NEXT SILICON VALLEY:
RIDING THE WAVES OF INNOVATION

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PREPARED BY
THE NEXT SILICON VALLEY
LEADERSHIP GROUP OF
JOINT VENTURE: SILICON VALLEY NETWORK

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ABOUT THIS PAPER

The Next Silicon Valley Leadership Group includes business and civic leaders who are committed to the Valley's future in these challenging times. The purpose of this White Paper is to provide a framework for understanding and communicating what is happening in the Valley's economy and to stimulate further action. The team will engage more leaders in a regional discussion of what the future can be and how to ensure continued economic and social innovation.

Doug Henton, Kim Walesh, and Liz Brown of Collaborative Economics wrote the White Paper with input from Leadership Group members. Comments are welcome. Please send to nsv@jointventure.org.

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JOINT VENTURE'S MISSION

Mobilize people from business, labor, government, education, and all segments of the community to identify and to act on regional issues to:

- Sustain our innovative economy, increase productivity, and broaden prosperity
- Protect the environment and promote livability
- Connect people to opportunities

through shared solutions and regional stewardship for a vital and vibrant community.

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SUMMARY

A Special Habitat. Silicon Valley is a "habitat" for innovation and entrepreneurship. The Valley is a gathering place for researchers, entrepreneurs, venture capitalists, and skilled workers who turn new ideas into innovative products and services. This special habitat allows the region to adapt to waves of innovation and adjust to economic cycles.

Today, the Silicon Valley habitat faces multiple challenges as it deals simultaneously with a boom/bust cycle, new waves of innovation, and the economic shocks from the September 11 terrorism attack. Will Silicon Valley adapt once again to these forces of change? What will be the Next Silicon Valley?

Silicon Valley's Recent Cycle. After annual job growth averaged 4.2% between 1994 and 2000**,** Santa Clara County lost 3.7% of its jobs from December 2000 to October 2001. This bust was inevitable as entrepreneurs and investors swarmed to take advantage of new Internet opportunities, proliferating new companies and driving down profit potential. This phenomenon is the "hype curve" and often accompanies the introduction of a fundamentally new technology.

Lesson from History: Waves of Innovation. Today is not the first time that Silicon Valley has experienced a boom/bust cycle. The Valley experienced significant job growth, followed by job losses, in the 1970s, 1980s, and early 1990s. Each time, from these down cycles emerged the "next" Silicon Valley economy. Economic adversity helped stimulate the Silicon Valley habitat to major innovations, including the commercialization of the integrated circuit (1970s), the development of the microprocessor and personal computer (1980s), and the application of the Internet (1990s).

Innovation from Adversity. Sometimes external shocks such as World War II, the cold war, Sputnik, the Vietnam War, oil embargoes, earthquakes, and dramatic events like the September 11 terrorist attacks can stimulate regional economies into a new phase. Computers, digital communications, the Internet, environmental technologies, and new security technologies have all been promoted by external shocks.

Next Waves of Innovation. As we adjust to the current boom/bust cycle, new waves of innovation are coming now. Innovation usually occurs near the intersection of disciplines at times of economic change. We can look forward to a deepening of information and communications technology in both the economy and society as we move past the first phase of the Internet toward the mobile Internet, new productivity tools, and applications of technology in education, government, and the community. We can expect major advances in biotechnology to converge with information technologies and create new opportunities in the emerging fields of bioinformatics, biomaterials, and biochips. The commercialization of nanotechnology holds the potential to revolutionize chip and computer manufacturing. Silicon Valley has strengths in each of these emerging areas, and companies already exist or are starting in these areas.

Accelerating Global Feedback. Silicon Valley's role in the global economy is changing, speeding up these oncoming waves of innovation and increasing volatility in economic cycles. The

Internet explosion spread quickly to other global regions, resulting in a massive overcapacity because of hypercompetition. Whereas this competitive feedback loop took 15 years in the semiconductor industry before Japan and other foreign economies learned to compete with Silicon Valley in the 1980s, it took less than 5 years with the Internet in the 1990s. This acceleration leads to great volatility for Silicon Valley firms and people.

Creating the Resilient Region. Silicon Valley continues to have strong technology, human, and capital assets and the largest concentration of technology firms in the world. The region's habitat for innovation and entrepreneurship remains its greatest long-term strength and the source of its great productivity advantage, which creates wealth for its people. Other regions, however, will vie to lead the next waves of innovation. And the accelerating waves of innovation and economic cycles combined with external shocks have begun to outrun our ability to respond as a region. Leaders need to create a resilient region — one that can support people, companies, and communities as they mutually adapt to increased economic volatility. The more innovation based the economy, the more important the social infrastructure that supports that economy.

Commitment to Social Innovation. Creating a resilient region will require a new commitment to social innovation. Valley leaders from all sectors need to commit to realigning workplaces, institutions, and infrastructure to new economic and social realities. Unless social innovation accompanies technology innovation, the relentless flow of new innovations can have real and growing downsides — downsides that threaten the special habitat that births them.

The Next Silicon Valley can emerge from our current challenges and ride the next waves of innovation based on new technologies. The Valley will prosper again. The challenge will be to nurture technological innovation continually and to promote social innovation that is just as strong so that all Valley residents can share in that prosperity and quality of life.

I. ANTICIPATING THE NEXT SILICON VALLEY

Silicon Valley is the world's most dynamic economic region because it is a habitat for innovation and entrepreneurship (Choong-Moon Lee, Miller, Hancock, and Rowen, 2000)[1]. In many ways, Silicon Valley's leading product has become innovation itself.

Dense networks and geographic proximity promote the essential face-to-face interaction necessary to foster constant deal making in ideas in Silicon Valley — not unlike what happens in other creative places such as the financial centers of London, Manhattan, and Hong Kong or in movie making in Hollywood. Simply recall the tales of the Wagonwheel restaurant during the semiconductor era, the Homebrew Computer Club during the freewheeling days of the birth of the personal computer, and the Sun Deck on Sand Hill Road or the many other gathering places in Palo Alto, Mountain View, and San Jose where entrepreneurial deals are made over breakfast and lunch.

If Silicon Valley's long-term future as a habitat of innovation is to remain bright, its near-term situation is cause for concern? What happened in 2000 that caused the current slowdown in the Valley? What is the impact of the events of September 11, 2001? How long will the slowdown last? What can we learn from prior slowdowns in the Valley? How will the Valley reinvent itself and continue its role as a leading innovator?

These immediate questions about the future raise important challenges for Silicon Valley. This paper addresses how short-term economic cycles, longer-term waves of innovation, and external economic shocks shape the Silicon Valley habitat. Is Silicon Valley strong enough to absorb these short-term forces and shift into new directions? What will the Next Silicon Valley look like? How can we ensure ongoing success?

This paper makes the case that the Next Silicon Valley is already emerging. We can see its outline in real companies today. But we also need to understand that the new world of global innovation is more volatile than anything that we have known before. We must learn how to ride constant waves of innovation, which cause "creative destruction" with major consequences for both organizations and people. The waves are speeding up as the world becomes even more interconnected. Understanding the cycles that drive the Valley and learning how to deal with them are critical for future success. What is happening now is not new. We have been here before. The only differences this time are the size of the waves; the magnitude of their impact on our region, the nation, and the world; and how we choose to respond.

[1] "Silicon Valley's habitat for innovation and entrepreneurship" was developed by a group of Valley academics and business leaders in the book *Silicon Valley Edge* published by Stanford University in 2001 to explain the unique advantages of this region. One of the co-editors is Dr. William F. Miller, Professor at the Graduate School of Business at Stanford, who first coined the term in his paper "Regionalism, Globalism and the New Economic Geography" in January 1996.

II. SILICON VALLEY'S RECENT PAST

One of the special functions of Silicon Valley is to cause economic earthquakes that shake the very foundations of the global economy. Such cataclysms have happened at least three times in the past 50 years: the commercialization of the integrated circuit, the development of the personal computer, and the application of the Internet. Each of these innovations changed the nature of the economy in fundamental ways — as the railroad, electricity, and the radio did in the past. Silicon Valley's current situation needs to be understood in this historical context.

Most recently, Silicon Valley experienced a short-term boom that launched a longer wave of innovation around commercial applications of the Internet.

BUST FOLLOWS THE BOOM

The bust we are now suffering is in direct proportion to the boom we enjoyed during the past five years. The economist Joseph Schumpeter, best known for coining the phrase *creative destruction*, taught these lessons of dynamic economic development in the early 1900s. We should have expected the bust as entrepreneurs and investors swarmed to take advantage of a new opportunity, proliferated new companies and jobs, and eventually drove down potential profits.

