

Economic Development and Analysis

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High Tech Cluster Economies: Bangalore, India and Silicon Valley, USA

Part 3: Regional Analysis and Recommendations

Submitted by

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Silicon Valley Economic Development Overview

The history of Silicon Valley is an excellent case study in economic development. The beginning of the area's growth came about due to Stanford University. The school, founded in 1891 in Palo Alto, struggled to compete with the historic educational institutions of the East Coast. An engineering professor, Frederick Terman, began actively working to establish the university's reputation as a nationally regarded institution. He aggressively recruited students and professors from the East Coast, funded student ventures, and persuaded students to remain in the area after graduation. After successfully supporting the inception of several of his students enterprises, most notably Hewlett Packard and Varian Associates, he continued to encourage them to locate in the new Stanford Industrial Park, an office and research park on Stanford's campus which was built to create revenue for the university. Using these innovative technology companies as a catalyst, the area attracted a great deal of government funding, either directly to government institutions located in the area or to private firms or schools contracted to do Defense work.

With the growth of the superconductor and products based on it, Silicon Valley began to grow very quickly. After the advent of the mainframe and later the personal computer, small and innovative firms began to grow into national powerhouses. The area generated a great deal of interest for its technological specialization, quick growth, and innovative corporate culture. The area was filled with individuals and firms with a strong culture of cooperation and innovation. Manufacturing of hardware, development of software, and the application of high-tech knowledge in a consulting venue soon followed and the area saw an unprecedented boom in venture capital and media attention during the internet boom of the 90s.

Silicon Valley has benefited from the convergence of several types of economic development strategies. First, the location of Stanford University, a private university, and its high-tech focus provided, and still provides, talented and well-trained employees and innovators. Second, funding from federal sources through the location of defense labs and manufacturing facilities, as well as investment in defense suppliers aided in the development of new technologies that created the foundation of every wave of Silicon Valley innovation. These two factors were instrumental in creating the current cluster that dominates Silicon Valley's economy and is the envy of most municipalities across the world.

Strengths

According to The Silicon Valley Edge: A Habitat for Innovation and Entrepreneurship, the strengths in Silicon Valley are not in its technical advancements, but in the highly specialized and progressive culture which facilitates the application of new technologies into very successful commercial ventures. This entrepreneurial culture is created and supported by several elements:

Supportive Government Regulations for New Firm Formation

The governments of Silicon Valley pride themselves on their pro-business stance. Their development of the SmartTrack program streamlined the construction permitting process in several jurisdictions utilizing internet technologies. Programs like these, which make entrepreneurship faster and easier, facilitate the formation of new businesses that can quickly respond to new opportunities.

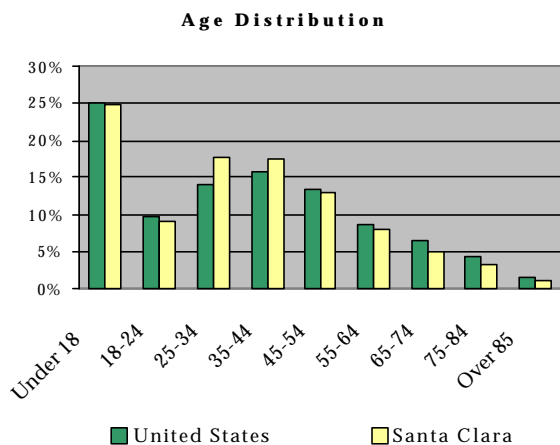
Leading Research Universities That Interact with Industry:

As demonstrated previously, a great deal of Silicon Valley's success can be traced back to the founding of Stanford University. There are currently several colleges and universities, which add to the talented labor pool.

