Published in: Marijk van der Wende & Maarten van der Ven (eds.), The Use of ICT in Higher Education: A Mirror of Europe. Utrecht: Lemma, 2003, pp. 277-297

Proximity and Affinity: Regional and Cultural Linkages Between Higher Education and ICT in Silicon Valley and Elsewhere

Keynote address at a European conference on "The New Educational Benefits of ICT in Higher Education" at Rotterdam, September 2-4, 2002

Hans N. Weiler
Stanford University

A personal preface

The subject of this chapter – if I may start on a personal note – carries a particularly strong personal connotation inasmuch as it reflects on an important part of my own biography. When I first came to Stanford in 1965 as a young assistant professor, there was no "Silicon Valley" yet – that name wasn't invented until the early seventies – , but my letter of appointment carried the signature of Frederick Terman, then the provost of Stanford University. It was Terman who, just a few years earlier, had started, together with his former students William Hewlett and David Packard, the "Stanford Industrial Park", which was the nucleus of what was to become Silicon Valley. Over the next thirty years, that development occurred virtually on our doorstep: from my house at Stanford the main entrance of Hewlett-Packard is literally around the corner.

In the late 1970s, one of the great treats for our children was to ride the famous roller coaster at the "Great America" amusement park near San Jose, around which the traditional orchards were rapidly being replaced by high-tech companies. As it turns out, the roller coaster serves as a pretty good metaphor for the bust-and-boom cycles that Silicon Valley has gone through over the past 30 years.

And when, in 1993, I went from Stanford to Germany to assume the presidency of Viadrina European University in Frankfurt/Oder, Intel had just introduced the fifth generation of its microprocessors, called Pentium – just next door, incidentally, from those roller coasters that our children used to ride. [One of those roller coaster-riding children, by the way, now a professor of labor economics and regional studies at Colorado State, deserves special credit for my continuing education in regional studies and, hence, for this paper (cf. Stephan Weiler et al., 2001).]

But the history of Silicon Valley has been a roller coaster in other respects as well. We bought our house at Stanford in 1972 for $56,000; that house would now cost well over a million dollars to buy. That would be good for us, if ever we wanted to move to Nebraska, but terrible for people who now seek affordable housing in Silicon Valley, including young assistant professors. And when we returned to Stanford from Germany in 1999, we were appalled to see what the newest boom of Silicon Valley in the 1990s had done to the traffic gridlock on the streets of Northern California.

I mention all of this at the outset to dispel any notion that I am presenting myself here as the unreconstructed enthusiast of the Silicon Valley experience. That experience is decidedly mixed. But I do regard what happened in this Valley over the last thirty years a remarkable phenomenon that is very much in need of better understanding, because of both its successes and its failures, and especially because of the sometimes rather naïve attention it has attracted internationally.

Overview

Nowhere in the world is the interaction between higher education and its regional context in the realm of technology as highly developed, as thoroughly analyzed and as widely commented upon (and often criticized) as in Silicon Valley. The question of how this – even by American standards – remarkable degree of symbiosis has been possible has found many answers in what is by now a fairly respectable literature on the subject.

Some of these answers focus on the very particular corporate culture that has emerged in Northern California's high-tech industry and on its peculiar mixture of competition and cooperation. Other answers have emphasized some of the characteristics of the North American academic culture in general, and of the special configuration of higher education, research, and development in the San Francisco Bay Area, in particular.

A full understanding of the unique technological and entrepreneurial environment that has emerged in this region over the last 40 years requires, however, a more encompassing view of how these two cultures – the corporate culture of the Silicon Valley high-tech industry and the academic culture of institutions like Stanford and Berkeley – complement and draw on each other. This mutual relationship is highly localized; its success depends on the physical proximity of its partners within a narrowly defined geographical space.

Thus, in the kind of symbiotic relationship that has developed between higher education and high-tech industry in Silicon Valley, proximity clearly matters. But that is not the only thing that matters: proximity is a necessary, but not a sufficient condition for successful symbiosis. What also matters is a basic affinity between the corporate and the academic cultures that are part of this relationship

– the sharing, in other words, of certain traits between knowledge-based enterprises and entrepreneurially oriented institutions of higher learning and research. There clearly is a “regional advantage”, as Annalee Saxenian (1996) shows in explaining the superior performance of Silicon Valley in comparison with other American high-tech regional clusters (such as the one that developed around Route 128 in Massachusetts). But this regional factor has to be complemented by the kind of “cultural advantage” that the basic affinities between higher education and corporate technology provide.