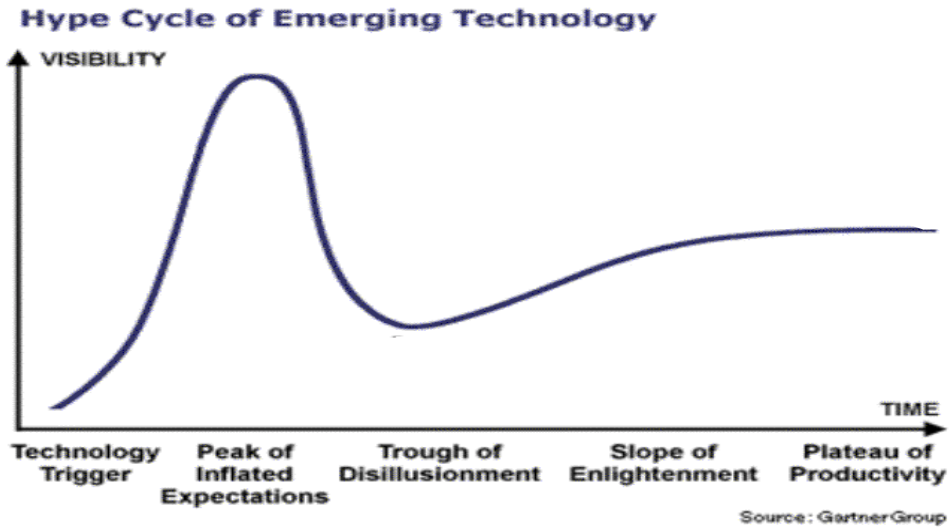
Schumpeter summarizes the uneven economic development process:

New technologies set off a burst of innovation. Innovation, however, is not evenly distributed through time; it appears in groups or bunches. Entrepreneurs financed by credit make investments in the new technologies. If these innovation investments are successful, imitators follow and the economy embarks on an upward surge: prosperity. Then, an avalanche of goods falls on the market and dampens prices, rising costs squeeze profit margins, and the economy contracts: recession. Recessions are the normal process of adapting to the bunching of innovations during the preceding prosperity. (Schumpeter, 1934)

A "HYPE CYCLE" FOLLOWS THE INTRODUCTION OF NEW TECHNOLOGIES

This bunching phenomenon is the hype cycle that accompanies the introduction of new technologies. An initial burst of economic activity is followed by a falloff as too many entrepreneurs and investors enter the field. This falloff is followed by more normal growth as the technology spreads to the rest of the economy. A diagram of the hype cycle has been developed by the Gartner Group.[2]

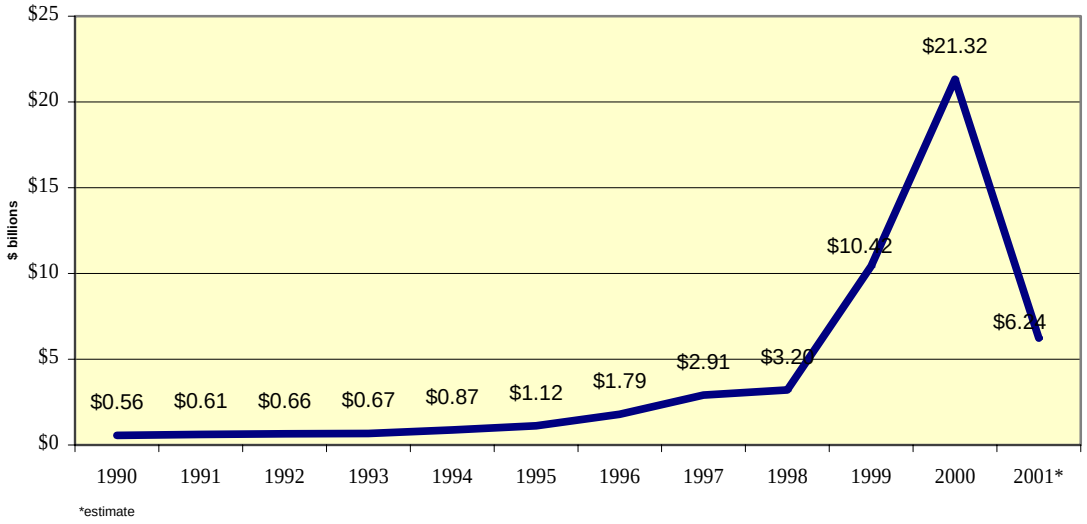
[2]GartnerGroup analyst Jacki Fenn defined the hype cycle as a tool to understand the impact of upcoming technologies. For additional information, please see http://www.umich.edu/~cisdept/mba/CIS745/GartnerHypeCycle.html .



Source: The GartnerGroup

The actual venture capital investments in Silicon Valley between 1994 and 2000 began to resemble closely a hype-curve phenomenon.

Total Venture Capital Financing in Silicon Valley



Source: PricewaterhouseCoopers MoneyTree Survey in Partnership with VentureOne; Collaborative Economics

In their 1999 book *The Internet Bubble*, Anthony and Michael Perkins noted that 133 Internet companies studied in their analysis would need to generate revenue growth of 80% every year for the next five years to justify their current market valuations. This growth, of course, was impossible given any realistic assumptions about the growth of these product markets and of the economy overall. As they explained, "The mania surrounding the Internet

companies has translated into too much venture capital, too many Internet start-ups, and too many Internet IPOs, driving both private- and public-company valuations to insane levels." (Perkins, 1999)

So as one might have expected, the bubble burst as it did in prior periods around the introduction of railroads, electricity, and radio. Its rise and fall is directly evident in the job numbers for Silicon Valley in the 1990s. At the start of the Internet explosion in 1994, the Valley was home to nearly 800,000 jobs. By the end of the boom in 2000, the region's employment topped 1.02 million — an increase of 225,000 jobs, or 28%. The average annual job growth during this period was 4.2%. Since the market broke in March of 2000, employment in Santa Clara County has fallen by 39,000, or 3.7%, from a peak of 1.05 million in December 2000 to 1.01 million in October 2001.

Jobs in Santa Clara County 1998 - 2001

Source: California Employment Development Department, 2001

The number of unemployed residents increased from 19,500 in August 2000 to 66,000 in October 2001. The unemployment rate rose from an historic low of 1.3% in December 2000 to 6.4% in October 2001. (California Employment Development Department, 2001)

The job losses came in several waves. First, the shutdown of venture capital–backed dot-coms[3] came in the latter half of 2000 and through mid-2001. These immediate job losses were not large because most of these companies were small. The second wave came when the telecommunication, network, and computer companies that supplied the infrastructure for the Internet expansion found that business investment in technology fell sharply in late 2000 and through 2001. According to *The Financial Times*, information technology spending by U.S. companies including telecommunications equipment and networking grew by 9%

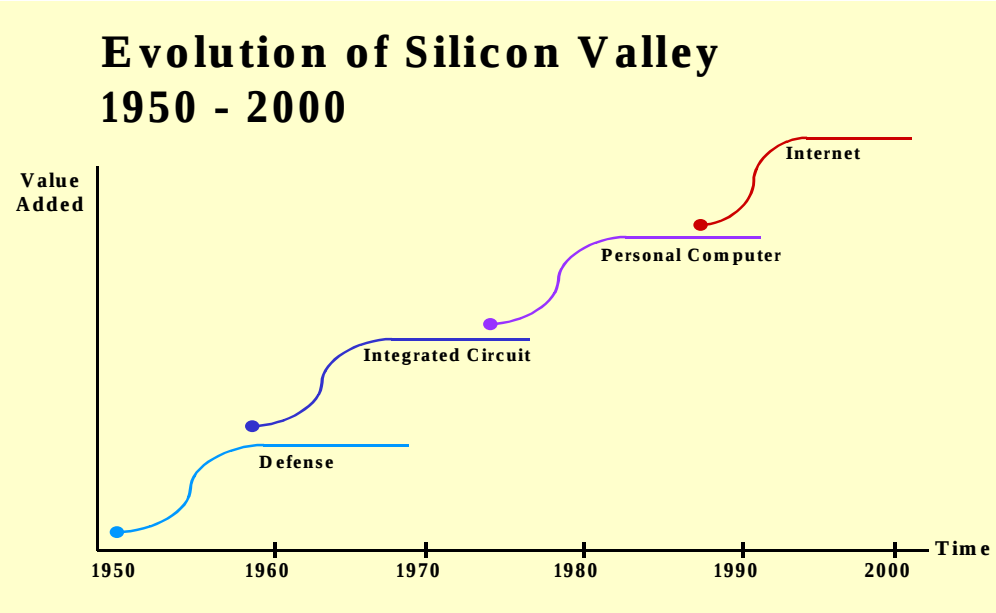
[3] *Dot-coms* refers to small venture-funded enterprises that applied Internet tools to directly reach customers, which represented about 10% of the total Internet economy according to a University of Texas Study 2000. The rest was infrastructure, networking, and tools.

annually in the late 1980s and early 1990s, then jumped to 16% from 1995 to 2000. (London, Abraham, Foremski p. 19) Growth fell abruptly to low single digits in 2000-2001. This wave resulted in significant layoffs at large companies such as Cisco, 3Com, and Hewlett-Packard.

A third driver of job losses is the general national recession caused by an already weakened economy receiving the shock of the attacks on New York and Washington on September 11. Layoffs are continuing in the fourth quarter of 2001.

III. LESSONS FROM HISTORY: WAVES OF INNOVATION

Four major waves of technology innovation have shaped Silicon Valley since World War II: defense, integrated circuit, personal computer, and Internet. Each wave was initiated with a hype cycle, leading to a scaling of employment. Waves of innovation take the shape of "S" curves and have a natural product life-cycle feature that follows the introduction of a new technology product (e.g., semiconductors or personal computers) as the basic technology diffuses from high value to community products (e.g., DRAM chips, disc drives). Each wave was interrupted later by external shocks, including competitive threats, and each downturn resulted in significant job loss.

