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Appendix

Chips of State: How US IT Companies Compete Globally

(The original of the 'Report 2')

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A More Competitive Information Technology Market

There is increased interest in how competition will evolve in a more global and more competitive IT market. Such interest again is focusing attention to Silicon Valley, the perceived epicenter of information technology innovation. This article will review the emergence of the current IT market in the US, the past and present role of Silicon Valley in that market, and the lessons that Silicon Valley offers for future competitive strategy development.

An Orchard Valley Blooms Silicon

The roots of the modern US IT industry lay in the technologies developed in World War II, particularly radar systems at the Massachusetts Institute of Technology. After the war, MIT continued to become a center of US government funded R&D, and during the 1960s, the Department of Defense continued to work with MIT scientists and engineers to develop missile technologies. This research at MIT and other universities and research labs, required the development of miniaturized mechanical and electronic components. From the foundations of this technology, commercialization of electronic components, such as semiconductors at AT&T Bell Labs, marked a disruptive technology change upon which the modern IT industry was based.

While the invention of the semiconductor was certainly significant in the development of the IT industry, it was not the only major disruptive change underway in the Boston area around MIT after the war. In 1946, Georges Doriot, a Frenchman who migrated to the US to attend business school and to serve in the US Army, founded the Boston-based American Research and Development Corporation (A.R.D.), the first publicly owned venture capital firm. Insurers and educational institutions owned nearly half of A.R.D.'s shares. With its $5 million bankroll, A.R.D. placed high-risk bets on start-up companies, helping the new companies get started in exchange for a stake in their futures. Before Doriot's arrangement, innovators had to seek private investors for their

idea. By 1972 Doriot achieved nearly a 15% return on his investments in over 150 companies, including Digital Equipment Corporation (later acquired by Compaq and then Hewlett Packard). Doriot innovated a system for funding the ideas that is another basis for the current IT industry successes.

Although the Boston area continued to retain and grow its technology and business world-class stature, another series of events was occurring at the same time in the area around Stanford University. These events would shift the hub of the IT industry from Massachusetts to California. After the war, the San Francisco peninsula was home to Stanford University and to the fruit orchards of Santa Clara Valley. The primary technology was aeronautics (Department of the Navy, and later, NASA–both at Moffat Field in Mountain View.) There was no significant non-military technology company. Just before the war, Fred Terman, a Stanford and MIT trained professor and senior university administrator, decided to dedicate some of the unused land on the Stanford campus in Palo Alto to an industrial park, the first university-owned industrial park in the world. He encouraged two of his graduate students, William Hewlett and David Packard, to form a company and house it on campus. Hewlett and Packard started producing electronics for the US Army from a garage. Other companies followed.

In 1956, William Shockley, one of the inventors of the transistor, moved to Mountain View from the California Institute of Technology, where he had gone after resigning from Bell Labs in 1953. Founding Shockley Semiconductor Laboratory in 1956, he brought eight employees from the East Coast who later started Fairchild Semiconductor. AMD, Signetics, National Semiconductor, and Intel all started as spin-offs from Fairchild, or alternatively as spin-offs of other spin-offs. Intel was initially funded by Arthur Rock, a Harvard Business School graduate (where he was a student of George Doriot) and the first venture capitalist in the San Francisco Bay Area. Rock also funded the founding of Apple Computer.

The orchids of Santa Clara Valley began to be replaced by the exploding semiconductor industry during the 1970s, and became known internationally as Silicon Valley.

At the beginning of the 1970s, all of the building blocks that were to become the US IT industry were in place, but one main ingredient was still missing. That ingredient came from Japan.

The US automotive industry was the prime mover for the US economy in the 50s and 60s. It operated as almost a monopoly, without

competition. Japan, during this time, had successfully mobilized its manufacturing skills to begin the production and export of automobiles (and later electronics) that not only created competition for the US automobile industry, but also challenged its inherent management and production inefficiencies. The result was that American companies began seeking efficiencies of operation that would defend their markets. One of these efficiencies was to reduce labor costs through a) business process reengineering (later business process management), b) the adoption of Japanese quality management techniques, and c) shifting decisions closer to the business unit level.