- Hayward State
- San Jose State
- UC Berkeley
- UC Davis
- UC San Francisco
- UC Santa Cruz
- University of Santa Clara
- Stanford University
- San Francisco State
- California Maritime Academy
- Northwestern Polytechnic University

An Exceptionally Talented and Highly Mobile Work Force

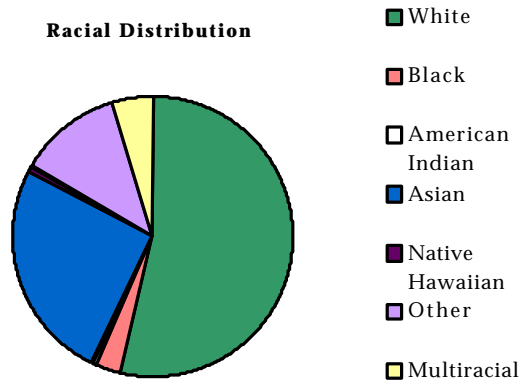
Silicon Valley's workforce is younger, more highly educated, and more diverse than the rest of the nation. While not as extreme as one might expect, the age distribution for the area is slightly skewed relative to the overall age distribution in the United States. In Silicon Valley 36% of the population is between the age of 25 and 44 whereas 30% of the national population is in this age group.



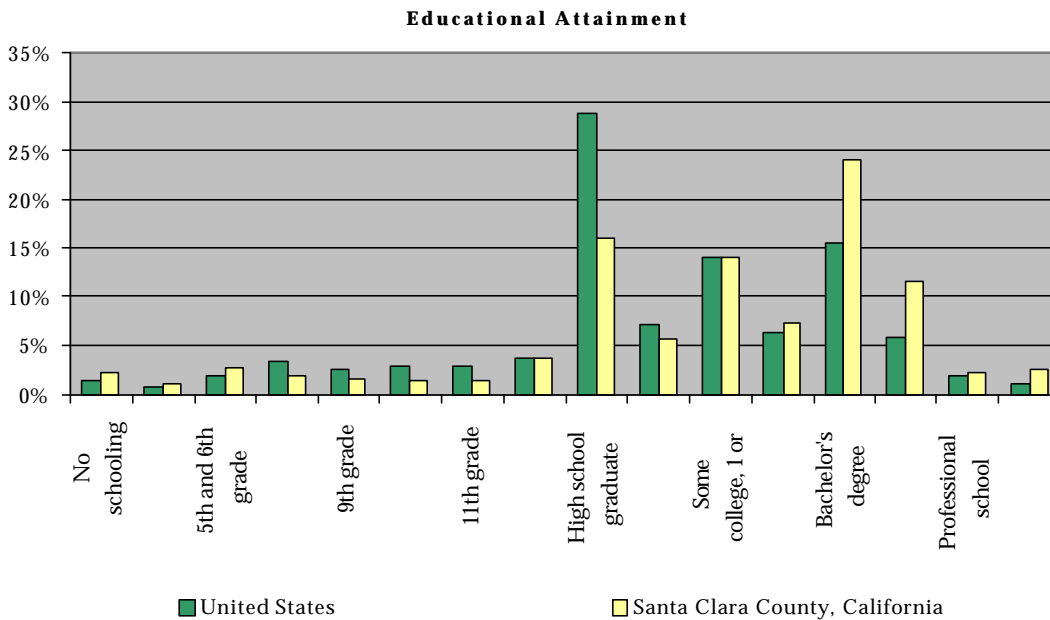
Age distribution is fairly constant for both men and women, however the ratio of males to females (51 to 49) is slightly higher than the national ratio of 49 to 51. While this data is slightly skewed toward younger males, it does not support the overall perceptions that one might have of Silicon Valley. The area is also extraordinarily diverse. Compared to the overall US, which was 75% White in 2000, Silicon Valley white's comprised only 54%, with the majority of the remainder being Asian (26%) or "Other" (12%).

Another example of the diversity of the area is language spoken. In the United States, 81% of households are English speaking, however in Silicon Valley, only 53% of households are English speaking, with the majority of the remainder speaking Spanish or an Asian language.

Educational Attainment is another characteristic in which Silicon Valley is quite different from the national population. While only 24% of the US population has obtained a bachelors or post-graduate degree, 40% of the individuals of Silicon Valley have achieved this level of education. This educated workforce is an important draw for employers in the area.