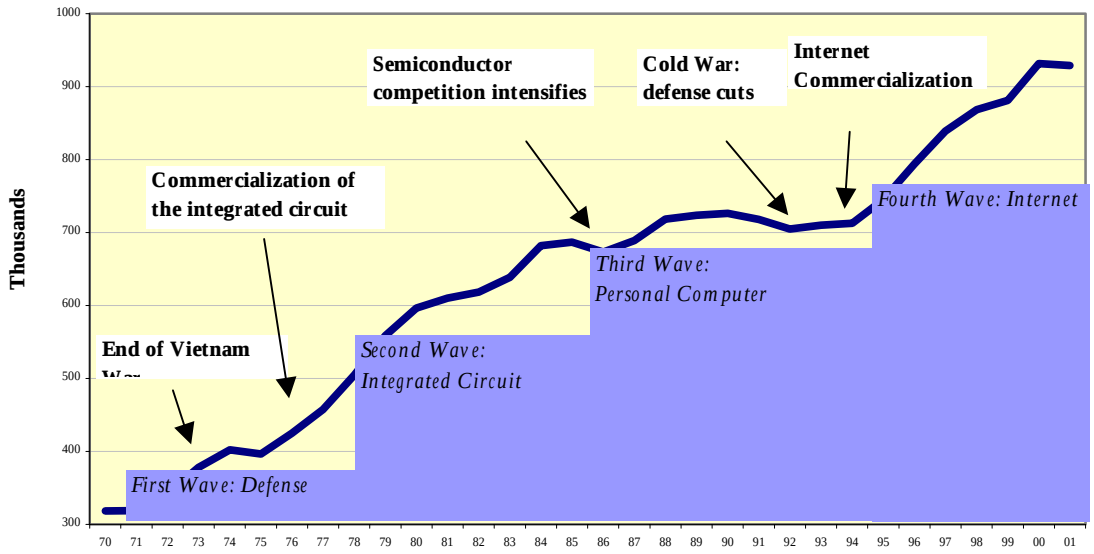


Source: *Silicon Valley Edge*

Each wave of innovation transformed the Valley's economy before disruption and was followed by a subsequent wave of growth. Each wave built innovation networks of talent, suppliers, and financial service providers that have helped make the next technology wave possible.

We can see this "S" curve or wave function represented by Valley employment growth (i.e., employment of Santa Clara County residents). Each previous incidence of job loss was larger than the current downturn in percentage terms — especially with a total loss of 67,000 jobs between August 1989 and April 1992 and 42,000 jobs between March 1985 and April 1986. We experienced a deep recession in 1969–71 as well. (California EDD, 2001)

A Brief History of Santa Clara County Employment



Source: Collaborative Economics

Silicon Valley's Prior Waves of Innovation

Defense (1950s, 1960s) — World War II and especially the Korean War had a dramatic impact on the Valley by increasing demand for electronics products from Valley firms such as Hewlett-Packard and Varian Associates. Defense spending helped to build the technology infrastructure of firms and support institutions during the 1950s. During the cold war and the space race, what mattered was not just the level of spending, but how the Defense Department procured technology. Often the defense agencies specified their requirements and let the firms innovate to find solutions. In addition, the Defense Department required second-source arrangements, in which producers ensured that alternative suppliers of their products existed, spreading technology capabilities within the region. This wave came to an end with cutbacks in defense spending in 1969–71, which stimulated the development of commercial application of defense technology.

Integrated circuits (1960s, 1970s) — The invention of the integrated circuit in 1959 led to the explosive growth of the semiconductor industry in the 1960s–70s. Starting with Shockley Semiconductor—which begat Fairchild and its many offspring, including Intel, Advanced Micro Devices, and National Semiconductor—more than 30 semiconductor firms developed in the Valley during the 1960s. Only 5 of the 45 independent semiconductor firms started in the United States between 1959 and 1976 were outside Silicon Valley. Don Hoefler, a reporter from *Electronic News*, gave Silicon Valley its name during this period. The technology wave had an additional push at Intel in 1971 with the invention of the microprocessor, which established the foundation for the next wave led by the personal computer. Foreign competition in the commodity chip business challenged this wave and forced the semiconductor industry to shift into specialized chips, including microprocessors.

Personal computers (1970s, 1980s) — The technology foundation established by the defense and integrated-circuit waves created a rich environment for launching this next wave. Silicon Valley had attracted a critical mass of technology firms, support industries, venture capital, and talent that helped ignite the PC revolution. Young talent meeting at the Homebrew Computer Club eventually gave birth to more than 20 computer companies, including Apple. The explosive growth during this technology wave led to an increase in the number of Valley firms from 830 in 1975 to 3,000 in 1990, with an increase in employment from 100,000 to 267,000. The initial focus on personal computers that became commodities quickly led to the development of more sophisticated workstations, led by firms such as Sun Microsystems. During this wave, the seeds were sown for the next innovation built around networks.

Internet (1990s) — After a period of slow economic growth in the early 1990s during the defense cutbacks following the end of the cold war and growing global competition in both the semiconductor and computer hardware industries, the question arose about what Silicon Valley's next act would be. Could the Valley reinvent itself once again? The answer became clear with the commercial development of the Internet in 1993 and the creation of the World Wide Web. Building on its prior technology strengths, the region became a leader in the Internet revolution. The result was the explosive growth of Internet-related firms. At the forefront were Netscape, Cisco, and 3Com. Between 1992 and 1998, software jobs grew by more than 150%, and jobs in computer networking doubled. Computer firms such as Sun and Hewlett-Packard and semiconductor firms such as Intel and AMD grew along with their Internet markets. The overcapacity created during the Internet bubble led to the current slowdown.

Source: "Lessons from Silicon Valley: Governance in a Global City-Region" in *Global City-Regions*

FROM ADVERSITY EMERGES INNOVATION

The process of continuous innovation and creative destruction that has characterized Silicon Valley's habitat has, however, a downside. The Valley has experienced a boom-bust cycle throughout its history.

- 1970: recession resulting from cutbacks in Vietnam defense spending
- 1985: recession resulting from overcapacity and foreign competition in the semiconductor industry
- 1990: recession resulting from defense cutbacks and overcapacity in the personal computer industry
- 2000: recession resulting from bursting of the Internet bubble and overcapacity in the telecommunication industry.

However, the boom/bust cycle also has an upside. It is during the down cycles that Silicon Valley has proved itself to be a true center of innovation and entrepreneurship and caught the next wave. During the 1970 defense recession, Valley firms shifted to commercial applications of defense technologies. In particular, the integrated circuit made the transition from defense to commercial use. During the 1985 semiconductor recession, semiconductor firms made the shift from commodity chips to higher-value microprocessors. During the 1990 defense recession, the Valley learned how to turn defense-sponsored ARPANET into the commercially viable Internet.

In each case, innovation was born out of adversity. Or, as Paul Saffo, a Menlo Park technology forecaster, explains, "Failure is an essential part of our ecosystem. It's like a forest fire burning space for new growth."

A recent *New Yorker* article (2001) described how this process works:

> During a boom, it is easier to raise money and easier to sell products. You'd think that would be a good thing if you were trying to start a business. The problem is that everyone else thinks so too: when the economy is hot, everyone's an entrepreneur. The more companies there are, the less likely it is that one of them will be able to sustain a lasting competitive advantage, no matter how flush the marketplace is. Starting a business is like investing in stock, you want to buy low and sell high…. What's more, the easier it is for start-ups to raise and make money, the harder they find it to manage money wisely. Companies need discipline — an ingrained sense of the relationship between effort and reward, product and profit. That's where a nice, brutal slowdown can come in handy…. Companies are like human beings: hardscrabble beginnings beget hard-minded men. (Surowiecki, p. 34)

The point is: Economic adversity at the time of a down cycle may be a stimulus to the innovation and entrepreneurship that will drive the next up cycle. This point has certainly been the case in the evolution of the Silicon Valley. Most innovation periods occurred at the bottom of the cycle, not at the top. In fact, the top of the cycle tends to lead to excess. The Internet boom that followed the Netscape IPO led in many ways to a period of excessive investment by venture capitalists, excessive spending by start-up firms without profits, and a mentality of "copying" technology rather than innovation.

IV. NEXT WAVES OF INNOVATION

What future waves of innovation are likely to drive the Next Silicon Valley? Although no one can predict the future, we can look at technology trends and current Silicon Valley strengths and begin to map potential "innovation paths."

We should understand three fundamental technology developments in order to anticipate future directions in the Valley:

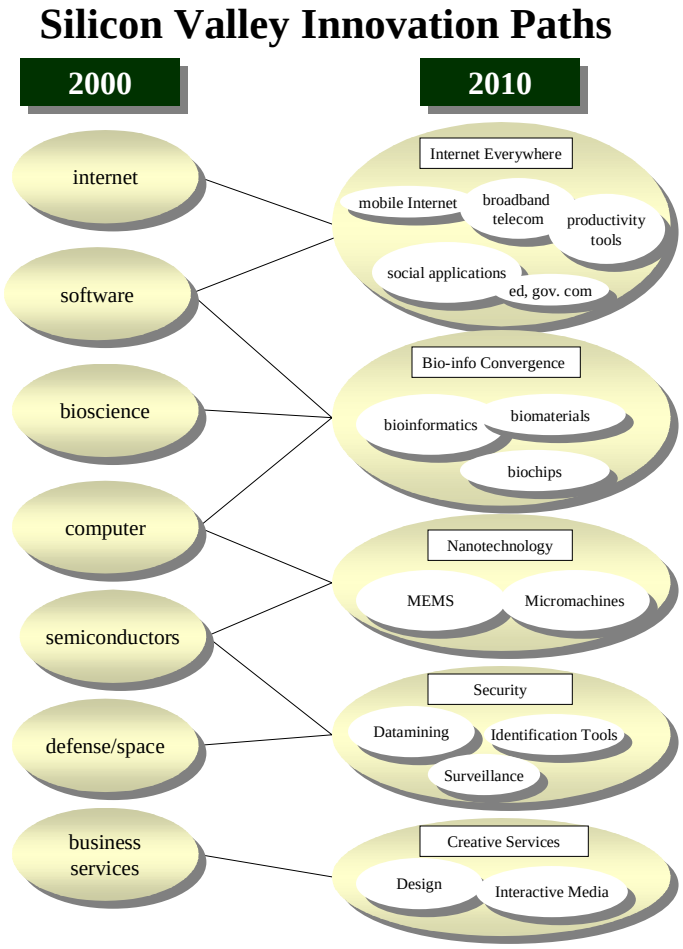
- The deepening of the information and communications technologies in our economy and society
- Convergence of biotechnology and information technologies
- Commercialization of nanotechnology and micromachining.