One challenge in achieving these efficiency improving changes was the IBM computer, which had, by this time, become a commercial success based electronics technologies such as vacuum tubes. These machines centralized the essential computing capability of US corporations, were expensive to buy and to maintain, and did not therefore support cost reduction management strategies. The result was the emergence of smaller, less expensive computers from companies such as Digital Equipment Corporation (DEC) called minicomputers built from semiconductors instead of vacuum tubes (the IBM machines were, as a result, now called mainframes!).

Over the 1970s and into the 1980s, minicomputers began to dominate the US computing market, and led to distributed computing as these minicomputers (now servers) became networked. The rise of the minicomputer and its descendants, the personal computer (Apple, then IBM), the calculator (Bowman, then HP), etc. also marked the disruptive shift of IT innovation from the East coast to Silicon Valley. As the leading technology center for the computing components of the emerging commercial IT industry, Silicon Valley was also becoming the focus of new computing technologies, including user interfaces (PARC and SRI), networks (PARC and Stanford), and software (PARC, Stanford). These developments were funded by the Silicon Valley venture capital industry; the technologically trained engineers, scientists, and entrepreneurs came from Stanford University and other leading Silicon Valley and US universities (notably Rice University in Houston); and the international reputation of Silicon Valley came from companies all over the world that came to learn and contribute to the technological foundations of the IT industry.

At the end of the 1980s and into the 1990s, the IT industry continued to grow, but at single digit rates. Three major forces, however, were

forming to move that growth to double digit levels. Those three forces were:

1. The prediction of computing meltdown in the year 2000; Mainframe computers that still supported major US businesses would crash when the date moved from 19XX to 20XX. New computers and software had to be bought to protect these businesses
2. The Netscape IPO in 1995; In a strategy to reduce the vulnerability of the US communication system to nuclear attack, the DoD developed the ARPANET, a decentralized computing network. Originally a highly classified project, this network of networks, or internet, was increasingly used in academia and selected US companies. Declassified in the 1990s, CERN in Switzerland developed a technology to efficiently find servers on the internet. Developed further by the University of Illinois at Urbana, the technology was commercialized by Netscape, which became public in 1995. Because of the success of this IPO, the "dot-com" bubble followed. Silicon Valley's software and equipment companies experienced significant market growth and IPO revenues during this bubble.
3. The telecom deregulation act of 1996; the AT&T divestiture and the subsequent 1996 telecommunications deregulation act created many telephone companies where there used to be only one company. Each new company needed to buy new computing equipment to grow its business. New services, based on Internet technology, would increase service revenues from these investments. Telecoms began to massively expand their expenditures. The "dot-com" bubble began to burst in December 2000 when these telecom companies expanded beyond the ability of new services to establish returns on investment. The IT industry and Silicon Valley went into steep economic decline during the following two years.

This short history, though not complete, illustrates many of the reasons why Silicon Valley holds the position it does in the IT industry. First of all, Silicon Valley is not successful only because it is technologically inventive. Indeed, many of the successes in Silicon Valley came from other parts of the US and the world. Secondly, Silicon Valley is successful because it is innovative---not only in technology, but also in business models, educational models, relationships with public

markets, and entrepreneurship. Most importantly, the history of the IT industry demonstrates that it is technology commercialization, not technology invention that ultimately is the successful strategy to economic growth of companies and regions.