This chapter explores both of these dimensions, proximity and affinity, in an attempt to pull together what we know by now about the reasons for the successes as well as some of the failures of Silicon Valley. Against this background, the chapter also raises the question of whether, and under what conditions, similar symbiotic relationships could emerge in other parts of the world, notably in Europe. The thesis that I advance here answers this question with considerable skepticism. This skepticism is based in part on the difficulty of reproducing the “regional advantage” of Silicon Valley in Europe, but more importantly on the considerable lack of affinity between European institutions of higher education and research, on the one hand, and technological entrepreneurship, on the other. Notable recent developments in this regard notwithstanding, this chapter maintains that the gap is still rather wide.

The focus in this analysis is on information and communication technology (ICT) which is by far the larger part of the production spectrum in Silicon Valley, especially when one includes the ICT components and infrastructures that other high-tech developments, notably in biotechnology or medical technology, require.

The analysis starts out with a review of the argument that proximity matters, and that the close configuration of high-tech companies, universities and other research institutions has made possible a density of interaction rarely found elsewhere.

I then proceed to a study of some of the cultural traits of Silicon Valley’s corporate sector, where the interaction of certain structural conditions, a special brand of entrepreneurial personality, and the institutionalization of particular norms and patterns of behavior have produced an environment *sui generis* which has proved unusually supportive of innovation and change.

In a third section, the chapter focuses on some particular characteristics of U.S. higher education institutions, and especially of universities like Stanford and Berkeley, that resonate particularly well to, and interact especially well with, the corporate culture of the region.

I conclude, fourthly, by showing why – against the background of this analysis – it appears to be so difficult to replicate both the regional and the cultural advantage

of Silicon Valley elsewhere, and in what direction one might seek and find possibilities of replication.

One other note: When one speaks of the "success" of Silicon Valley, the real story is one of considerable ups and downs, of cycles of boom and bust. The history of Silicon Valley over the past thirty years provides an instructive series of such cycles, each of which has resulted in a substantial loss of jobs, but has also each time generated a new wave of invention and innovation. This was true of

- the recession resulting in the early 1970s from cutbacks in defense spending, which led to exploring the commercial applications of defense technologies,
- the recession in 1985 resulting from overcapacity in the semiconductor industry, which led to a concentration on higher-value microprocessors,
- the recession in 1990 resulting from overcapacity in the personal computer industry, which led to the development of the Internet.

The most recent recession, which began in 2000 with the bursting of the Internet and *dot.com* bubble and was exacerbated by the fallout of the events of September 11, 2001, is once again weighing heavily on the fortunes of Silicon Valley. Analysts predict that, here again, the current bust will marshal innovative energies for a new boom that is likely to be directed to such fields as the mobile Internet and wireless communication, new applications of technology in education and elsewhere, further advances in biotechnology (bioinformatics, biomaterials, biochips) and the field of nanotechnology (The Next Silicon Valley, 2001, 8-11; Rowen 2000, 198-199).

1. Proximity matters: The regional advantage of Silicon Valley

Ed McCracken, Chairman and CEO of Silicon Graphics, Inc. once explained the importance that his company attaches to regional proximity: "We drew a ten-minute commute circle around Hoover Tower [on the Stanford campus] to define acceptable locations for our company." (cited by Gibbons 2000, 213) Commuting has become much more difficult in Silicon Valley in recent years, but the principle still holds. Indeed, the very nucleus of Silicon Valley – Stanford Industrial Park – was conceived, and succeeded, on the basis of the physical proximity between the first high-tech start-ups of the 1950s and 1960s, notably Hewlett-Packard, Varian, and Fairchild, and the laboratories, libraries and lecture halls of Stanford University. They were not even ten minutes of commuting, but merely a short bike ride away from one another. The possibility for the new companies to use Stanford laboratory facilities for their development work, and the opportunities for Stanford students and graduates to work in high-tech companies at the cutting edge of technological development proved to be such a fruitful kind of symbiosis that it has found numerous replications up and down the valley that stretches between the Stanford campus and San Jose Airport.