In all three areas, the basic science and technology are already in place, and they are converging. The questions involve commercialization and new applications of technology. In these areas, Silicon Valley's habitat for innovation prevailed in the past and can do so again.

DEEPENING OF THE INFORMATION AND COMMUNICATIONS TECHNOLOGIES

The first phase of the Internet is over. As the authors of the recent *IMF Economic Outlook* pointed out, "Only last year, it seemed self-evident that we were witnessing an economic miracle — an information technology revolution powered by innovation in computers, software and telecommunications. Now, with the collapse of IT stocks and the plummeting investment spending on IT goods, some are declaring the revolution a myth. Yet this pattern is typical of technological revolutions: many have an initial phase of a boom and bust in the stock prices of innovating companies and in spending on goods embodying the new technology…. [T]he broad dynamic of the IT revolution is similar to those in textiles, steam power, rail and electricity. First, there is productivity growth in the innovating sector, which contributes directly to economic growth. Second, a fall in the price of innovation encourages its widespread use by businesses and also confers enormous gains on consumers. Third, as production in all sectors begins to reorganize around the capital goods that embody the new technology, there is a much broader based surge in productivity. The IT revolution has experienced its first two stages." (International Monetary Fund, 2001).

The Internet is ready to begin its next phase — "capital deepening" — in which networking and communications technologies will become embedded in all aspects of the economy and society, much like electricity did more than a century ago. Call this phase "*Internet everywhere*," just like we turn on the switch and have electricity everywhere.



Here are several embedded Internet possibilities to consider for the Next Silicon Valley:

- *Mobile Internet:* Wireless technologies allow for mobile computing and the mobile Internet available at affordable prices. Already well advanced in Europe, especially Scandinavia, mobile Internet is a new growth opportunity in the United States and Silicon Valley as networking, communications, and computing continue to converge, drawing on our strength in each field. Wireless fidelity or Wi-Fi is the networking technology that is making the promise of ubiquitous Internet connectivity possible. According to the *Economist*, "the mobile Internet is at the same stage of development as the Internet was in 1995. There are hundreds of start ups, and nobody really knows which technologies or business models will win or what consumers or corporate users really want." (Standage, 2001).

- *Productivity Tools:* Networking tools and business software are merging toward a broad business market focused on increasing productivity. These software firms — often, *B-to-B* or *business-to-business firms*—usually have a very different market than dot-com B-to-C (business-to-consumer) firms have. Generally, these markets have continued to grow faster than consumer markets. Businesses that improve supply chains, enhance logistics, and expand marketing reach can make significant gains. Promising

opportunities exist in software for consumer-relationship managing. Leading firms in this growing field include Siebel Systems, Peoplesoft, BEA Systems, and Oracle. The potential for networking to change the nature of business will grow as the "capital deepening" process continues.

- *Social Applications:* Internet everywhere will be evident most dramatically in the wide applications of networking and communications technologies in education, government, and community. Think about e-government, e-learning, and e-communities becoming commonplace. This change will require thinking about customers first, not just technology. Recent nominees for technology-in-society awards given by Applied Materials at the Tech Museum in San Jose highlighted the great potential of social impacts of technology in education, health, and environment. Some local examples include Schools Online in San Jose, whichprovides teachers Internet learning tools in almost 6,000 schools in 20 countries, and Benetech's Bookshare at Moffett Field, which downloads materials that can be read in Braille. Another local example of the social use of technology is the Digital Clubhouse Network based in Sunnyvale, which teaches kids and adults digital storytelling for personal healing and community building.

A recent (October 21, 2001) *San Jose Mercury News* survey of major Silicon Valley firms active in new application of wireless technology identified a number of developments with an emerging mobile Internet cluster:

- *Agilent Technologies* provides instruments that test the capabilities of electronics and communication equipment. Agilent instruments will be responsible for making sure that the next wave of wireless devices works.

- *Apple Computer* was the first company to build wireless networking into mainstream computing products and the first to build antennas into all its desktop and laptop computers. Apple wants schools to use iBook laptops and wireless base stations to create a mobile computer lab.

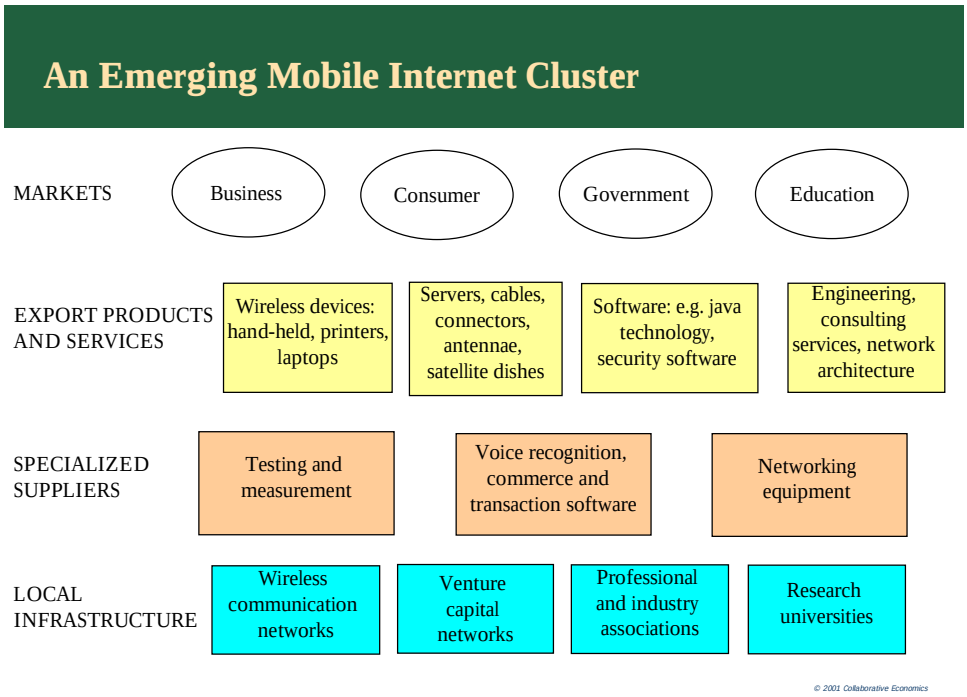
- *Cisco Systems* is focused on local-area networking technology — specifically the radios, adapters, and hubs that enable the wireless transmission of Internet data. Cisco equipment is part of the initiative to put wireless LANs in Starbucks coffeehouses.

- *Hewlett-Packard* is incorporating wireless capabilities into its printers, cameras, handheld computers, laptops, and other devices. HP expects that by 2004, wireless-related businesses will represent an $80 billion opportunity for the company.

- *Intel* is focusing primarily on local-area network technology — the company says it will begin shipping 802.11a products next month. In the personal-area-networking space, Intel makes Bluetooth products.

- *Oracle* has committed to enabling its e-business software products for wireless. That commitment includes making the products voice compatible.

- *Sun Microsystems*' vision is for its hardware and software to drive every part of the wireless equation, from the servers that store wireless content to the mobile devices that receive it. On the server side, the company is focused on honing its server software to prepare for a world in which more people access information from mobile devices. On the mobile device side, Sun offers its Java technology, which already powers 31% of cell phones in Japan, according to Nikkei Market Access Research.



Source: Collaborative Economics

Some industry followers see new opportunity ahead as these areas converge in new and more sophisticated ways. For example, Michael Malone, Editor of Forbes ASP, says:

> Most of the world is hunkering down and still laying off people. The economic indicators are still pointing in every direction. Announcing another great era of prosperity is risky. But the fact is that all the signs of a turnaround are in place. It is across the board from chips to wireless to information technology…. It is the first-born offspring of the Internet, only smarter and more agile and obedient than its predecessor. For now, let's call it Internet II (Malone, 2001).

Malone and other observers see two major barriers to achieving this vision: our current lack of *broadband high-speed Internet capacity* and a lack of a *public infrastructure* with security, confidentiality, integrity, and uniform encryption standards. While SBC Communications, Sprint Broadband, ATT Broadband, and other private telecommunications are now actively

competing to build more broadband capacity, the federal government will probably have to continue to play a key role in building a public infrastructure.

An important question for the next Silicon Valley is whether the future of the Internet will be driven more by fixed connections using high-speed broadband or by wireless, mobile devices.

CONVERGENCE OF BIO AND INFORMATION TECHNOLOGIES

The mapping of the human genome was a historical milestone, opening the door to entirely new medical products and services. Some people say that we are entering a "biotech age." Years of significant investments by the National Institutes of Health are now beginning to pay off in commercial applications. More than 2000 biotechnology firms are now spending more than $10 billion annually in private R&D. The market for biotechnology products was $16 billion in 1996 and is estimated to double to $32 billion by 2006 (Oliver, 2001).

The Bay Area has the largest concentration of public bioscience firms of any region in the United States, including San Diego and New England (see the figure just below). The largest Bay Area company is Genentech (South San Francisco) with 3100 employees. Chiron (Emeryville) employs 2,200, and Bayer (Berkeley) employs 1000.

According to the Bay Area Bioscience Center, regional bioscience firms specialize in human therapeutics and diagnostics, laboratory instrumentation and supplies, and medical devices and equipment. Other specialties include analytical labs, fermentation services, agriculture and veterinary products, environmental/remediation services, chemical manufacturing, and contract services.