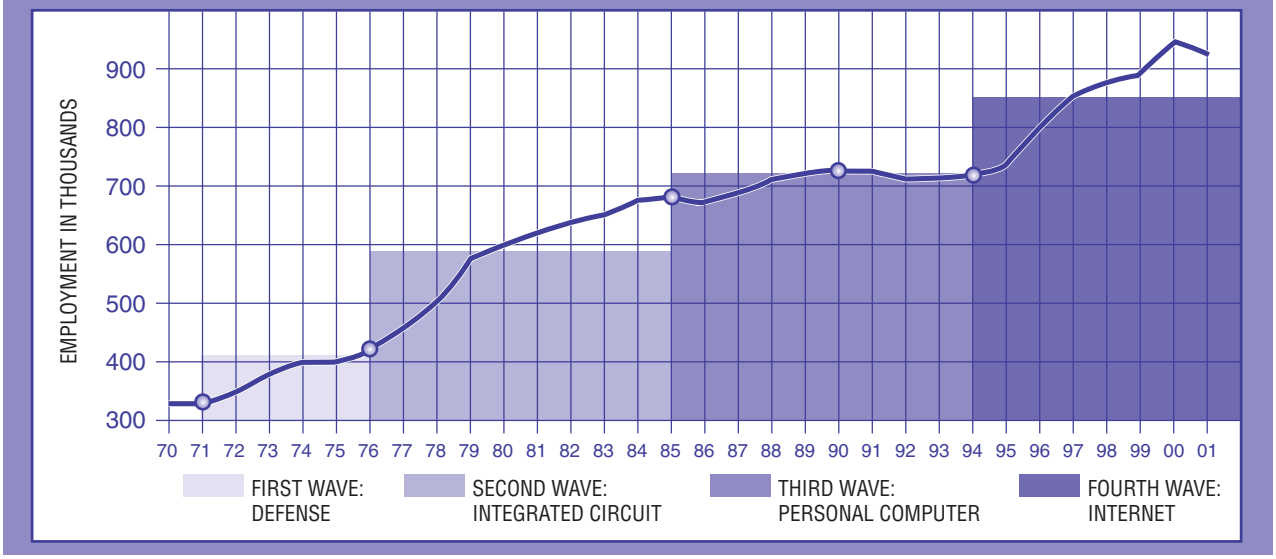
The fundamental IT technologies that were commercialized were mostly sponsored by the US government, and its Department of Defense (and the Defense Advanced Projects Agency, DARPA) in particular. The most significant driver to this sponsorship was the cold war, in which the US and the former Soviet Union competed on technological superiority as well as ideology and proxy conflicts in Korea and Vietnam. This government sponsored research was done primarily at universities such as MIT and Stanford. Each of these universities also started separate research labs that became national centers of defense related R&D. Examples were MITRE (MIT Research and Engineering) and SRI (Stanford Research Institute.) Department of Defense sponsored university research occurred until the late 1970s, when university policies shifted away from support of defense objectives. Today, Department of Defense funding of university IT research is minimal, and US government funding has shifted toward biotechnology in response to national health issues and more recently, the threat of biological and chemical attacks on the US.

Because of the success of these research institutes, the Xerox Corporation also started an advanced research center next to Stanford. This organization, though not government sponsored, began the commercialization of many of the technologies being developed at Stanford and by Stanford researchers. This Palo Alto Research Center (PARC) was a major contributor to the success of Silicon Valley companies such as Adobe, Xerox, Apple, and 3Com. Arguably, it was PARC that became the primary differentiator between Boston and Silicon Valley in their future technology commercialization trajectories. The irony of this is that Xerox itself did not benefit significantly from the contributions of PARC.

Today and Tomorrow

Silicon Valley has a long history of boom and bust. In the post-WW II era, it has had four main boom and bust periods. However, as seen in the following figure, those busts were more periods of consolidation than significant decline in employment.

Figure 1 **Waves of Innovation resulted in increasing employment in Silicon Valley**



(Source: Joint Venture Silicon Valley Network and SiliconValleyOnline.org, July 25, 2006)