The elements of this symbiosis have multiplied since those early initiatives; all of the many and expanding opportunities of electronic and remote communication notwithstanding, however, virtually all of them have benefited from the physical closeness between institutions of higher learning, research institutions, and high-tech companies. Looking a bit more closely at this symbiosis leads me to the following observations:

a) A particularly important role was played, and continues to be played, by university-based programs of continuing education for the engineers and scientists of cooperating companies, beginning with the "Honors Cooperative Program" initiated by Stanford provost Frederick Terman in 1953, which combined classroom instruction on the Stanford campus with instruction via close-circuit instructional television links to individual companies (cf. Saxenian 1996, 23), and continued by its modern day successor, the Stanford Center for Professional Development that now has 452 companies as members and uses a mix of virtually all available technologies in delivering credit courses, industry seminars, and professional continuing education programs (DiPaolo 2002).
b) Stanford's most valuable and generous resource was and is its land. Considerable tracts of university land were allotted for the creation of the Stanford Industrial Park in the 1950s, where companies such as Varian, Hewlett-Packard, General Electric and others benefited both from attractive leasing conditions and the proximity of Stanford's intellectual resources (Castilla et al., 230).
c) As Silicon Valley got off the ground, the opportunities in the region for Stanford students, graduates and professors to form their own companies while retaining their affiliation with the university multiplied. Examples include Hewlett-Packard, Sun Microsystems, Yahoo and many others; defining "Stanford start-ups" rather tightly as companies where "both the technology for the first product and a majority of the founding team came from Stanford", Gibbons (2000, 202) has calculated that about 60 percent of Silicon Valley revenue in both 1988 and 1996 was produced by Stanford start-ups (ibid., 204-205).
d) Another element in the linkage is the growing importance of the licensing and patenting of faculty inventions both for the financing of universities and for fostering the links between university and industry (cf. Grindley and Teece, 1997; Henderson et al., 1998); the *Chronicle of Higher Education* (2002) has estimated, using data from the last five years, that Stanford, leading all research universities in the U.S., generates licensing income of eight cents for every dollar of research spending, followed by the University of California (6 cents), the University of Wisconsin at Madison and the University of Washington (4 cents each), and MIT and the State University of New York (3 cents each).
e) One of the newer developments in this symbiotic relationship is the emergence of new hybrid types of institutional cooperation between universities and high-tech industry, exemplified by the Center for

Integrated Systems – "a partnership between Stanford University and member industrial firms to produce world class research and Ph.D. graduates in fields related to integrated systems", where the "member companies provide financial support, interaction with their engineers and scientists, and access to resources (such as software, hardware and fabrication, etc.). Through participation by their senior executives, they also advise and guide research directions and curriculum development. CIS programs are managed through the guidance of Stanford faculty, using their standards for academic achievement." (from the Center's website, www-cis.stanford.edu); membership is $150,000 a year, and the list of members reads like a Who is Who of Silicon Valley. Institutions like the CIS serve an increasingly important brokering function at the interface between corporate and academic interests (Castilla et al., 229-233) – what Hirsch (1972) has called "boundary-spanning units" designed to connect different institutional worlds; not surprisingly, their role has also become the subject of considerable criticism regarding the danger of undue influence on the university's freedom of research (cf. Noble 2001; Aronowitz 2000, 43-44; Press and Washburn 2000).

f) Silicon Valley has seen a particularly high degree of mobility of scientists between academic and corporate roles, holding these roles often at the same time and with the tacit or open consent of the university on the grounds that these linkages provide excellent avenues for both effective technology transfer into the industry and for alerting the university to new demands and opportunities in technological development.

So much for some of the more important linkages in this network. Even though some of them might work, and have worked, over larger distances, they have proven to be particular effective in the Silicon Valley context by virtue of the physical proximity of the participants. What Castells (1996) has called a "new spatial logic" has demonstrated its particular strength in the proximity of the networks that have emerged in Silicon Valley, and has provided new answers to the question of "why clusters cluster" (Brown and Duguid 2000, 17). In reviewing what they call the "mysteries of the region", John Seely Brown and Paul Duguid of the Palo Alto Research Center of Xerox emphasize "the character of the local and the importance of direct human interaction", especially where, as in information and communications technology, knowledge is a critical factor (2000, 19): "… learning, innovating, sharing practices, and circulating inchoate knowledge all require reciprocity – close interaction and mutual exchanges among the people involved" – and they see "the workings of the universities within the region" as a prime example of this kind of reciprocity (ibid., 35).