Region	*Number of Public Companies*	*Market Capitalization 6/30/01 (in millions)*	*Number of Employees*	*Revenue (in millions)*
San Francisco Bay	76	$92,168.20	26,464	$5,851.40
New England	48	$53,575.20	20,641	$3,069.90
San Diego	31	$23,272.10	7,976	$874.00
New Jersey	21	$10,591.70	3,556	$549.90
Mid-Atlantic	19	$22,240.20	3,871	$769.00
Pacific Northwest	19	$17,189.60	3,258	$1,096.60

Source: Ernst & Young, October 2001

Bay Area bioscience companies (public and private) account for more than 52,000 direct jobs. The area's academic and research institutions employ nearly 10,000 more people working on life-science projects. According to the Bay Area Bioscience Center, "Assuming 60,000 direct private and public sector jobs and a multiplier of 2 to reflect employees of the

area's financial institutions, venture capitalists, public relations, publishing, construction, legal, accounting and management firms which provide services to the life sciences industry and research institutions, results in an estimated 120,000 employees in Northern California alone." The California Health Care Institute (La Jolla, California) names the biomedical industry as California's second-leading high-technology industry, employing more than 210,000.

Given the Silicon Valley's existing strength in information technologies and the Bay Area's emerging strengths in bioscience, including its leading role in NIH-funded bio research at UC San Francisco, Stanford, UC Berkeley, and the national labs, the possibilities for the Next Silicon Valley to include convergence between these two sectors in this region are strong if we can connect our research and business assets better. As Susan Atkins points out in the 2001 Biotechnology Industry Organization (BIO) Biotechnology Forum:

> The celebrity marriage of the millennium is under way to the fanfare of the media and Wall Street alike, but it's no Hollywood couple that is tying the knot. This is the much hailed union between high tech and biotech and if the media pundits are even partially correct in their predictions, it could transform medicine as we know it and, not incidentally, resuscitate the ailing valuations of the two market sectors.

It is the beginning of a new "hype curve"? Opportunities in our region for the convergence of bioscience and information technology extend well beyond pharmaceuticals and medical devices to include biomaterials, biochips, and bioinformatics. The following are some possibilities to consider for the Next Silicon Valley:

> *Bioinformatics:* The key tool for the commercial application of genomics is information technologies that speed up the process of discovery and product development. Silicon Valley is poised to be a leader in the growing field of bioinformatics as it combines info technology strengths with the bio strengths of the region. As venture capitalist Sam Colella reported in *Fast Company*, "recent breakthroughs in genomics have unleashed an abundance of raw data. Those findings need to be crunched in order for drug companies to develop better leads for new types of medicine. We have moved beyond just identifying genes. The next phase can be personalized medicine." For example, Nanogen is testing products that help bridge the gap between research and clinical settings based on on-the-spot analysis of genetic samples
>
> *Biomaterials:* Biotechnology holds the promise of creating new materials for applications in manufacturing and agriculture, including new fibers such as Dupont's 3GT fiber based on bacteria, new polymers such as magneto-optics used for optical computers, and smart materials such as time-released seeds developed by Silicon Valley–based Landec.
>
> *Biochips:* The continued miniaturization of integrated circuits following Moore's Law requires materials at the molecular level. New type of biochips will be emerging to address this challenge. Recently, Bell Labs announced that it had built layers made up of thousands of organic molecules with just one or two electrically active components. This step is important in turning molecules into

electric switches. Palo Alto–based Genecore is teaming with Dow Chemicals to build biochips, including biological optical switches using a new technique: silicon biotechnology. Affymetrix bought an old National Semiconductor manufacturing facility in Santa Clara to create biochips that place hybrid bits of DNA on computer chips instead of transistors.

It is worth noting that IBM's next-generation machine is Blue Gene. IBM created it to decode the human genome, and it is three orders of magnitude more powerful than IBM's previous high-speed computer, Deep Blue. According to Harvard Business School Professor Juan Enriquez, "at IBM headquarters, many believe that their company will become a life-sciences company." Here in the Valley, Sun Microsystems' largest project is to decipher protein. Sun and IBM have teamed up with 40 life-science organizations to form the I3C to help accelerate the development of genomics and protein research. Oracle has launched a $185 million collaboration in bioscience projects with Hitachi and Myriad Genentics.

It is also worth noting that whereas venture-capital investment in the Bay Area declined by 27% from the second quarter to the third quarter of 2001, the bright spot was investment in medical software and information services, which increased 70%. This change may indicate a move toward bioinformatics. And the biotech stocks have consistently outperformed information technology stocks in the past year.

However, caution is in order as well. As the *Financial Times* (2001, November 27) pointed out in a recent survey, "The book of life has yet to transfer to the bottom line", the discovery of the human genome could revolutionize medicine but it also involves massive data processing, new risk and higher cost. The survey cites a report by Lehman Brothers and McKinsey that estimates that the average cost of developing a new drug could double to $1.5 billion in the next five years.

COMMERCIALIZATION OF NANOTECHNOLOGY AND MICROMACHINING

Nanotechnology has become one of the most highly energized disciplines in science and technology. Nanotechnology borrows from physics, engineering, molecular biology, and chemistry to create a cross-discipline that is developing useful products that operate between the micro world of individual atoms and molecules and the macro world of materials. Recently, government research in this field increased more than 50% with the announcement of the National Nanotechnology Initiative in 2000.

The dwindling size of circuits in electronic chips drives much of the interest in nanotechnology. Computer companies with large research labs such as IBM and HP have substantial nano programs. Once conventional silicon electronics are no longer feasible given the small size of chips (probably in the next ten years), a good bet is that new nanotechnology electronic devices will replace them.

For example, researchers at Hewlett-Packard have patented a potential breakthrough in their quest to develop computer circuits made merely of individual molecules. HP hopes to refine the process to create microchips as powerful as the next generation of silicon-based chips — but 1,000 times smaller and much less expensive. That advance and others in the burgeoning

field of nanotechnology could make computers small enough to be worn, embedded in materials, or perhaps even injected.

Several commercial applications of nanotechnology are currently available. IBM has developed disk drives at the nanoscale. Gilead Sciences has developed lipid spheres — liposomes that measure 1000 nanometers — that encase an anticancer drug. Carbon Nanotechnologies has made carbon nanotubes more affordable by exploiting a new manufacturing process. Both IBM's Almaden Research Center, which is pioneering research on the next generation of disc drives, and Gilead Sciences are based in Silicon Valley. Another leading nanotech firm, Quantum Dot, was founded by Paul Alivisato, a leading researcher at UC Berkeley.

A leading expert on molecular machines, Eric Drexler of the Palo Alto–based Foresight Institute, says that "the ability to construct objects with molecular precision will revolutionize manufacturing, permitting material properties and device performance to be greatly improved. For example, low-cost, lightweight strong materials would make transportation far more energy efficient. Perhaps the most exciting goal is the molecular repair of the human body." (*Scientific American*, September 2001)

Potential opportunities for the Next Silicon Valley include:

> *Nanochips*: New nanotechnology tools could allow computer chips to be manufactured at the molecular level. This development would allow biologically based computers. Intel recently announced a new breakthrough in design of chips that will enable the development of cheaper and faster microprocessors based on nano-level technology with more than 1 billion transitors compared to 42 million in Intel's latest Pentium 4 chip. Applied Materials is building "nanochips," tiny computer chips to power mobile devices. Applied expects that high-speed wireless networks will drive demand for such chips
>
> *Smart materials designed at the molecular level:* Potential nanomaterials include new fibers for optical cables that transmit light without degrading, new polymers and ceramics with greater strength, and new materials with memory such as medical instruments that assume a benign shape in the body.
>
> *Micromachines*: Microelectromechanical systems (MEMS) will allow micromachines to power a whole variety of industrial applications with less energy and resistance.

Together, further deepening of information and communications technologies, the convergence of bio and information technologies, and the application of nanotechnology hold promise for the next waves of innovation in Silicon Valley. All three areas build on current Valley industry strength as well as research capacity. Silicon Valley's leadership is by no means secure.

Two other areas of business and technology innovation may increasingly be important to the region's near-term future.

Security Technology
The imperative to bolster national security against terrorism will prompt new applications of software and electronics technologies from Silicon Valley as well as investment in new areas in response to such emerging threats as bioterrorism. Three areas appear particularly ripe for growth in the near term:

- *Data Mining:* software that lets government agencies extract, share, and analyze valuable information from raw commercial and scientific data

- *Biometrics/Identification Tools:* digital technologies that positively identify people by scanning human features such as the irises of the eyes, or that determine what people are carrying on their person

- *Communications:* mobile phones and GPS systems that can be retooled for locating 911 callers and tracking terrorist activities.

Creative Services
In a world of increasingly fast technology diffusion, exploiting the creative element in a product or service may be one of the few ways of sustaining competitive advantage. Increasingly, the creation of value relies not just on "technology," but also on the immaterial qualities of goods, such as design, ease of use, image, and quality of service.

This "soft side" of the technology revolution is driven by individuals and service companies in creatively driven fields. More and more, the development, production, marketing, and sales of tech products involve people trained in artistic skills: Graphic designers, animators, creative writers, and music producers are starting to take their place in the "technology" workforce. Employment in creative services companies in fields such as digital arts, interactive media, design, film/video, and communications/advertising is growing nationally and is concentrated in smaller, entrepreneurial firms.

Though the region is not yet known for excellence in creative services, a new wave of innovation in this arena could birth from its dense network of entrepreneurial service professionals and its emerging artistic/cultural sector.

