktop software can't, though he readily acknowledges shrink-wrapped software is still the best option for times when users need deep functionality for specific tasks.

Halfbrain has attracted attention because its spreadsheet looks so much like a full-featured desktop application, but Guttman wisely doesn't intend a frontal assault on established software vendors. Rather, he sees a market in delivering components such as specialized interactive calculators that can be incorporated into content or commerce sites.


	A	B	C
1	How Much Is Bill Gates Worth?	Thanks to Evan Marcus' Bill Gates' Net Worth page	
2			
3	William H. Gates III, Co-founder, Chairman, and CEO of Microsoft has been rated by Forbes Magazine as the richest person in the world for the fourth consecutive year (as of October 1998). Bill's net worth has reached such astounding levels that we decided to find a way to present it that made sense to the average person.		
4			
5	<b>Bill's net worth</b>		
6	Microsoft's stock price now:	\$107.00	
7	Number of shares that Bill owns:	787,059,300	
8	<b>Bill's net worth, now:</b>	<b>\$84,215,345,100.</b>	
9			
10	<b>Bill's wealth as a proportion of:</b>		
11	NASA's budget	13.1 billion	643%
12	The US National Debt	5,631 trillion	1.50%
13	All the gold in Fort Knox	38.4 billion	219%
14	HalfBrain.com's Marketing Budget	25 thousand	336861380%

Figure 1 -- Halfbrain's BrainMatter Web-based spreadsheet.

The company is also seeking partners to bring its technology to enterprise intranets, where it can function as a lightweight abstraction layer on top of legacy data sources. For example, a business user could create a personal forecasting tool based on data from various internal and external sources, using Halfbrain's soon to be released scripting language. This approach reduces the load on internal IT, because "the person who makes the request can actually do the prototype," Guttman says, echoing some of the prototyping concepts discussed on page 5.

#### Platforms: Desktop.com and MyWebOS

The final approach startups are taking to deliver Web-based productivity apps is the most ambitious. Desktop.com and MyWebOS both promise not just specific applications, but entire OS-like environments via the Web. Both companies have built Windows-like workspaces with the familiar interface comforts of the desktop, but delivered entirely through a browser window. These platform services generally come with a set of built in applications -- MyWebOS has a full office productivity suite, while Desktop.com has initially focused more on personalized tools such as to do lists, news readers, photo albums and exercise logs -- as well as free remote storage space for personal documents. But in both cases the real power of the service lies in open APIs.

Desktop.com and MyWebOS allow developers to create Web-based apps with consistent user interface elements, and simultaneously provide a distribution channel and community resource for distributing those applications. The two companies are banking on convincing a critical mass of

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developers that writing applications for their platform will be far simpler and more rewarding than building similar functionality from scratch.

It's all but certain that there will be deals struck among the various Web-based app vendors, depending on where their products overlap. Beyond the actual functionality they offer, these startups will also differentiate themselves in their business models and market focus.

## THE DAWNING OF A NEW ERA?

### A long way to go

Some functions lend themselves more to Web-based apps than others. In general, the more important manipulation and storage of data, the more likely a Web-based app can compete with or surpass the desktop alternative. Also, where customizability or specific niche features are important, Web-based productivity apps may enjoy an advantage.

But as we noted above, the competition between Web-based and desktop productivity applications isn't necessarily a zero-sum game, at least in the next few years. Web-based apps will establish footholds in areas where they solve particular problems, and most users will initially employ them as supplements to desktop suites. The ability to convert files back and forth, and to synchronize data in online and offline databases and repositories, will also smooth the co-existence of the two models.

### A new world order?

Over time, though, Web-based apps may turn out to be a disruptive innovation in the exact sense of Christensen's Innovator's Dilemma. The Web-based app vendors are developing new, low-end markets not well-served by desktop productivity software. They don't offer the same features, yet, and they have other limitations such as slower performance, making them secondary tools for most customers. As they evolve, however, they may become more central.

Both the startups developing these Web-based services, and the established vendors they may ultimately compete against, now face the challenge of bridging the gap between small and large organizations. The startups described above all have innovative technologies and products, but they will have to execute effectively to turn that into a viable market and to convince customers they are getting something valuable. The existing software vendors need to find ways to incorporate more flexible Web-based applications into their own product lines, but that may mean competing with themselves.

As always, some companies will make the right decisions and others will fail. Seeing how Web-based apps changed the landscape will be easy in hindsight, but isolating the reasons why that innovation propagated the way it did will be far harder.

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*\* Events Esther plans to attend. # Events Kevin plans to attend.*

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