Just recently, *The Economist,* in its August 24, 2002, issue, joined this argument by claiming that "physical presence counts even more than it used to" – all the possibilities of modern remote communication notwithstanding, and cites Silicon

Valley as one of its prime examples as it concludes: “One of the mysteries of the wired (and wireless) world is that proximity still counts.” (2002, 50)

2. The entrepreneurial culture of Silicon Valley

There is something about the corporate culture of Silicon Valley that sets it apart not only from the corporate world outside of the United States, but from other industrial regions in the U.S. as well. Annalee Saxenian of Berkeley makes a rather compelling case for this essential difference in values and behavior in her comparison between Silicon Valley and Route 128, the major technological development circling the greater Boston area in Massachusetts (1996). She points out the “complex balance of cooperation and competition” (149) which has made possible a much greater openness across corporate boundaries and has meshed well with a prevailing corporate model of relatively open, decentralized, and specialized structures; “some secrets are more valuable when shared” (Lee et al. 2000, 10) is a typical attitude in Silicon Valley. It is this interaction between cultural and structural openness which Saxenian and others see as the principal reason for the distinct advantage of Silicon Valley over Route 128 in recovering from the crisis of the 1980s. This can be documented particularly well in a comparison of corporate cultures and structures between Sun Microsystems and Hewlett-Packard on the Silicon Valley side and Apollo and Digital Equipment Corporation (DEC) in Massachusetts (Saxenian, 1996, 126ff.).

Beyond this broad contrast of corporate cultures, there are a number of more specific characteristics of the Silicon Valley setting that play in my judgment an important role in explaining its unique development. The following strike me as particularly salient (see also Weiler 1998):

a) Entrepreneurial failure is not seen as a sign of defeat, but as a valuable learning experience (Gibbons 2000, 211): “Silicon Valley is quick to forget mistakes” (The Economist 1997, 8) and “it’s hard to learn when you succeed” (Business Week, 1997, 146). This “tolerance of productive failure” (Gibbons, ibid.) is perhaps one of the key cultural traits of Silicon Valley, and the one hardest to replicate in systems where bankruptcy is still seen as a major and fatal individual and corporate catastrophe.
b) Risks are sought and accepted to a rather unusual degree, which among other things explains and makes possible the particular culture of venture capitalists. This culture, as one analyst has it, proceeds on the calculus that, out of 20 companies, four will go bankrupt, six will stay in business but lose money, six will produce a modest return on the investment, three will do pretty well and one will “scoop the jackpot” (The Economist 1997, 11).
c) There is a major cultural commitment to change, as reflected in the maxim: “Either we obsolete ourselves, or the competition will” (The Economist 1997, 11). The result, both for individual companies and for the

region as a whole, is a spirit of constant experimentation and a sense that "Silicon Valley continues to reinvent itself" (Saxenian 1996, 161) – much more so than its competitors in other regions of the U.S. – and one of the reasons why Silicon Valley has always managed to bounce back from its various defeats.

d) While the reinvestment of profits to assure further growth is standard business practice everywhere, it has become a particularly focused practice in Silicon Valley. This is not only reflected in the substantial contribution of high-tech companies to the venture capital pool of the region, but also in the considerable investments by Silicon Valley companies in the training and research capacity of their partner institutions in higher education. Stanford University has been a particularly fortunate beneficiary of this strategy: the hundreds of millions in gifts made to Stanford by the Hewlett and Packard families alone, in inflation-adjusted dollars, are said to rival the founding bequest made by Leland and Jane Stanford at the university's inception in the 1890s (Kaplan 1999, 37). But all higher education institutions of the region, including the junior colleges, have benefited substantially from this corporate strategy of reinvesting into the Valley's infrastructure.