V. THE SECRET OF SILICON VALLEY: PEOPLE IN "HABITAT" OF INNOVATION

How has Silicon Valley made continual leaps across technology waves in four decades, moving from leadership in integrated circuits in the 1960s to leadership in personal computers in the 1970s and the Internet in the 1990s? All these innovative leaps occurred in the face of rising costs, growing competition, and increasingly rapid diffusion of technology.

The real secret is that Silicon Valley is a special habitat for innovation and entrepreneurship. It consists of dense, flexible networks and relationships among entrepreneurs, venture capitalists, university researchers, lawyers, consultants, highly skilled employees, and others who know how to translate ideas into new commercial products and services fast enough to stay on the edge of the innovation curve. These complex networks continually connect people to good ideas and test the changing market, always searching for the next innovation. Annalee Saxenian of UC Berkeley called Silicon Valley the first "networked region" in her pathbreaking book *Regional Advantage*, which compared Silicon Valley to the Route 128. She also makes the case that these networks create regional advantage with benefit for both people and firms.

In fact, Silicon Valley has become known as much for its innovation and entrepreneurship as for any specific industry or technology. The region excels at applying and commercializing new inventions. In the context of waves of innovation, scientists — including those in other regions — invent and create the initial wave. Entrepreneurs then innovate and bring new ideas to market, amplifying the wave.

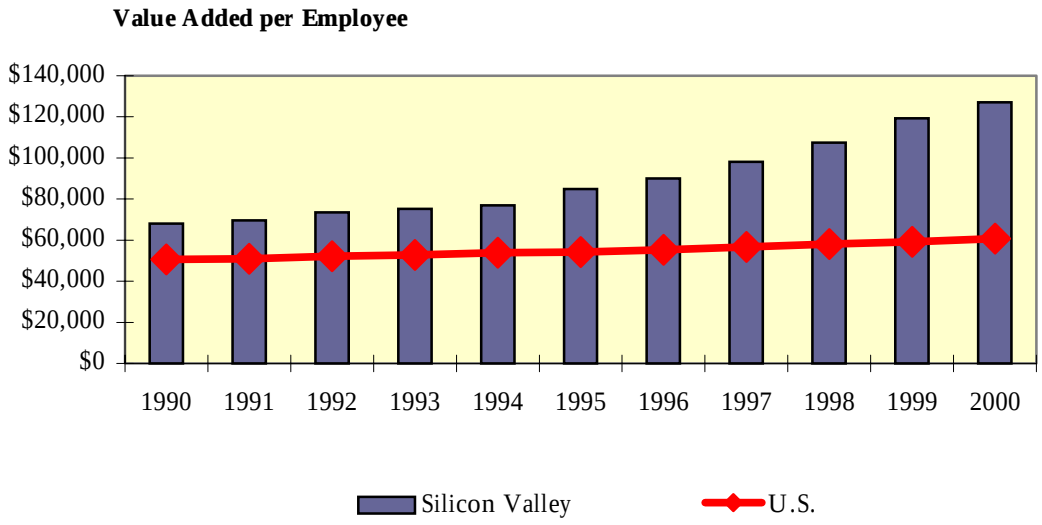
For example, the original work on integrated circuits occurred at New Jersey based Bell Labs. The work of Bob Noyce at Fairchild and later at Intel commercialized it and fueled the explosive semiconductor wave that began in the 1970s. Likewise, the first commercially viable personal computer was invented in New Mexico, but we commercialized it here and again rode the explosive PC wave of the 1980s. Again, the Internet was not invented here. It was a project of the Defense Department and developed by a firm based in Boston, BBN. But it was commercialized here, and we rode one of the most explosive waves of all in the 1990s.

INNOVATION IS PLACE BASED

Innovation and the successful entrepreneurs who drive innovation are embedded in regional networks that connect assets in ways that create wealth and opportunity for both firms and individuals. Innovation is a "social" process. It rarely occurs because a single individual or firm takes an idea to market. Instead, it involves many people playing many roles in a dynamic collaborative process built around creative teams and face-to-face interaction. Creative work, unlike routine production, requires close proximity. Innovation is not a linear process, but an active process of learning through trial and error. Networks speed up the innovation process by connecting people across boundaries and accelerating learning (see the figure just below).

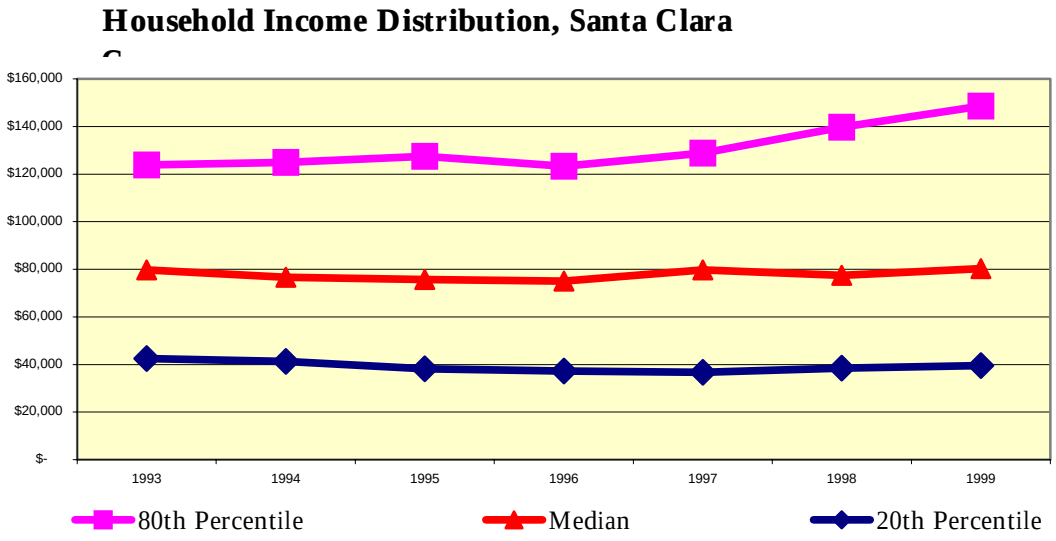
The importance of these networks of innovation is evident in the fact that productivity in the Valley, as measured by value added per employee, was twice the national average in 2000 ($127,000 per employee in the Valley versus $60,800 per employee for the United States.)

This productivity advantage is the result of the tight innovation networks that promote the efficient use of talent, technology, and capital and reduce transactions costs. This productivity advantage also translates directly into the Valley's high average wages. In 2000, the Valley had the highest wages of any region in the United States ($60,800 in the Valley versus $36,100 in the United States). Average wages in the Valley increased 22% in 2000; the average productivity gain was 7%.



Source: Economy.com, Joint Venture's *Index of Silicon Valley 2001*

However, the goal of shared prosperity based on real productivity growth has not yet been achieved, as a gap between the top 20% and the bottom 20% widened in the 1990s (see below).



Source: U.S. Census Bureau, Current Population Survey, *Joint Venture's Index of Silicon Valley, 2001*

Why Innovation Is Place Based

What do we know about how innovation occurs in today's economy?

Interactive: We know that innovation is interactive. It doesn't occur in a straight line, chain-link fashion from research lab to development to commercialization. As British historian James Burke points out:

> Innovation is often surprising and unexpected because the process by which new ideas emerge is serendipitous and interactive…. Interlocking threads of ideas, people and events are woven into a web of knowledge and – bingo – we get today's world of science and technology.

Values Face-to-Face: The most rapid advances in a trial-and-error, iterative learning process take place through face-to-face interaction and information exchange. Face-to-face interaction remains important in the Internet age. A recent report by the National Bureau of Economic Research found that "increasingly the economy is dependent on the transmission of complex uncodifiable messages, which required understanding and trust that historically have come from face-to-face contact. This is not likely to be affected by the Internet, which allows long distance 'conversations' but not 'handshakes.' "

Innovation in Networks: In the traditional economy, ideas were held tightly within institutions; in the new economy, ideas flow more freely within networks. The unit of innovation has become the network, not simply the firm. Separation and hierarchy do not work when speed is of the essence. Increasingly, the process of innovation does not take place simply within an individual company but through knowledge-creating networks of individuals with ideas in companies, universities, and other institutions. The key is the sharing of tacit knowledge through interactive processes based on trust, willingness to share, and mutually beneficial exchange over time.

If innovation is iterative, face-to-face, and network based, then innovation is also place based. The networks at the heart of the new innovation model function most effectively when their components cluster geographically in a region. Geographic clustering of people, companies, and institutions is a powerful mechanism for transferring and augmenting personal knowledge, skills, and experience quickly.

The most innovative work occurs primarily in face-to-face exchange within teams and networks where people work in close proximity to each other. For this reason, the creative heart and soul of the economy (where the action is) will continue to be tied to place. Ultimately, place matters because people matter. Talented and creative people want to be where the action is, where their ideas stand the best chance of coming to fruition.

Source: *Innovative Regions: The Importance of Place and Networks in the Innovative Economy*

DAMAGE TO THE HABITAT

The Silicon Valley habitat has suffered damage as a result of the excesses of the Internet boom. The bursting of the Internet bubble and the resulting layoffs are hurting real people. The rapid growth of employment placed a strain on the labor force supply in the region, creating talent shortages and requiring significant migration to the region. This migration, in turn, placed pressure on the region's housing market and transportation systems. The price of housing skyrocketed, making it difficult to attract and retain workers. The decline in quality of life caused by congestion contributed to Silicon Valley's reputation as a bad place to live.