Silicon Valley is an international destination for talented individuals. In *Silicon Valley's*



New Immigrant Entrepreneurs, a study by AnnaLee Saxenian at the Public Policy Institute of California found that in 1998, Chinese and Indian immigrants were running a twenty-five percent of the high-tech businesses in Silicon Valley

Experienced Support Services

These services, in such areas as finance, law, accounting, headhunting, and marketing specialize in helping new companies form and grow. These industries have business knowledge and skills available for entrepreneurs so that they may grow quickly without the typical growing pains associated with new business formations. An important part of this is access to Venture Capital. While this has slowed dramatically due to the economic recession, there is still a great deal of infrastructure available when the next

wave of innovation and growth arrives. In addition, there is a great deal of international funding available. Interestingly, in June of 2002, the Indian Venture Capital Association founded a Silicon Valley chapter, once again demonstrating that the ties between India and Silicon Valley are growing stronger and more complex.

A Spirit of Adventure and a Willingness to Take Risks.

Perhaps the most difficult part of the Silicon Valley mystique is the unquantifiable cultural attributes that make it so successful at the commercialization of new technologies. The area has a culture of entrepreneurial spirit and innovation. As seen in the latest wave of growth in Silicon Valley, the area saw a self-confidence (or arrogance) which empowered the young and courageous to take tremendous risks, many of which paid off handsomely. It is difficult to know if the current downturn will hamper this entrepreneurial gambling in future waves.

A Diverse Technological Economy

Silicon Valley also has an extraordinarily diverse technology economy. The past wave of growth was fueled by the convergence of technology sectors such as software, hardware, and Internet products. The industry and firm mix of the area was well-equipped to provide products and services which best utilized all three of these sectors. It is predicted that the next wave will be the convergence of Biotechnology, Information Technology and Nanotechnology (See below).

Regional Focus

An additional strength of Silicon Valley is the regional focus of the area. Because Silicon Valley lacks a definitive geographical border, the governments and institutions have adopted a more regional focus and cooperative attitude. They recognize that their success or failure is dependent on the entire region's progress. Some of the regional bodies fostering growth and cooperation are:

- Santa Clara Valley Transportation Authority
- Silicon Valley Joint Venture
- Association of Bay Area Governments

Network Clusters

Michael Porter's definition of a cluster is:

...geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also co-operate.

(The Competitive Advantage of Nations)

Certainly, Silicon Valley has all of these things. As the archetype of cluster networks, the area is seen as a cluster success story to economic developers everywhere. The above characteristics all come together to create an industry which has both competition and cooperation.

According to Markun,

The people who began or were employed in these new firms considered themselves as technological trailblazers and the formal and informal "communities"... The residents of this technological society were, originally at least, a strongly homogenous group: white, male, Stanford or MIT educated engineers who migrated to California from other regions of the country...Along with sharing the same type of risks, the entrepreneurs also shared a camaraderie unsurpassed almost anywhere else in American industry. Even engineers and scientists who work at competing firms during the work day remained close friends off the job. According to an account by Tom Wolfe (1983), the manager of one semiconductor firm would not hesitate to call a competitor for assistance on technical matters. After work, the engineers and programs would meet at popular drinking establishments in the Valley to share high-tech "war stories." These after-hours discussions enabled the individuals to share industry gossip as well as facilitate employment searches in the region (Saxenian 1994).

