

The current wave of the
Computing Revolution flows
around interconnectivity, and the
winners in this rush will be
manufacturers and consumers.

FUNDING the Computing Revolution's THIRD WAVE

THE JOB OF AN EARLY STAGE VENTURE CAPITALIST is to anticipate technology trends, invest in promising companies able to ride the wave of new technologies, and help them build successful businesses. As such, we spend considerable time thinking about the future, anticipating the next wave of technology, and investing ahead of the wave. This essay attempts to describe the past, present, and future of the Computing Revolution from a technological as well as a societal perspective.

We are in the midst of the Computing Revolution; a revolution historians will one day rank with other great leaps forward in society, including the Industrial Revolution and the Farming, or Agrarian, Revolution. And, as so often happens, those in the middle of the revolution often fail to see the impact of these changes as they occur.

Previous revolutions have fundamentally altered society in many ways. From commerce, to communities, to cognition, each previous revolution has remapped society in predictable and unpredictable ways. The Computing Revolution is no different.

The first wave of the Computing Revolution began

with the commercialization of the silicon chip, and lasted 10–15 years, into the 1990s. The first wave was about silicon. It was about devices. Hardware. Silicon Valley emerged and grew to prominence around Silicon-based devices. Memory chips, processors, printed circuit boards, disk drives, monitors, and modems became the building blocks of a new generation of computing devices. Many communities across the U.S. tried to ride that first wave, but Silicon Valley companies won hands-down. The most notable loser was the Route 128 area around Boston.

How did Silicon Valley trump Boston? Two answers: Open systems always beat closed systems and “coopetition” beats competition. Sun Microsystems beat Apollo Computer because its architecture was based around the open standards of Unix and Ethernet. Apollo used a proprietary operating system and networking architecture. Open beats closed. Sun Microsystems beat Digital Equipment Corporation because it sourced disk drives, processors, and other components from other companies in Silicon Valley. DEC tried to build as much as possible in-house. Coopetition beats competition.

And with the focus on silicon-based computing devices, it made sense for a community of companies to work together in the Valley. It allowed engineers at different companies to share ideas and needs easily. And it allowed physical products to move quickly and cheaply between companies located a few miles apart.

The second wave of the Computing Revolution began in the mid-1980s and came into its own in the 1990s. It was all about software. Unlike Silicon-based devices, software companies sprouted up in many different areas. Microsoft, of course, is the most notable of these companies. But, the earliest software programmers came from Silicon Valley and they came out of the video game business, notably Atari. Just as the video game industry was going through the second pullback cycle, the first personal computers were rolling out, creating a need for programmers, and a new platform on which to work.

Distribution separated the winners from the losers in the software industry. Better distribution beats better technology. Did anyone believe back then that

replacing electrons. And wireless connectivity is becoming ubiquitous. But many of the rules learned in the first two waves will separate the winners from the losers today. Open will still beat closed. Coopetition will continue to trump competition. And distribution will continue to triumph over technology.

But the third wave is also writing new rules for the winners in the silicon and software waves. Christmas 2000 saw a marked slowdown in PC sales. Portable wireless devices are growing at a faster rate than PCs. Wireless phones have overtaken PCs in terms of population penetration. And expensive bloatware software is being replaced by software applets, software on demand, and freeware.

It may also be instructive to examine the Internet Gold Rush to see what lessons we may have learned. Today, no one will doubt, that hundreds of companies had excessive valuations over the past five years. During that time, smart people, and most Wall Street analysts, sought to further inflate outrageous valuations on companies they recently took public. What happened? Quite simply, the investing community

THE INTERNET WAS NEVER ABOUT creating a whole new class of middlemen to transact business online. Instead, it stands to be the greatest productivity tool ever invented, ——— creating whole new classes of winners and losers. ———

DOS was better than the Mac OS? Was Excel better than Lotus 1-2-3? Was Internet Explorer better than Netscape Navigator? Of course not, at least not initially. But Microsoft proved the maxim that distribution beats technology—and their distribution advantage gave them time to improve and perfect their product technology.