Like a natural habitat, the Silicon Valley has become a delicate ecosystem with a set of tight relationships among its inhabitants. The excessive growth of the boom distorted these relationships and undermined the attractiveness of the region. The degree to which these social and physical strains have undermined the innovation network of the region is still to be determined.

The Next Silicon Valley needs to emerge from this changing habitat for innovation and entrepreneurship. The economic health of the region will depend on its underlying social health, including the quality of its education, the affordability of its housing, and the upward mobility of its people. At its core, the high productivity of the region is based on both core assets — including its talent, technology, and capital base — and the ability to reduce "transactions cost" through its networks and relationships. Anything that harms those assets or networks will hurt the Valley.

VI. SILICON VALLEY AND THE CHANGING GLOBAL PARADIGM

As the waves of innovation continue, the role of Silicon Valley in the global economy is going to be changing. The Next Silicon Valley will look different from the way it looked in the past two decades as it enters a new phase of globalism. Dr. William F. Miller of Stanford University outlines the new world business paradigm that emerged in the 1980s and 1990s. This new paradigm was characterized by global sourcing and distributing, extensive direct foreign investment, and the development of technology and industry clusters. Dr. Miller contrasts:

- *Old Globalism* based on the search for low factor costs where international businesses invested in regions with low-cost land and labor to serve as export platforms to produce high-volume commodity products

- *New Globalism* based on the search for the best locations to host high-value, specialized, and innovation-related activities where businesses invest in regions to gain access to specialized workforces, research and development and commercialization capacity, innovation networks, and unique business infrastructure.

Regions participate in the New Globalism by creating specialized habitats that can grow high-value businesses and investing in people. It is possible to envision a worldwide network of regions, each playing a different role in the value chain and creating a"win/win" outcome for regions. As local regions of a country become more the locus of economic development, economic authority is decentralized to the regions. These region-to-region relationships foster regional networks as part of a new globalism/new regionalism.

ACCELERATING TECHNOLOGY FEEDBACK LOOPS

As the new world business paradigm has been evolving since the 1980s, the role of Silicon Valley has been changing as well. As one of the leaders in the new globalism/new regionalism, Silicon Valley prospered as it attracted investment in talent, technology, and capital. It has become the prototype "habitat for innovation and entrepreneurship" as described in the *Silicon Valley Edge*, now imitated by regions worldwide.

The recent boom/bust cycle suggests that possibility of a new global role for Silicon Valley. Silicon Valley has become a generator of new technology innovations in the past decades from integrated circuits and microprocessors to personal computers and workstations to computer networking and Internet software. The difference in that time has been the accelerating speed of technology diffusion. An invention in the semiconductor industry in the 1970s diffused to Asia in the 1980s, resulting in fierce foreign competition and ultimately the reinvention of the semiconductor industry in the 1990s. The new globalism/regionalism resulted in a rapid feedback loop that threatened the industry and then helped it move to a higher level of competitiveness. A similar feedback loop occurred in the 1980s in the personal computer industry, with initial innovations in Silicon Valley soon copied elsewhere, resulting in the shift of the computer industry in the Valley toward higher-value products such as high-speed workstations.

The technology feedback loop in the 1990s was much quicker. Soon after the commercialization of the Internet in the early 1990s and the successful IPO of Netscape, a worldwide explosion of investment occurred in Internet products and companies. Because the barriers to entry for applications of the Internet were much lower than for either semiconductor or personal computer manufacturing, the number of Internet companies grew rapidly in the late 1990s, quickly crowding out profits. Only a few Internet companies have survived the shakeout. However, the amount of money invested by venture capitalists in this sector grew rapidly in Silicon Valley from $8 billion in 1999 to more than $16 billion in 2000. When the bubble burst in March 2000, the impact on the Valley was severe.

THE UPSIDE AND DOWNSIDE OF THE NEW GLOBAL PARADIGM

As new globalism/new regionalism has promoted regional networks, it appears to have both an upside and a downside. The upside involves expanded trade and investment ties, the sharing of intellectual capital and talent, and the benefits of cooperative relationships. These regional networks are both international (Silicon Valley–Taiwan-India) and domestic (Silicon Valley–Austin-Portland). When the economies of one region's people, land, and firms are expanding, regions in the network benefit from higher standards of living.

However, a downside is apparent as well. The increasingly rapid diffusion of technology creates negative feedback loops that can increase the instability of regional economies, especially the lead innovator such as Silicon Valley. Thus, the Internet explosion quickly spread to other domestic and international regions, resulting in massive overcapacity because of hypercompetition.

The 2001 International Monetary Fund Outlook points out that increased linkages between economies have made the business cycle more synchronized than previous ones. An adverse shock in America now has a bigger impact on the rest of the world than such a shock once might have had. The synchronized nature of this downturn has increased the vulnerability of the global economy to shocks.

VII. LIVING WITH VOLATILITY: CREATING THE RESILIENT REGION

The Silicon Valley region — its companies, people, communities, and institutions — is going to need to ride waves of innovation as well as traditional economic cycles going forward. Revolutionary technologies have revolutionary consequences — both positive and negative. Unless social innovation accompanies technology innovation, the relentless flow of new innovations can have real and growing downsides — downsides that threaten the special habitat that births them.

"Social innovation" refers to innovation in both the workplace and society — its institutions, culture, and policy/legal frameworks. For example, in the past 30 years, Silicon Valley people and institutions have pioneered less-formal, less-hierarchical workplaces and social orders. More recently, Santa Clara County became the first in the nation to ensure health care for all children. Management guru Peter Drucker writes that "social innovation may be of greater importance and have much greater impact than any scientific or technical innovation." Going forward, the Silicon Valley region needs to rediscover its roots as pioneer of new and effective mind-sets and institutions.

The wave of new technologies developed commercially from the early 1990s triggered hope that a different kind of economy was emerging — one that offered the prospect of improved productivity, rising standard of living, and full employment. We have learned that neither this wave nor the next will be a panacea. We also saw vividly that the demands, speed, and volatility of the economy create real challenges for people, companies, and civic institutions.

The experience of the 1990s showed that the region has gone only partway in creating institutions and infrastructure that can help people, communities, and companies adapt to and weather economic change. This inability threatens the long-term sustainability of the habitat.

- Exceptional demand for talent in tech industries led to massive recruitment into the region. Whereas the Valley had a natural labor force growth of 1.6% during the 1990s, the job growth from 1995 to 2000 averaged more than 3.6%. The inability to hire qualified people quickly cost Silicon Valley companies an estimated $3 billion in recruitment and hiring.
- Job growth outstripped housing growth by a factor of four, skyrocketing housing prices. Housing affordability in Silicon Valley declined to 16% in 2000, compared to 60% nationally.
- Skyrocketing housing prices caused financial hardship for many residents, especially those not involved directly in professional high-tech occupations. In 1999, for example, wages in technology cluster industries increased 20%, whereas wages in all other sectors increased only 1%. This shift has led to talent shortages in key critical professions (such as teaching and safety personnel) and some lingering resentment of tech companies and people.
- Households at the bottom 20% of the income distribution saw their standard of living fall during the boom period. Six of the 12 fastest-growing jobs in Silicon Valley pay $26,000 annually or less. And a recent survey of women in Silicon Valley found

that one-fifth of their full-time jobs do not provide enough income to support one person in Silicon Valley, much less provide health or retirement pension benefits.

- Availability demands by companies and long commutes led to declining investment in family and community life. In a recent survey, 73% of respondents reported that to advance in their job or career, they need to be available whenever their employer or client needs them.

Lacking a strong social infrastructure and regional capacity to cope with rapid change, the Valley has experienced a decline in its attractiveness as a place to live — the ultimate threat to its future innovation capacity. At its core, the innovation asset of the Valley is its talented people at all levels: researchers, entrepreneurs, technicians, and support infrastructure, both public and private. The loss of talent — because of out-migration or burnout — translates directly into a loss of productive and creative capacity. The competition for talent will only increase in the future; demographics show that between 1995 and 2015, the 25-to-44-year-old labor force will decrease nationally by more than 3.2 million workers.

A COMMITMENT TO SOCIAL INNOVATION IN WORKPLACE AND COMMUNITY

Creating a resilient region will require a new commitment to social innovation — changing mind-sets, practices, and institutions fundamentally in both the workplace and the community. The Valley of Entrepreneurs will need to become an Entrepreneurial Valley where innovation and entrepreneurship are in every sector — business, government, education, and community — and underlie creative approaches to common problems. The following fronts are particularly ripe for a new wave of social innovation:

Creating Resilient People and Organizations

- *Expectations between Employers and Employees.* The old relationship between employer and employee, characterized by paternalism and relative security, is clearly gone — replaced most recently by a transactions-oriented model focused on wage escalation and stock option lures. It's time to rethink how employer and employee expectations can align for the next waves of innovation. On the one hand, employers want to engage the full hearts and minds of adult workers, and they want flexibility from them. Adult employees, on the other hand, want to enhance their employability, and they want flexibility to lead their multidimensional lives.

- *Support for Employee Transitions.* A central challenge of an innovation-based economy is to ensure that companies have flexibility and the labor force has mobility, without undermining people's lives and livelihoods in the process. Silicon Valley needs to lead the country in creating a reliable and flexible transition support system, so that workers who move from one work relationship to another do not have devastating gaps in insurance coverage, income, and retirement savings benefits. This consideration is especially critical at times of economic downturn like 2001–02, when laid-off workers need safety-net support and assistance in job transition.

Increasing Stakeholders in the Innovation Economy

- *Developing a New Technical Workforce*. If innovation continues to define the Valley, then technical professions will remain among its most in-demand and highest paid. Can we take more creative approaches to developing a homegrown workforce? Can we become a national model for developing, recruiting, and retaining "nontraditional" technical workers — such as women, Latinos, older workers — in technical professions? Redoubling efforts in this area could require expanded roles for universities and community colleges, for corporations, and for community-based organizations.