Weaknesses

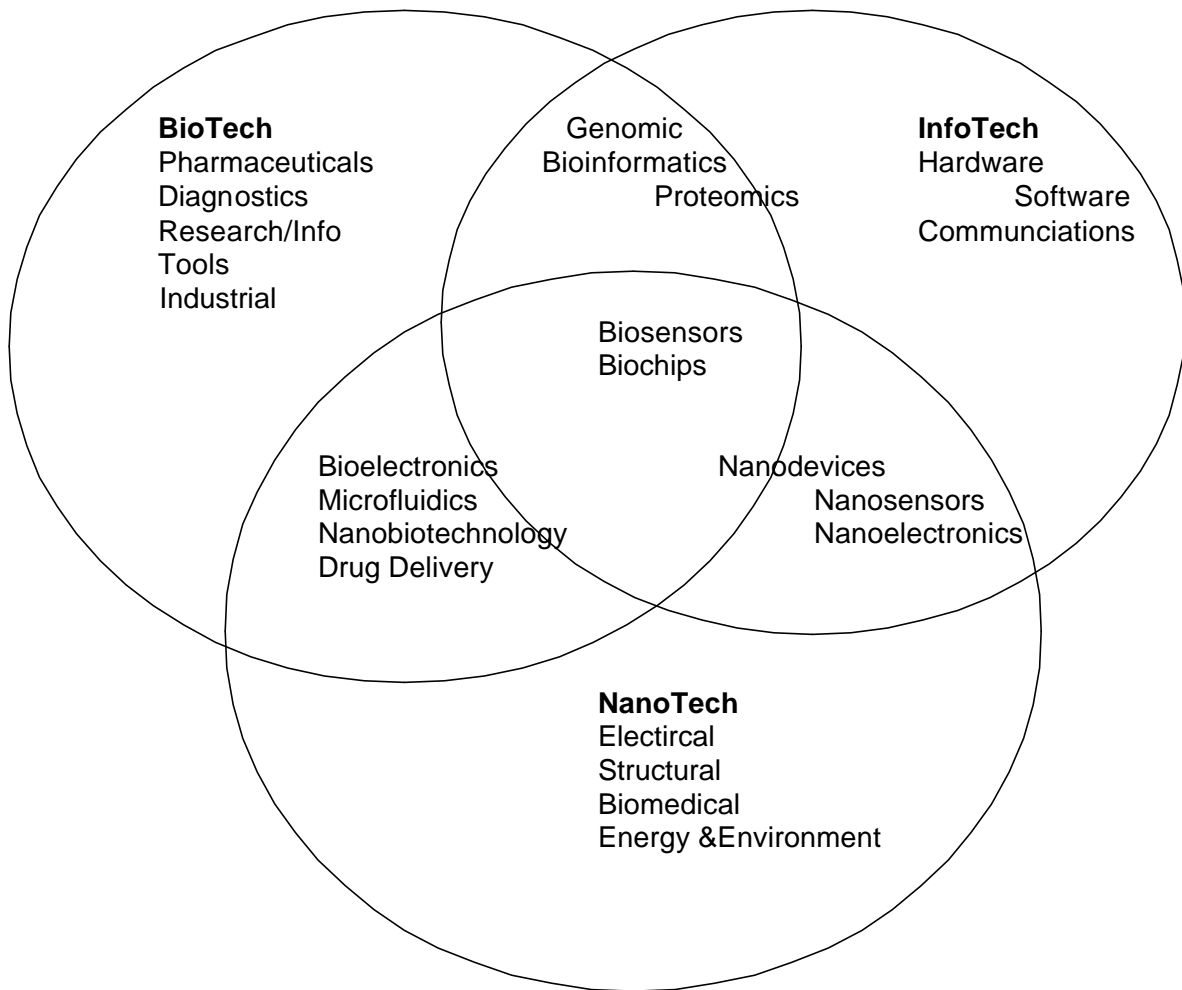
As demonstrated by the bursting of the "dot com bubble" and its resulting fall out in Silicon Valley, even the quintessential cluster economy is not immune from economic difficulties. There are several weaknesses in the Silicon Valley economic strategy. First, Silicon Valley is very dependent on the US economy. Because it's high-tech products are first bought in the highly developed US market, a downturn can be quite dangerous to the area. Second, the area continues to suffer from the dot-com bubble. Psychologically, the area has had a difficult time regaining its self-confidence and the confidence of others in its business methodology, leaders, and culture. Third, the area is extremely vulnerable due to its concentration in one area: high tech innovation. A more diverse economy would not be as easily disrupted. Finally, the area has seen remarkable growth over the past fifty years and is still straining from the growth. Housing prices have skyrocketed, the infrastructure has not kept up with growth, and the quality of life-previously a major draw-has declined slightly.