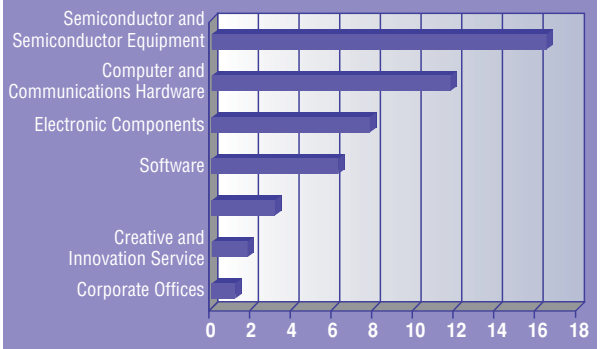
Today, Silicon Valley is home to billion dollar IT industry companies that did not exist ten years ago, including Yahoo, Google, and eBay. It is ironic that successful IT companies such as Amazon, And Microsoft (Seattle), Dell (Austin) and Red Hat (Research Triangle) are considered by the general press to be Silicon Valley companies, even though they are not headquartered in the Valley. Older companies are innovating with existing technologies and new business models that are changing those companies. An example is Apple and its iPod ecosystem. It is also important to recognize that the IT industries that resulted from the waves illustrated in Figure 1 have produced concentrations of continuing employment in those sectors (see Figure 2.)

Today, IT companies are in a period of adjusting to being mature companies with more moderate growth rates than in the past. Corporate governance and protection of intellectual property are continuing issues that IT companies must resolve. There is potential for some companies to experience higher growth based on major potential government programs (an example is the privatization of government agencies) or healthcare legislation. The timing of such programs is uncertain, however.

It is well understood by major US IT companies that a mature industry must compete more aggressively for market share. This is being done by buying access to new customers by acquiring companies (and possibly complementary services that augment existing

product lines–an example is the July acquisition of software testing company Mercury Interactive by Hewlett Packard.) An alternate strategy is to attract new customers with more compelling or cheaper products or services (e.g. Apple iPos ecosystem.)

Figure 2 2005 Silicon Valley Cluster Employment Concentration Relative to the US



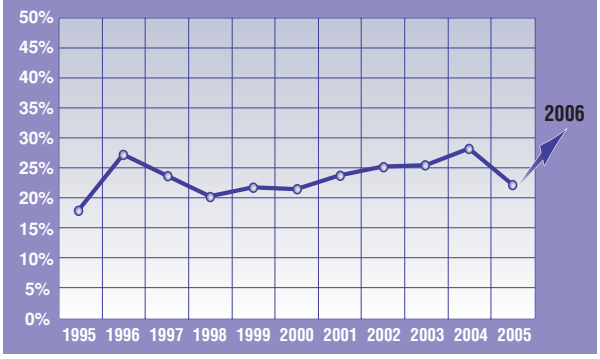
(Employment concentration compares the percentage of employment in a regional cluster to the percentage of employment in its national counterpart. An employment concentration greater than one signifies that industry cluster employment is over-represented in the region.)

(Source: Joint Venture Silicon Valley Network and SiliconValleyOnline.org, July 25, 2006)

In the first half of 2006, a steady deal flow in information technology, and increasing interest in healthcare companies resulted in US venture capital investing reaching its highest level since 2001. IT investments in the first half of 2006 increased 8% to $7.15 billion. Other new areas that are receiving investments are alternative energy and clean technology ($315 million in first half of 2006.

Most importantly, venture capital funding for Silicon Valley companies is continuing at levels comparable to the levels before the bubble occurred. (Figure 3).

Figure 3 Silicon Valley Percentage of total US Venture Capital Investment remains above 20%



(Sources: PricewaterhouseCoopers/National Venture Capital Association Money Tree™ Report based on data from Thomson Financial)

Example IT areas that are attracting venture capital today are:

1. Technologies and design frameworks called Web 2.0. (e.g. the most well known example is the Google maps application)
2. Software-as-a-service (SaaS) is emerging as the dominant delivery mechanism for web applications.
3. Security remains a continuing concern for most US companies.
4. Open source software, in which source code for software is distributed, is changing the landscape of the software industry

Recipe for Competitiveness?

The success of the US IT industry has been the focus of numerous research organizations and studies. Europe and Asia have long attempted to replicate the US IT model, and in particular the Silicon Valley implementation of that model. With few exceptions, those attempts have not enjoyed the same levels of success, at least not yet.