e) One honors achievement, and nothing else. As Steve Jobs, one of the founding fathers of Apple, once put it succinctly: "What matters is how smart you are." This has had – among other things – the interesting result of opening up the Silicon Valley labor market to immigrants in major ways. One third of the engineering workforce in Silicon Valley comes from mainland China and India, and immigrants play an increasingly important role at the entrepreneurial level as well – beyond such well-known foreign-born members of the founding generations as Andy Grove of Intel who came from Hungary, Eric Benhamou from Algeria at 3Com, Philip Kahn from France at Borland, und Dado Banatao from the Philippines (S3, Chips and Technologies). For the period 1995-1998, 29 percent of the high-tech startups in Silicon Valley – a total of some 1200 companies – were run by Indian or Chinese immigrants and accounted for almost $17 billion in sales and almost 60,000 jobs (Saxenian 2000, 253). To this corresponds the pattern of admission and graduation in the leading engineering schools of the region and beyond; In the U.S. as a whole, the number of doctorates in science and engineering granted annually to immigrants from China and India has more than tripled and doubled, respectively, between 1990 and 1996, accounting – together with Taiwanese – for 62 percent of all foreign doctorates in science and engineering. At California's universities, the number of Asian doctorates in science and engineering is again twice what it is in the U.S. at large (Saxenian, ibid., 250). These figures indicate the extraordinary extent to which the success of Silicon Valley depends on foreign talent; they also explain the development of a flourishing network of technical and commercial relationships between Silicon Valley companies and the home regions of these immigrants.

3. Affinity matters: Higher education and the culture of change

I have already referred to the importance that authors like John Seely Brown attach to the principle of reciprocity where the creation and utilization of knowledge is concerned, and to the many ways in which the relationship between higher education and ICT in Silicon Valley manifests this principle particularly well. This is because of the "close interaction and mutual exchanges of the people involved" that physical proximity makes possible – what *The Economist* called "F2F" – face-to-face (2002, 50). Proximity, however, is not the whole story.

The other reason why the relationship between higher education and the development of the ICT industry in Silicon Valley has developed into such a truly symbiotic partnership is the cultural affinity between these partners – the degree to which the universities involved resonate to the particular cultural traits of their corporate partner institutions, and vice versa. There is not, as there is in many other parts of the world, a "cultural divide" between the world of high-tech business and the world of higher education.

In reviewing this particular and rather striking kind of compatibility and correspondence, I am very much aware of two *caveats*: First, that this kind of affinity may be not only an asset, but a liability as well. Here as in other respects, it is important to listen carefully to the critical voices that I have already cited (cf. also Kirp and VanAntwerpen 2002). Secondly, even this rather remarkable degree of compatibility has its limitations; as an economist who freely admits to "love the market", William Bowen considers it necessary, in his remarkable Romanes Lecture at Oxford two years ago, to emphasize "that universities are not businesses (though they have many business-like aspects)" (2000, 3).

With these reservations in mind, I am going to review some of the elements of this correspondence that make for such ready and remarkable reciprocity between the academic world of Northern California and the high-tech industry of Silicon Valley.

a) One of the very basic elements of affinity between institutions of higher education in the United States and the corporate world is that both subscribe to an entrepreneurial paradigm of operation. That is not unusual for companies, but it's relatively rare for universities outside of the U.S. – even though Burton Clark, when he went out to find some that had emulated the American "entrepreneurial university" model claimed that he found a few (Clark 1998). Clearly, the cultural match even in the U.S. is limited: universities do march to a different tune when compared to commercial enterprises, but their willingness to explore new ventures, to take a certain amount of risk, and to remain flexible in placing resources

behind new goals make them generally more open to the kind of cooperation that has emerged between, for example, Stanford and the companies of the Stanford Industrial Park.

b) American universities, especially the better ones, appear to have a particularly robust sense of their own independence and self-determination. I remember a conversation between Mr. Biedenkopf, then the Prime Minister of Saxony, and the president of Stanford University, John Hennessy, in which Biedenkopf was wondering whether Stanford was not afraid of undue outside influence considering the large amount of outside money it received, much of it from corporate sources. Hennessy's answer was that, on the one hand, Stanford would never think of accepting any money that had any strings attached, and that, on the other hand, donors dealing with Stanford would know better than to expect buying influence over Stanford's research and teaching agenda. Now that is clearly a bit too good to be true, and American higher education is not quite that immune to seduction (cf. Noble 2001; Aronowitz 2000), but by and large the cooperation between academia and Silicon Valley companies has benefited from a mutual respect for the independence of the partner, and from a rather relaxed and self-assured attitude on the part of universities vis-à-vis the corporate world. Traditionally, European universities have been a great deal more nervous about these contacts.