Opportunities

However, there is great opportunity in the area. As Stan Williams of Hewlett-Packard explained at The Next 20 Years Technology Conference:

We are actually watching the birth of three great new technologies, all simultaneously. 'Bio' is the utilization of chemistry in life to not only understand living organisms but to manufacture all types of things that we have in our environment. 'Info' is the harvesting, storage, and transmission of information about our environment in all sorts of ways. And 'nano' is the control of matter at the scale where basic material

properties are determined. All three of these areas are completing the transition from applied science into technology right now. And during the next 20 years, all three of these are going to see exponential types of increases—many experts estimate these increases to be to a factor of 10,000—in the improvement of the capabilities of each.



Source: Collaborative Economics, Inc.

Silicon Valley is poised to lead the next wave of innovation with the convergence of Internet Technologies, Biotechnologies and Nanotechnologies. Because of its information technology focus, many people do not know that Silicon Valley is also extremely strong in biotechnology. This is an extraordinarily important emerging sector.

The market for biotechnology products was \$16B in 1996 and is estimated to grow to \$32B by 2006.¹

In addition, Silicon Valley has many strengths in Nanotechnology. *Small Times* magazine has identified the region as having the highest concentration of research and industry capabilities in the nanotechnology field. This includes not only research strength at UC-Berkeley, Stanford, NASA Ames and Livermore Berkeley National Laboratory, but also at least 50 nanotechnology companies. *Small Times* also noted that “Silicon Valley has had four decades to develop a technology-focused infrastructure, academic agenda, talent pool, and culture of innovation.”

There are also several R&D centers, which have an interdisciplinary approach to capitalize on the above-mentioned opportunities:

- *Stanford Bio-X Center* connects the schools of Medicine, Sciences and Engineering around the use of computational tools in molecular, cellular, tissue and organ research. The catalyst for this work is the new Clark Center, a building designed by Norman Foster that will serve as the hub for 275 interdisciplinary researchers.
- *QB3 Institute for Quantitative Biomedical Research*, one of the California Institutes for Science and Innovation funded by Governor Gray Davis, will draw on the strengths of three UC campuses (San Francisco, Berkeley and Santa Cruz) in biology, computer science, physics, chemistry and engineering. The goal is to integrate our understanding of biological systems at all levels of complexity, from atoms and DNA to cells, tissues, organs and entire organisms. This will require advances in bioinformatics and bionanotechnology, and could lead to advances such as personalized medicines.
- *Center for Information Technology Research in the Interest of Society (CITRIS)*, the other California Institute in northern California, is a partnership between UC-Berkeley, Santa Cruz and Davis. Leading Silicon Valley companies (e.g. HP, Sun, Intel, Agilent) and private donors have pledged over \$170 million to match the state’s \$100 million investment. The goal of CITRIS is to develop “societal-scale information systems” that can enhance our quality of life by boosting energy efficiency, reducing traffic congestion and improving our ability to respond to natural and man-made disasters.
- *The Lawrence Berkeley National Laboratory (LBNL) and UC-Berkeley* both have created new nanotechnology initiatives. LBNL has received approval from the Department of Energy for the \$85 million “Molecular Foundry,” a national user facility that will provide researchers and Bay Area companies with the cutting-edge tools they need to explore the frontiers of nanotechnology. In addition, UC-Berkeley is launching a major initiative in nanoscience and nanoengineering to develop a new multidisciplinary curriculum, recruit additional faculty and create shared facilities for nanoscale imaging and fabrication.
- *NASA Ames Research Center* is planning to expand significantly on its foundation of nanotechnology research activities, including carbon nanotubes (important to nanoelectronic devices, computers and sensors), computational nanotechnology (key to modeling and simulation) and biosensors (including collaboration with the National Cancer Institute to develop a nanoelectronic-based biopsy sampler).

¹ “Preparing for the Next Silicon Valley”, p8.