The reason is that the Silicon Valley model is not well understood by most business strategists, not even in Silicon Valley. A partial list of the factors that led to the success of the Silicon Valley business model includes the following:

1. The venture capital structure of funding start-up companies
2. Initial and expandable customer base
3. The availability of investment exit mechanisms in either or both of the public and the corporate markets
4. Stanford University and its culture of entrepreneurial technology innovation
5. Government support of universities and companies that employ the technologies and people of those universities
6. A business culture that encourages risk of innovation as opposed to risk of invention. Innovation is the ability to create and capture economic value from invention. It is innovation that really drives both the economic prosperity of companies and the shareholder value of those companies.
7. Stock options to attract talented technologists and managers (the current stock option scandal comes from the excesses of this element)
8. Clean slate business environment (in Silicon Valley there were no commercial high tech businesses when Terman, Shockley and the other pioneers implemented their vision.)
9. Ability to attract foreign companies to invest in the region, and start new foreign-owned companies in that region
10. A transportation system that allows people and ideas to move freely, quickly, and inexpensively between companies and universities (e.g. customers, vendors, etc.)

In fact, all of these are elements of the Silicon Valley model, but no single one of them is sufficient. For example, MIT and the Boston area have many of these elements, and indeed, there has been notable IT business success there. But Boston is still number two in terms of VC funding in the US and no major IT company is now headquartered there. What is missing?

The answer is that all of these elements are required, and they have to be available at the right time. Other regions, such as Boston, Research Triangle, and Austin have been able to build innovation centers that have produced successful IT companies, but not on the scale of Silicon Valley.

Can Silicon Valley survive and remain competitive?

Since the 1970s, the periods of IT industry and Silicon Valley recession have been marked by predictions of the demise of the industry and the Valley. Each of these periods preceded a major new wave of innovation and business growth.

Today, those same predictions are being made. Outsourcing of high technology jobs to locations outside of the Valley, particularly India is occurring. Cost of living is high and homes are prohibitively expensive for many. Traffic gridlock is typical on highways that once were always clear. Major IT companies of the Valley are maturing, and some are declining. Mergers and acquisitions are becoming larger as companies consolidate. There is no agreement on what the "next big thing" will be.

This was also the situation in 1974 and in 1985 and in 1994. The Google IPO occurred in 2004 (about a 10 year cycle.). It may be, however, that the next wave of IT industry expansion has already begun (with the Google IPO?), but it is not being recognized. Today, it is apparent that there opportunities developing in IT segments such as online content and advertising.

Innovation isn't just confined to commercialization of new products. It can also build upon creative new practices, processes, relationships, or business models, and even institutional innovations such as open-source computing -- invention occurs in all these domains. While breakthrough innovations can generate significant economic value, sustaining that value requires a capacity for continual incremental innovations.

Silicon Valley is a center of innovation, and will be the primary beneficiary of the IT industry expansion. Its innovation model cannot be duplicated.

Europe and Asian Adoption of US IT Industry competitive practice?

This is a question that is of significant importance to Europe and Asia. Certainly, both regions have tried to find successful strategies for adopting US IT industry competitive practices.

Although some positive results have occurred, it is concluded that these efforts have not been successful to the same extent as in the US.

Furthermore, it is not certain that these regions should try to adopt US IT practices without significant changes. History has shown us that different regions will follow different trajectories to achieve economic well being of their populations. The most successful trajectories will be those that are best aligned with the history, and policies of the region, but which also support an innovation culture.

It is not clear that Europe's innovation strategies support an innovation culture. For example, Europe tends to encourage innovation through large publicly funded projects. Such public investment competes directly with venture capitalists, and tends to direct funds to a few politically favored firms rather than spreading the funds across hundreds or thousands of companies.

According to the Economist (July 15, 2006.) Europe's innovation problems lie in lack of an entrepreneurial spirit, an underdeveloped venture capital industry, and complex patent process, and regulations that significantly increase costs for smaller firms.

There are, however, positive innovation practices being used in Europe. For example, research by the British Centre for Economic Performance showed that British groups have benefited greatly from US R&D spending by placing offices in Silicon Valley and paying attention to what is going on. It is therefore not surprising that Mr. Tony Blair, the Prime Minister of the UK, traveled to Silicon Valley during the first week of August this year to meet with IT and biotech executives.