c) From the point of view of the university-industry relationship and its success, one of the key ingredients in the institutional make-up of American universities is the rather unique construct of the "professional school". Different from academic departments like Psychology or Economics or Political Science, professional Schools of Engineering, Schools of Business, Schools of Law, or Schools of Education form bridges between the world of academic research and the world of professional practice, committed and held to the rigorous academic standards of the institution, but at the same time deliberately open to the knowledge needs of the worlds of technology, of business, of legal affairs, or of education. They tend to be interdisciplinary and structured around areas of professional concentration, and serve as a particularly congenial vehicle for the kind of interaction that has emerged between places like Stanford and Silicon Valley. It is not surprising that the key institutional players in this relationship were, on the side of the universities, Schools of Engineering and Business, drawing their strength and expertise from a wide range of disciplines throughout the university.

d) Another characteristic of American higher education that has served particularly well in the kind of relationship we are considering here is its differentiated nature, i.e., the fact that it covers a broad spectrum of very different kinds of institutions of higher education along a gradient of higher or lower selectivity – from highly selective private and public institutions like Stanford and Berkeley to the community-based junior colleges such as, in the case of the Silicon Valley neighborhood, Foothill College or de Anza College. This kind of differentiation allows the system to optimize the

accommodation of students with a wide variety of interests, aspirations and talents; it also provides a calibrated range of cooperative possibilities for the relationship between higher education and the high-tech industry – from cooperation in cutting-edge technology research in institutions like Stanford's Center for Integrated Systems (CIS) to the very successful training programs for engineering and technical staff in which companies like IBM and SUN cooperate with the local junior colleges. The kind of focus that this division of labor allows each type of institution would be very difficult to achieve in the kind of all-purpose university that is more common in Europe.

e) Just as in the corporate world of Silicon Valley, it is true of higher education in the United States that personal leadership matters. It matters in different ways, given the different nature of the institutions, but just as it is hard to write the history of Silicon Valley without paying tribute to the likes of David Packard, William Hewlett, Robert Noyce (Fairchild - Intel), Gordon Moore (Fairchild - Intel), Steve Jobs (Apple) and the many others who shaped that unique corporate culture, it is difficult to overestimate the role that outstanding academic leaders like Frederick Terman, William Miller and James Gibbons at Stanford or David Kerr and Richard Atkinson at the University of California have played in making their institutions the kind of high-quality centers of scientific excellence that would both inspire, and benefit from, the kind of technological breakthroughs that mark the history of Silicon Valley. Not the least important part of that academic leadership, incidentally, was the attention it paid to the balanced intellectual growth of their universities; while it would have been easy to give in fully to the lure and luxuries of technology, both Stanford and Berkeley stand out nationally and internationally for having maintained a sound and solid base in the humanities and the social sciences as well as in the natural sciences and engineering.

f) It is this broad-based intellectual competence at universities like Stanford and Berkeley that is also capable of nurturing the kind of critical discourse on the relationship between education and information and communication technology that has become the more important the more dominant a social force that relationship has become. That critical discourse stems from different intellectual traditions and has by now engaged a number of scholars and thinkers within and outside the United States (cf. Aronowitz 2000, Noble 2001, Press and Washburn 2000), but it is no accident that some of the most serious critical reflections on the relationship between technology and education come out of the very universities that figure so prominently in the growth of Silicon Valley: From Larry Cuban's hard-nosed assessment ("Oversold and Underused", 2001) of the role of computers in the classroom to Hubert Dreyfus' philosophical treatment of "the limitations of life in cyberspace" (2001). And Nicholas Burbules, who with Thomas Callister has become one of the most penetrating analyst of "the promise and the challenge of new technologies" for higher education (2000a, 2000b), has a PhD from Stanford.