The third wave of the Computing Revolution began in the late 1990s, and is upon us today. That wave is about networking and communications. Interconnectivity. It began with machines talking to machines. It moved to software talking to software. It is maturing to people talking with and working with people, anytime, anywhere, on any device.

While some of the winners in the third wave have been identified, such as Cisco, others are waiting in the wings. The communications landscape is shifting quickly. Traditional voice-switched networks are being replaced by packet data networks. Long-distance costs are approaching free. Carriage is becoming a commodity. In our transmission lines, photons are

forgot, or conveniently ignored, tried and true lessons of the past, while in the stock market greed triumphed over fear—at least until spring 2000. Let's hope we all remember the following rules and guidelines in the future:

New technologies are more likely to complement old technologies than replace them. An underpinning of every fluffy valuation was the wrong assumption that the new economy company would destroy the old economy company. Amazon.com would put Barnes & Noble out of business. Well, that never happened. Television did not destroy radio, nor did it replace movie theaters. The VCR did not result in a drop in movie attendance. MP3 audio files will not destroy the recording industry, and online retailing will not replace Main Street. How silly does our national debate over Internet sales taxes look now? Remember the rhetoric about the Internet's attack on Main Street? Online retailing will peacefully coexist with Main Street retailing, and the

winners will be those that leverage both channels effectively.

A dumb idea is a dumb idea—even on the Internet. Buying pet food online. This one takes the cake. Most pet food doesn't cost much, and it comes in big heavy bags. So, what exactly are the benefits of selling it online? And do they outweigh the shipping costs? I don't think so. A little bit more controversial—online groceries—a truly bad idea, I suggest. What happens if you take a low margin business, replace free labor (from the shopping customer walking down the aisles) with hourly labor (to select items for the customer) and replace free delivery (from the shopper driving their groceries home) with expensive delivery by the online grocer? You end up with a business with negative margins.

A business must be profitable or else it is not a business. This rule is a simple rule of economics. At some point in time, a business needs to generate more cash than it consumes. Otherwise it is more properly called a “nonprofit entity,” or charity. Investors will not fund a company forever. Today, the buzzwords we venture capitalists look for is a “path to profitability.” In the very recent past, we instead played hot potato, and hoped and prayed that when the music stopped, we weren't the last ones funding the company.

The 30 P/E rule. Sooner or later, great growth companies will trade around a 30 P/E, or multiple of earnings. Of course, this presupposes the preceding rule, which is the company has earnings. When a company has a P/E in the stratosphere, how does it revert to the 30 P/E norm? It means that either the earnings will grow exponentially, and the stock price remain relatively flat, or the earnings will grow more slowly and the stock price will fall to the norm.

Business model, customers, brand—not the other way around. For thousands of years, successful businesses have been born and have prospered by following a few simple steps, in order. They found a product or service they could produce and someone else would buy, and buy at a profit. They grew their business over time by adding more customers. And, the most successful ones built a reputation that turned into a brand over the years. Why did we think the Internet would be different? Well, quite simply, it was the gold rush mentality applied to the creation of business on the Internet.

As a result, many entrepreneurs pursued their Internet dreams with a backward business model. That is, they raised a lot of money (and venture capitalists were guilty here, as were the Wall Street investment bankers and the investing public) to first build a brand. The Internet conventional wisdom was that only one brand would prevail in a category, hence the

need to build it quickly. Once the brand was established, customers would flock to the new Web site. And, with enough customers, the new business would have enough time (and money) to figure out a business model. Amazon.com's pursuit of this model put CEO Jeff Bezos on the cover of *Time*. However, I submit that Amazon has yet to build a successful business because, several billion dollars later, they do not yet have a proven business model.

Is it a feature or is it a business? Venture capitalists have been burned investing in technology tools over the years because it is quite easy for a neat tool to be integrated by someone else into their core product. Consider Microsoft Windows, Yahoo, or AOL. These products have evolved over the years by incorporating new features, many of which were the dreams of entrepreneurs to build the next billion-dollar company. For example, Web Calendars were a bad stand-alone product, but perhaps a good add-on to a portal or office productivity suite. As a result, companies that make cool tools often have a hard time building big businesses. But over the past three to five years, we saw a new phenomenon: The entrepreneur who builds a product but who never intended to build (much less run) a profitable standalone business. The only goal of these entrepreneurs was to sell their company to a larger company. Good idea? Judge for yourself.