An even more successful example of placing offices and IT specialists in Silicon Valley is the experience of India. Thousands of Indian engineers came to, and contributed to Silicon Valley IT firms in the 1990s. They attended US universities and learned both the technologies and entrepreneurial business models of the Valley. Many became wealthy, and contributed to the expansion of IT education and businesses in India. With the collapse of the internet bubble, many of these professionals returned to India. Taking with them the learnings of Silicon Valley, these professionals contributed to the emergence of the Indian outsourcing industry, now a major global IT industry.

A Suggestion for the Japanese IT Industry

Japan and the US IT industry have been partners for many decades. Indeed, many Silicon Valley companies such as Apple Computer and

Oracle have implemented Japanese management concepts. Japanese IT companies have invested in Silicon Valley firms and are also customers of US IT companies. The best-managed Japanese IT companies have established offices in Silicon Valley, and actively support those offices. These offices provide the Japanese firms with a window on the technology and business models of the US IT industry and relationships with leading universities.

In spite of these continuing practices, however, there is still concern in Japan that the innovation capabilities of Japanese IT companies have not benefited as much as potentially possible. The reasons for this concern are that the Japanese innovation models do not meet many of the previous stated characteristics of the Silicon Valley innovation model, although some of these characteristics are emerging in Japan now as the economy finally begins to expand again. However, many Japanese companies remain slow in their adoption of IT technologies, in spite of their abundance of inventive engineers and scientists. Such slowness is partially due to a focus on creating new technologies and products, and not on developing innovative mechanisms for commercializing those technologies and products. The result is that the ability of Japanese IT companies to compete successfully in the emerging 21th century IT based economy is uncertain, and that Japan must execute a "catch-up" strategy to sustain its global economic position in IT industries.

Japan's position as process technology leader is globally recognized. In particular, Japanese innovations in manufacturing processes produced the Japanese successful automobile and electronics industries. This suggests that a fruitful route to IT innovation in Japan is to develop a process that can be implemented to meet Japanese IT competitiveness objectives through innovation processes.

Such an innovation process would use the Silicon Valley model as a reference objective. In other words, the intent this approach is not to replicate that model, but rather to focus on innovation (as opposed to invention) as a process and learn, adopt, and adapt those innovation models to Japanese business processes. An example is to move to a culture of innovation risk by developing a new business based on a customer's (or a vendor's) idea, not an internal desire to invent a new technology or product only.

The role of the Japanese government in such an innovation process can be significant. Japan, as Asian counties and Europe, uses large public funds to create new high technology

programs. This method of high technology funding requires rigorous planning and strict investment governance in order to comply with the government's fiduciary role. However, such programs may also compete with the emerging venture capital industry in Japan, subvert the entrepreneurial culture and adds risk by directing funds to a few favored firms. To create a more innovative high technology project process, the government should consider the awards of grants less than \ 10,000,000 to Japanese universities that have entrepreneurial cultures and good relationships with Japanese corporations and venture capitalists. These grants could develop new ideas to a next stage of potential additional development funding or implementation by venture funded start-up companies or the R&D departments of large Japanese corporations.

The R&D departments of large Japanese companies should migrate to the open, collaborative R&D model that is emerging in the US. In this R&D model, the focus of R&D shifts from development of internal ideas to the identification and incorporation of technology innovations from external smaller companies. Partnerships with these companies can be formed and these companies can potentially be acquired. The R&D department then performs development and alignment of those technologies to the company's customers and markets. This acquisition and development (A&D) model has been used successfully by Sun and Cisco, for example. The benefits to the large company R&D department include 1) access to more proven advanced technologies, 2) reduction of time to market and 3) improved alignment with company markets and customers. Note that this model differs from the merger and acquisition (M&A) model in which the acquired company is primarily used to expand customer or product base of a company's revenues.

Japan has all of the elements necessary to develop an IT competitive business model that is comparable in efficiency to that of Silicon Valley. The challenge is to integrate those elements into an innovation process as Japan has successfully done in the past with other processes.

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