Threats

There are several important threats that Silicon Valley should consider while formulating their economic development strategies. First, there are limitations of the high-speed broadband infrastructure, which has fueled much of the Internet boom. This infrastructure is highly dependent on federal investment and is therefore out of the control of Silicon Valley stakeholders. In addition, the new platform, wireless technologies comes with its own set of problems. Wireless security is a particularly large obstacle to the adoption of this technology. As of yet, there is not a common platform or encryption which could facilitate the development of better products and services in this area.

In addition, there are several emerging centers that are successfully drawing companies away from Silicon Valley. For example, Washington DC, Boston, Austin, Texas, and many other cities have worked extremely hard to get a small piece of Silicon Valley's pie, and somewhat successfully. Also, the competition from international centers has become particularly fierce. Areas like Bangalore, which boast highly educated labor forces with much lower salaries pose significant threats to Silicon Valley, especially in older technologies farther along in their lifecycle.

Finally, there are a few issues, which the region must continue to consider. First, the quality of life in Silicon Valley has diminished due to extremely fast growth and skyrocketing costs of living. Traffic, pollution, and sprawl have become a part of the area, as in many other areas across the country. Second, serious questions are now being raised about the environmental issues surrounding many of Silicon Valley's products. The components of semiconductors, personal computers and monitors are extremely toxic and are being banned from landfills in the United States. The exploration of used equipment has been found to lead to environmental problems in poorer countries like China. It is possible that this issue could become a very polarizing one for people who use these products. Finally, the next generation of Silicon Valley innovators and entrepreneurs have yet to prove themselves. The strength of the area has always lied in its talented and innovative work force; therefore, the next wave will be a product of these individuals.

Bangalore Development: Strengths, Weaknesses, Challenges And Opportunities

Strengths

Presence of high-profile academic institutions

Bangalore is home to more than 100 research universities and technical colleges, some of them the best in the nation (complete list provided in Part 2). Institutions like Indian Institute of Management - Bangalore (IIM-B), Indian Institute of Science (IISc), Indian Institute of Information Technology - Bangalore (IIIT-B) and Institute of Bioinformatics and Applied Biotechnology – Bangalore (IBAB) are premier incubators of highly trained talent of the Indian subcontinent. These institutions create an atmosphere conducive to learning and development of knowledge, which is vital for fostering collaborative partnerships among the intellectual class. This aggregation of education and research institutions can be likened to clusters located in close proximity and seek to develop synergism between institutions to enhance development and innovation. The aggregation of like-minded intellectual class enhances close working relationships that

has brought scores of international companies including – IBM, Intel, Microsoft, Oracle, Sun Microsystems and American Express. These high profile companies have set up software development centers or contracted with local firms in order to take advantage of Bangalore's supply of high-trained, English speaking computer graduates. Thus these urban institutions have developed into centers of science and technology, incubators of self-grown companies, major source of employees as well as potential as employers, creators of housing and purchasers of goods and services. The fast-growing partnerships between business, government and academia to further enhance these influencing factors

Gap in per-capita income

Being a developing country and given the highly inflated convertible rate of the rupee, there exists a vast gap in the per-capita income between the West and India, salaries are high by Indian standards but are only a fraction of those commanded by programmers in the US or Europe. This difference is advantageous to the development of the Bangalore region as more and more jobs from the West are outsourced due to cheap labor. After the boom in the information network and advent of the Internet, the transaction costs have drastically reduced rendering conveyance times to the minimal. An employee in administration with required qualification draws a salary as high as Rs.92,000 (\$1916.67) per annum. On the other hand an employee in the professional group with technical qualifications draws Rs.115,140 (\$2398.75) per annum. These are the average figures and are comparable to similar figures from Silicon Valley. The salary levels found in the industry are low compared to international levels. According to a survey conducted by National Science and Technology Management Information Systems, a Division of Department of Science and Technology, Government of India in 1998, and conducted by STEM, an NGO, comprised four constituents of the IT industry, about 52% of the firms ranked the salary levels as low, 20% ranked them as substantially low, and the rest ranked them as comparable to international levels².