With these recent lessons as a backdrop, let's turn to investing for the future. Many have compared the Internet phenomenon to the tulip craze of the 1600s when Holland's tulip bulbs were all the investment rage. Speculators bid up prices on rare bulbs through gross speculation. Then, the market collapsed. While there may be some similarities in the way the prices of tulips and Internet stocks were bid upon, tulips did not change the world. The Internet will.

The Internet was never about creating a whole new class of middlemen to transact business online. Instead, it stands to be the greatest productivity tool ever invented, creating whole new classes of winners and losers. I would suggest that manufacturers of products, services, and information will be the big winners as will consumers of these items. Many of the middlemen, however, will be the losers. Indeed, those in the middle of transactions between manufacturers and consumers stand to lose big. And this will threaten a substantial part of the world economy, as two-thirds of our GDP goes to middlemen. As we have learned from past experience, the Internet as a technology will not displace its predecessors completely. It will, however, threaten and eliminate intermediaries in many industries.

The Winners

Some of the winners in the third wave of the computing revolution should include:

Manufacturers. End-user demand for products, services, and information will not shrink in the future. In fact, demand should increase if the Internet fulfills its promise of lower prices by increasing the efficiency in the supply chain. More important to manufacturers, however, will be the development of a new channel of distribution direct to the end user. Consider Dell Computer. Through their direct distribution channel they have a structural advantage over other manufacturers who use distributors and retailers. Those manufacturers that figure out how to integrate a new channel of distribution alongside their existing channels will win. Other winners will be manufacturers who emerge and sell directly to end users as their only distribution channel. In this scenario, margins should rise as well as manufacturers pass along some, but not all, of their supply chain savings to consumers.

keyboards get smaller and the user interface challenges increase exponentially. The user interface issues revolve around two simple concepts: Input and output. Input devices are moving from the keyboard (full size, Chicklet size, phone-pad size) to the stylus (touchscreen keyboard, stylus alphabets like Graffiti, handwriting recognition as attempted by the Apple Newton) to voice (limited alphabet, speaker-dependent, speaker-independent). Output devices today are screens of a variety of fixed sizes. In the future, screens will become flexible and foldable, expanding beyond the physical-form factor. They will eventually become virtual; projecting from the device into open space. Voice will also play an increasingly important role in smaller output devices.

Messaging. Email is the killer app on the Internet. People spend more time using email every day than they do browsing the Web. Over 70% of AOL's traffic is in the form of communication between and among people—email, instant messaging, chat, and bulletin boards. And messaging is going wireless. It already has in Europe and Asia. The U.S. is a wireless

A PREDICTION: Users who need frequent remote access to corporate email will carry a PDA and a wireless phone. Those who do not need remote access to corporate email will shed their PDAs in favor of their enhanced wireless phones.

Wireless devices are here to stay.

Consumers. A collapse of all or part of the supply chain will present savings for manufacturers and consumers alike. In fact, for those industries where the Internet completely rewrites the rules across the supply chain, we should expect to see deflationary pricing pressure.

Greater Washington, D.C. If any region in the U.S. is poised to benefit disproportionately from the third wave, it is the Greater Washington region. With its concentration of traditional telecommunications carriers, ISPs, wireless carriers, optical networking companies, and other Internet infrastructure companies, the region is poised to take a leadership role in the economy of the third wave.

Easy beats difficult. User interface will make or break companies in the third wave. As we move our transactions and information from PCs to laptops to PDAs to wireless phones, display screens get smaller,

messaging laggard, except with wireless email where the Blackberry is making strong inroads with early adopters. In the third wave, we will see an integration of email, instant messaging, and wireless messaging. No longer will you have to find a recipient in their various messaging receptacles on their various devices. Rather, messaging will become smarter, with a message roaming among and between devices and locations of a particular user, landing in the relevant device, and erasing its trail in the irrelevant devices.