g) I have already discussed what an important role the talents of immigrants have played in the Silicon Valley story. Here again, the openness of the industry has been matched and reinforced by the degree to which graduate programs in science and engineering have been opened up to foreign graduate students, with California institutions being much more open than the national average, especially where students from Asia are concerned. This policy has produced a steady and increasing stream of well-trained scientists and engineers for the companies of Silicon Valley, which in turn has produced its own generation of high-tech immigrant entrepreneurs, many of them with excellent and mutually beneficial relationships with their home countries. Some serious doubts are now being cast upon this policy in the light of some of the United States government's post-9/11 measures; Silicon Valley would be particularly affected by any curtailments and restrictions in the access of foreign technological talent to American graduate training.
h) Lastly, one of the linkages between universities and high-tech industry that is not to be underestimated is the trend in American higher education towards the steadily increased use of ICT in its own academic operations. This trend is well documented for the country as a whole (cf. Harley et al., 2002), but it is – not surprisingly – particularly pronounced in Northern California. Stanford is, once again, a case in point, with its Center for Professional Development (DiPaolo 2002), its partnership in the UNext and the "Alliance for Lifelong Learning (AllLearn)" online and distance education ventures, and the major initiative, with the help of the Wallenberg Foundation, of the Stanford Center for Innovations in Learning (SCIL) for systematically exploring and advancing the educational use of technology (http://scil.stanford.edu).

4. The limits of replication: Higher education and IT entrepreneurship in Europe

The general wisdom in the literature regarding the chances of replicating elsewhere the peculiar symbiosis between higher education and high-tech industry of Silicon Valley is decidedly skeptical. Brown and Duguid have developed an "ecological model" of what has happened in Silicon Valley – an ecology that "is built … through shared practice, face-to-face contacts, reciprocity, and swift trust, all generated within networks of practice and communities of practice" (2000, 37). This ecology, they argue, is very hard to replicate, even at enormous cost (for such things as the Valley's leading universities and other infrastructure, for example) because "knowledge ecosystems develop over time, building connections between participants until they reach a critical mass and take on a collective dynamic all their own." (ibid., 38)

There is much to be said for concurring in this cautious view of replication. To make both proximity and affinity work has taken many years even where, as in Silicon Valley, both were present to a remarkable degree.

By and large, the situation in other parts of the world is characterized by limited proximity, even more limited affinity between higher education and high-tech development, and a great deal less of the kind of "shared experience" that Brown and Duguid consider such an important prerequisite for the functioning of the "ecological model".

Let me elaborate a little with reference to the country that, outside of the United States, I know best: Germany. I suspect, however, that the situation is not dramatically different in the Netherlands or elsewhere in Europe.

There is no question but that the ICT industry in Germany and in other European countries has developed significantly in recent years, and certain zones of concentration have emerged, notably around Munich, Dresden, and Berlin. There has also been a significant development in the creation of "science and technology parks" all over Europe – many, though by no means all, of them linked to one or more institutions of higher education – such as the one in Aachen, the Barcelona Science Park, Sophia-Antipolis in Southern France, the Centuria Science and Technology Park near Bologna, Silicon Fen in Cambridge with links to Trinity College and the ambitious project in Adlershof in Berlin that is closely connected to the Humboldt University (Galbraith 2002).

Furthermore, and as the chapters in this book amply document, major efforts have been undertaken to open up European universities to the possibilities of ICT both as a field of research and development and as an instrument for more effective teaching and continuing education (cf. also Commission of the European Communities 2001); the OECD classifies this latter development as "high" in the UK and Scandinavia, as "medium" in Germany and France, and as "low" in Southern Europe (Larsen 2002, 77). The German Federal Ministry of Education and Research has been particularly active in supporting IT developments in higher education such as the "notebook universities", and the joint federal-state commission for educational planning (*Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung, BLK*) has played an important role in coordinating federal and state initiatives in this realm (BLK 2002; cf. Kleimann and Berben 2002). Institutional and inter-institutional efforts range from the established traditions of European distance education at institutions like the *FernUniversität Hagen* and the "Open University of the Netherlands" (Curran 2002) to more recent ventures such as the "Virtueller Campus II", a joint effort by the universities of Hanover, Hildesheim and Osnabrück to more effectively integrate multimedia forms of teaching (CHE 2002, 11).

However, all of this considerable advancement in the linkages between higher education and ICT notwithstanding, I am arguing that the kind of symbiotic

relationship that has been at the very core of the Silicon Valley experience remains an elusive goal in settings such as Germany – at least until and unless some major changes take place.

To back up my thesis, I go back to the analysis of what has made Silicon Valley – even by American standards – such a unique habitat for a symbiosis of higher education and technological development and innovation.