- *Mobility and Support for Low-Income Workers.* A reality of Silicon Valley's economy is job growth at the very high-wage and very low-wage levels (half of the 12 fastest-growing jobs pay $26,000 or less.) Much of this lower-skilled work is essential to our economy and to our personal lives. Creative approaches are necessary to ensure that low-wage jobs can become a springboard to better opportunity and that low-wage workers can meet basic needs. Such approaches could include nonincome kinds of support, such as affordable housing, childcare, and health care (e.g., the Healthy Kids Initiative) and an expanded Earned Income Tax Credit.

Strengthening and Aligning Infrastructure

- *Investing in Early Care and Education.* A person's ability to learn in school and throughout life is shaped substantially in the earliest preschool years. Research has demonstrated that early investments in childhood education have among the highest returns on investment possible. Can we commit to a strategic regional approach to early childhood development, including childcare and preschool education — laying the groundwork for a highly competitive local workforce of the future and ensuring that parents can work and be productive?

- *Strengthening Public Benefit Organizations.* Silicon Valley's public-benefit organizations and civic institutions play a critical role in enhancing quality of life and supporting people. Can we pioneer new ways to contribute talent and resources to them? Can we figure out how to sustain these institutions during economic downturns — when their services are often needed most? Can we value "civic careers" and help people transition through them?

- *Building Housing and Strong Neighborhoods*. The experience of the 1990s showed the economic and social downsides of job growth that dramatically outstripped growth of housing supply. Can we build more housing with an eye toward ensuring access to housing for people of all income levels and toward building strong neighborhoods? Can we figure out how to use scarce land more efficiently while creating more vital and interesting places to live and work?

Strengthening Valuable Interaction

- *Connecting Networks and Building Community.* Networks have become a key enabler of economic and social innovation. Although the Valley has strong economic networks, more work is necessary to bridge social networks. Recent research on social capital in Silicon Valley suggests that relationships that bridge like-minded groups are not as strong in the Valley as in other regions. Leveraging this kind of social capital has proved important for finding a better job, solving family or neighborhood problems, and engaging in the civic life of the broader community. (See *Building Community: Social Connections and Civic Involvement in Silicon Valley*.)

THE UNDERLYING IMPORTANCE OF TRUST

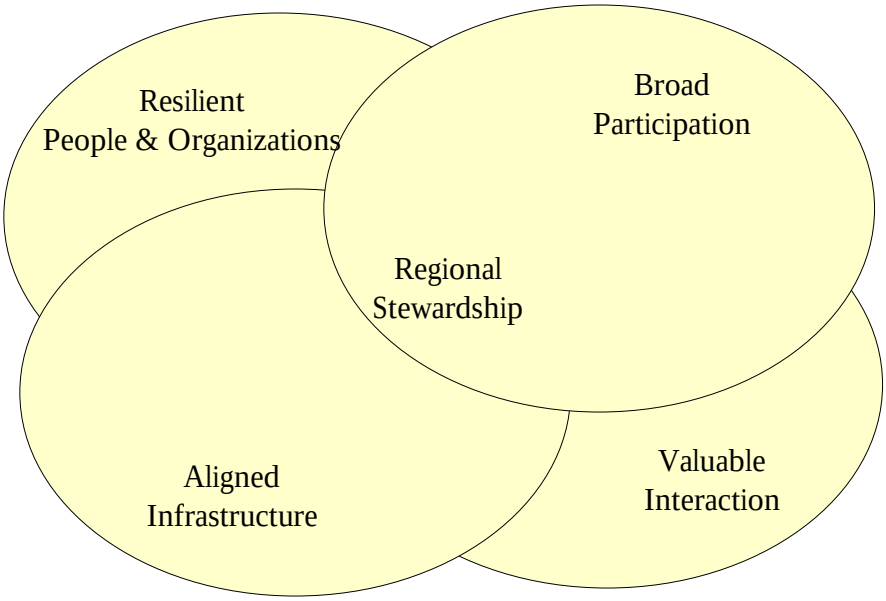
The more innovation based the economy, the more important the social infrastructure that supports that economy. High-trust relationships among entrepreneurs, investors, and researchers lie at the heart of an innovation economy that aims to ride new technology waves. At the heart of the next wave of social innovation needs to be a strengthening of trust relationships among people, companies, and civic institutions.

Increasingly in the future, the health of the economy will depend to an important degree on social cohesion. In her new book, *Paradox of Prosperity,* Dr. Diane Coyle finds that this trust or "social capital" has become the critical economic asset. Trust has become important because it fosters the cooperation and risk sharing that promotes innovation and flexible responses to change. Dr. Coyle argues for a high-trust economy built on strong face-to-face relationships in which technological sophistication goes hand in hand with more robust social relations.

As Silicon Valley goes forward, companies need to trust that the region understands their needs and will be supportive of them. People need to trust that if they give their all for the innovation economy, the innovation economy will support them in meeting other life goals. Lower-wage workers need to trust that they can have a real stake in Silicon Valley's future. Civic institutions need to trust that corporations will value and support them in the long haul.

In the end, aggressive leadership on social innovation, including from the business community, will define how well the region can adapt to the coming waves of economic innovation. It is time for a next generation to act as regional stewards — people who are committed to the long-term future of the place called Silicon Valley—building on the legacy of the Valley's senior leaders.

Social Innovation in Workplace and Community



VIII. NEXT STEPS: LEARNING TO RIDE THE ECONOMIC WAVES

As a leading innovation region, Silicon Valley needs to recognize its special place in the global economy and create social innovation to support its long-term innovation capacity. The new globalism/regionalism paradigm needs to be amended to include not only the development of regional networks but the clear recognition that leading regions such as Silicon Valley need to prepare for the inevitable feedback loops from rapid diffusion of technology and a more interconnected global message and society. Although innovation waves and boom/bust cycles may be inevitable, we can moderate their impact and anticipate them better.

The waves of innovation that drive Silicon Valley continue to outrun our governance and social infrastructure. The Valley, which lives on innovation and change, has not developed the private or public institutions that can help the people and businesses of the Valley adapt to change. We see current trends continuing while we live in a world of waves and cycles. This failure to see and to adapt heightens the boom/bust cycle and undermines our long-term competitiveness because we fail to invest in the human resources and community assets necessary to maintain the attractiveness of the Valley to talent and innovative firms.

In many ways, Joint Venture: Silicon Valley Network was an attempt in the early 1990s to address the economic challenge of the last wave. The 1993 *Blueprint for a 21st Century Community* addressed this issue directly by focusing on how technology and human infrastructure can be built to support the new economy. The *Blueprint* stated:

> Just as Silicon Valley firms have reinvented themselves, Silicon Valley as a community must reinvent itself. Just as companies reach beyond themselves for the key ingredients necessary to compete, the region needs to have equally strong networks that can provide those resources. Just as firms have learned to build strong alliances, Silicon Valley must develop relationships between business, government, education and community to provide the world class economic infrastructure of skills, technology, financing and tax and regulatory environment required for success in a global economy.

Smart Valley, Challenge 2000 education reform, permit streamlining, and The Enterprise Network were all designed to connect better the needs of emerging technology industries with educational, technological, and government infrastructure.

Now the focus has to shift again to connecting the economic and social infrastructure for the Next Silicon Valley to achieve the broad goals outlined in the *Silicon Valley 2010* developed by Joint Venture in the late 1990s in response to community challenges. We need to cultivate leadership to focus on:

- *Understanding the accelerating diffusion of technology and its increasing volatility in the global economy and sharing this information widely.* We do not need to be surprised by these economic cycles and waves of innovation any more. We need to be prepared. Being prepared means undertaking ongoing economic monitoring that better identifies emerging technologies in order to stay ahead of the technology curve

and better prepare our workforce and workplaces of the future. Because we know that technology in the Valley does not go in a straight line, we need be more innovative in thinking about technology development and identifying new opportunities to foster.

- *Fostering networking that renews the habitat for innovation and entrepreneurship* around the new waves of innovation by connecting Silicon Valley and Bay Area assets in deepening information technologies, promoting convergence between emerging bio and info tech, and applying nanotechnology to our current strengths in semiconductor and computer manufacturing. This requirement especially means better connecting the leadership of the Silicon Valley and Bay Area around the convergence of bio and info technologies.

- *Promoting social innovation in addition to technology innovation* to develop the social infrastructure and new workplace necessary to promote the more effective transition of talent in the next Silicon Valley.

The initial step is to recognize that Silicon Valley does not have a "right" to create or ride the next wave. David Hackett Fischer, author of *The Great Wave*, which traces price revolutions and rhythms of the economy since medieval times, provides a useful observation for our times:

> In the United States, problems of economic understanding have been compounded by the effects of economic prosperity. The Greeks called it hubris and thought it always ended in the intervention of the goddess Nemesis. That lady makes her appearance when wave-riders begin to believe they are wave-makers, at the moment when the great wave breaks and begins to gather its energy again.

Ultimately, Silicon Valley's habitat for innovation and entrepreneurship is not really about a particular industry or technology. Rather, it is about creative people who innovate continuously because of strong networks and infrastructure that allow people and organizations to adjust quickly to change in an environment of trust. Riding the waves requires understanding that they exist and readying people and firms to move quickly in response to changing circumstances.

Silicon Valley will reinvent itself, once again. And, once again, it will look different. This time, let us hope that we will learn how to link our technology and social innovations better in ways that create both prosperity and a good quality of life for all residents in the Valley.

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