Active content. Over the last five years on the Internet, content was a destination. It was something you searched for. Yet, content has not proven to be a profitable business model because people are not ready, willing, and able to pay for it. Free content has been a backbone of the Internet to date. And even without successful content businesses on the Internet, today's venture capitalists are investing heavily in

wireless content. This, too, should prove to be a less than profitable proposition. Instead, *active content* should develop during the third wave. Active content is content with fulfillment. Consider traffic as an example of the difference between content and active content. Today, you can receive near real-time traffic information over the Web, on your wireless phone, and on the radio. Yet, you must decide, individually, what to do with the traffic reports you receive. Car GPS systems are the latest high-end option on luxury cars. These systems are fun today, but they become invaluable when they can take a real-time stream of traffic information and route you the fastest way to your destination based on the current traffic conditions. That is active content and *that* is valuable.

Cordless. The third wave will bring about the disappearance of cords. Devices connected to the Internet will always be turned on, and the connections will always be live. Similarly, wireless devices will lose their cords as well. Those clever earpieces people use with their wireless phones today? Well, the earpiece will remain but the cord will disappear, replaced by very short-range wireless transmissions between the phone and the earpiece.

Handheld devices. The form factor of the PC is shrinking. Instead, the portable PC form factor is converging with the wireless phone form factor. The central question is whether your wireless phone will incorporate the features of your PDA or whether your PDA comes equipped with a phone. Quite simply, who wins in convergence, Palm or Nokia? As wireless phones outnumber PDAs by about 100:1, Nokia and other wireless phone manufacturers stand to win the wireless phone and PDA convergence race. Instant text messaging using SMS and other simple protocols will overwhelm WAP, the wireless Web and Bluetooth combined on this platform. However, the longer messages traditionally sent via email will triumph on enterprise-integrated PDA platforms such as the Blackberry. A prediction: Users who need frequent remote access to corporate email will carry a PDA and a wireless phone. Those who do not need remote access to corporate email will shed their PDAs in favor of their enhanced wireless phones. Wireless devices are here to stay.

eBay. The eBay business model is terrific. eBay is building a virtual global commerce community that migrated from consumer-to-consumer sales to small business-to-consumer sales. In the years ahead, manufacturers of first-run products will use eBay as a new distribution channel for their products, sitting alongside traditional retail and other channels. The eBay model is the classic "eliminate the middleman" model of the Internet, and stands to win big over the next decade.

The Losers

Of course, every wave of technology that creates new winners also washes away a few losers in its path. Here are a few predictions:

Middlemen. Isn't it astounding to think that middlemen—that is, businesses whose added value lies in distribution or information inefficiencies—account for almost two-thirds of our economy's GDP? Examples of distribution middlemen include distributors, resellers, and retailers of products belonging to others. Information intermediaries include lawyers, tax accountants, and stockbrokers. While the Internet will not eliminate the entire class of middlemen, it will lay to rubble entire industries of these intermediaries. Let's look at two different industries to be influenced quite differently by the evolution of the Internet—clothing and music.

I suggest the clothing industry will be impacted in a minimal way by the evolution of the Internet. First, because most clothing is not a commodity. Yes, it is simple to buy hosiery, undergarments, or shirts online. However, dresses, suits, pants, and other clothing where style, fit, and texture are important will be difficult online sales. Brick-and-mortar retailers of these products will continue to thrive. And, for those commodity clothes purchased online, the cost of the retail outlet will be replaced by the cost of delivery and higher product returns. There will be very little inefficiency wrung out of this industry at the consumer distribution end.

In contrast is the music industry. The Internet will unleash wholesale on this industry, and Napster is just the beginning. Why? Because the MP3 audio file is a more efficient medium to store and play music than its physical alternative—the CD. In addition, the MP3 audio file can be physically distributed for free, unlike the CD which must be stamped out at a manufacturing facility, physically moved around, and ultimately sold in a retail store. Combine MP3's efficient storage and distribution format with exponentially increasing capacity of mass storage devices, and consumers will soon be able to store every song ever recorded on a device no bigger than a Sony Walkman.