On the face of it, proximity would seem to be the one ingredient in the Silicon Valley formula that it would be easiest to emulate in Europe, particularly in a setting that, compared to the wide open spaces of the American West, is pretty condensed to begin with. However, proximity, as we have seen in Silicon Valley, is not just geographical closeness; if it were only that, regions such as the greater Munich area or Dresden would be good candidates, just as Route 128 in Massachusetts should have worked much better than it did. But to physical presence needs to be added the willingness and the ability to make use of its opportunities, the capacity to engage in "F2F", in face-to-face interaction on a sustained basis, to generate what Brown and Duguid, using Alfred Marshall's famous expression, have called "the mysteries in the air" of Silicon Valley, the shared community of discourse, knowledge, practice, and trust (2000, 20ff.). It is this shared community that is much harder to come by in a setting such as Germany where the two cultures of academia and entrepreneurship still have very little in common.

By way of elaborating on this basic proposition, let me point out a number of more specific difficulties that would lead me to counsel caution against any easy hopes to replicate the Silicon Valley experience elsewhere, but that one would also have to bear in mind in any attempt to move in the direction of closer interaction between these two cultures.

a) Cultures of entrepreneurship have, as we have seen, their own traditions and value systems. This is why they are not easily transplanted and copied. At the same time, certain traits in corporate cultures are obviously more conducive than others to innovation and change and, especially in knowledge-based industries, to interaction with higher education. It is here that, for the corporate culture of Germany, one would have to note distinct deficits in the acceptance of experimentation and risk, in the tolerance of failure, in the value that is attached to achievement and, quite notably, in the willingness to bring in talent from all over the world.
b) Similarly, any honest assessment of the academic culture in European universities would reveal a number of traits that are not – to put it mildly – easily compatible with an entrepreneurial culture of innovation and change. Those traits would include relatively rigid and inflexible organizational and decision-making structures, a relatively weak tradition of cooperative research, especially of an interdisciplinary nature, a relatively underdeveloped relationship to professional practice (of the kind

that has found a legitimate institutional form in the American professional school), and a traditional image of the professoriate as a self-sufficient entity with which the notion of academic entrepreneurship is not easily compatible. There has also been, with some notable exceptions, a reluctance in European universities, reinforced by rather restrictive admissions regulations, to open their doors too wide for talented graduate students from other parts of the world. Much of this, I should hasten to add, has begun to move and change over the last ten years, and there are exceptions to the summary statements expressed here, especially in institutions like the German *Fachhochschulen* ("Universities of Applied Science") which have taken a much less inhibited interest in open cooperative relationships with industry and business. On the whole, however, the overall tendency in that part of European higher education that I know something about is still one of considerable reluctance to get involved in a steady and institutional interaction with the corporate world.

c) This reluctance becomes quite apparent in the actual state of the relationship between academia and the corporate sector in countries like Germany. There is very little of the "trust" that Brown and Duguid consider so essential for a functioning "knowledge ecology"; instead, there still is, on both sides, a strong residual element of suspicion of the other's motivations and values. This is accompanied, and no doubt reinforced, by a good deal of ignorance about one another – an ignorance that is only gradually giving way to better mutual understanding through such devices as corporate membership on university boards, joint programs of continuing education, cooperative research projects and the like. Ever so gingerly, steps are being taken in recent German legislation on faculty remuneration to facilitate the migration into and out of academia of scholars who see their natural home in both the university and the corporate world. This is still a long way from the ease with which Stanford professors move between the Stanford School of Engineering and their Silicon Valley start-up companies down the road, and there may be some virtue in not making this process too easy. Without a further erosion of the boundaries between higher education and the corporate world, however, neither will the innovative benefits of closer cooperation be reaped nor the important possibilities for critically assessing the work of the corporate sector be realized.

Conclusion

The key argument of the earlier parts of this chapter was that it takes the combination of regional proximity and cultural affinity between higher education and the ICT industry to explain the Silicon Valley experience. This argument holds in reverse as well when it comes to understanding why it might be difficult in other parts of the world (or, for that matter, the United States) to replicate this experience simply by putting universities and high-tech companies together in

the same area. “Aspiring regions can clearly learn from established ones”, concede Brown and Duguid, but the kind of “knowledge ecosystem” that they have identified in Silicon Valley does seem to defy mechanical imitation (2000, 38).

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