Retail stores and CD pressing plants are the points primarily threatened by this trend. Although I do believe there remains an important role for the traditional record labels in the creation and growth of artist brands, especially new artists. Of course, in this model, artists and consumers stand to win big, as music will become cheaper, and artists will share more of the pie.

How about books? Amazon.com claims to have reinvented the bookselling industry. But have they? I

suggest they have simply replaced the corner bookstore with a Web store, and replaced the store's brick-and-mortar cost with the cost of running a Web site and shipping books to individual customers. In fact, if you look at the production chain of a typical book—from author to publisher to printer to distributor to retailer to consumer—Amazon has only changed the retailer component.

By contrast, look at author Stephen King's online experiment. He offered his last novella online at one-tenth the price that same book might have sold for in a store and received over 400,000 downloads the first day it was available. Thus, he established a new distribution chain: author to consumer. While I don't expect e-books to completely replace paper books, look for them to make strong inroads in the markets for college textbooks and reference books.

PCs. No, I am not suggesting the death of the PC. I think it will remain on office and home desktops for a long time to come. However, the pace of replacement will slow dramatically, primarily as a result of the Internet. Over the last 20 years, PCs have been on an incredible cycle of obsolescence, driven largely by Intel and Microsoft and their ever-faster processors matched by ever-bigger operating systems and applications. We have moved quickly from the first machines being able to process text quite well to a need to process graphics, then audio, then images, then video. Of course, the PC manufacturers encouraged this pace of obsolescence as it benefited their businesses dramatically.

But the Internet changes the desktop equation from one of raw machine horsepower to one of just enough horsepower coupled with lots of bandwidth. In the third wave of the Computing Revolution, power is shifting from hardware and software providers to bandwidth providers. Instead of feeling a need to replace our desktop machines every 12–18 months, we now feel a need to upgrade our bandwidth every 12–18 months. And with DSL, cable, and satellite bandwidth offerings getting better every quarter, we will see more turbulence among ISPs as consumers and businesses seek to constantly upgrade their connections. At the same time, desktop replacement cycles will more than double, creating very hard times for the industries that rode their success on rapid obsolescence.

Laptops. Conventional wisdom suggests that laptops will continue to gain market share at the expense of PCs. I'm not so sure. People use computers to communicate (email and instant messaging), to work on documents (spreadsheets, word processing, presentations, programming), and to gather information (Web browsing.) Of course, people choose a laptop

for portability. It allows them to work from home, on the airplane, or in a hotel room. With a laptop, your applications and your documents are always with you. But the third wave of the computing revolution introduces a wild card into the need to carry your applications and documents with you. For, if you could communicate, access your own applications and documents from any computer connected to the Internet, and browse the Web from anywhere, why lug a laptop around?

I suggest the laptop is a lousy solution for access to email and instant messaging because you are not even online for much of the time you carry around your laptop. Devices like the Blackberry are far superior for remote email access, and wireless phones should become the dominant device for remote instant messaging.

And, of course, Web browsing is already ubiquitous. I can't think of the last time I stayed in a hotel that did not offer me multiple ways to surf the Web, either in my room on a PC or via the TV, or in the hotel's business center.

As the third wave of the Computing Revolution creates a new series of winners and losers, the obvious question is: What will the fourth wave be and when will it arrive?

I believe the fourth wave will be about *cognitive computing*. Indeed, cognitive computing will usher in a series of devices and applications that are always on, always connected to the Internet, and always connected to us individually. Cognitive computing will integrate the fields of information technology, nanotechnology, and biotechnology. Using biology, cognitive computing stands to take over when Moore's Law runs out of steam on silicon platforms.

During this next wave, input devices will move beyond voice recognition to thought recognition as we develop ways to use our brain directly, instead of through our fingers and voices. During the fourth wave—which probably begins in earnest toward the end of this decade—our most fundamental question will likely be: Will the computer control the brain or will the brain control the computer? **C**

JOHN BACKUS (backus@draperatlantic.com) is a managing partner of Draper Atlantic Venture Capital, Reston, VA, where he has his finger on the pulse of entrepreneurship in a major IT region of the U.S.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

© 2001 ACM 0002-0782/01/1100 \$5.00