Government Support

Bangalore's growth, especially in the IT sector is reinforced primarily by the adequate support of the administration. The far-sightedness of the administration has paved the way for creation of an economic development agency, Software Technology Parks of India (STPI), to enhance the IT growth sector. The aggressive economic development marketing has bolstered the confidence of investors, both institutional and foreign. The government established Karnataka State Electronics Development Corporation (KEONICS) to advance the electronics industry in the state. This new corporation served to promote the region and "entered directly into production, setting up its own plants and operating joint sector projects with Indian and foreign industrial houses, promoting private enterprises through marketing support, and running manpower training centers" (Heitzman, 2001). The success of the STPI scheme led to a private initiative called the Information Technology Park, 'the first such development in India', which was a joint collaboration between the state government and private enterprise from India and Singapore. (Krishnaprasad 1996; ITP 1997; Junction: A Quarterly Review of the International Tech Park, Bangalore (February 1997, May 1997). The provision of high-

² Information Today & Tomorrow, Vol. 19, No. 4, December 2000, p.8-p.10

quality telecommunications network to high-density industrial parks coupled with added benefits in terms of entry tax exemption, power tariff concessions, clearances from the pollution control board and concessions on the company registration charges. Apart from attracting outside industries, Bangalore seeks to incubate startups and encourage entrepreneurial growth. “Karnataka State Industrial Investment & Development Corporation Ltd., and Karnataka State Financial Corporation formulates a special package for providing financial assistance to the Information Technology Industry” (KA IT Policy, 1998) This package has the following features: 1) Equity contribution in small and medium enterprise; 2) Reduced margin money from the promoters; 3) Reduced interest rate; 4) Seed Capital/Venture Capital assistance in deserving cases.

Weaknesses

Inadequate telecommunications setup

Being the fastest developing city at an annual rate of 4.4%, and afflicted with high poverty rate due to shifting population trends, Bangalore is prone to the common urban problems. Faced with urban sprawl, the telecommunications infrastructure still has not caught up with the growing needs. The technological parks such as STPI, Electronics City has concentrated network connections but infrastructure within the city is still at developing stages. This creates an impeding factor for small businesses and startups not located within the industrial parks. According to a recent report in Times of India, the major outsourcing contracts are going to the top tier software industries thus rendering second tier software industries prone to cutbacks.

Urban Sprawl

Bangalore's economy is moving rapidly toward industrialization and privatization predominately driven by globalization and the expansion into the free-market. This has created a wave of internal migration to urban centers, which is drastically outpacing local infrastructure capacities. As a direct result of the city's inability to meet the needs of this ever-growing immigrant population, the majority of which originates from the poorer rural areas of Karnataka, a host of unintended consequences are now being experienced in Bangalore. Such consequences include: overcrowding due to mass migration into industrial centers, increasing income and health status disparities between the classes, slum housing and inadequate public services, and social and family breakdown leading to unhealthy and anti-social behavior. “Two faces of the same city are now emerging. The first portrays a vibrant, innovative and highly modernized industrial arena, a true success story in a developing nation sorely in need of capital investment and domestic enterprise. The second shows mushrooming shanty towns, inadequate public services and huge disparities in income, health and opportunities, between those who have access to the high-tech industry and those who do not” (India-2001 Country Assistance Strategy (CAS), University of California at Berkeley International Health Project). This creates total antithesis for the quality of life and could be perceived as a possible threat for in-migration of IT professionals into Bangalore region and could prove to be a deterrent factor in the future.

Lack of adequate inter-industry collaborative efforts

In spite of the presence of large number of academic institutions and software companies, there lacks a proper infrastructure for networking. There often exists a

competition for attracting talent from rival companies rather than collaborative existence. International cooperation opportunities must be maximized through business, regional and international organizations and local government agencies in order to train transfer knowledge rapidly and cheaply and open up markets. This can be followed up by effective knowledge sharing organizations, which bring about overall societal good. It is also important to translate the academic successes into successful commercial ventures through increased industry partnerships. Innovation is impeded through “brain drain” to other lucrative markets outside the region, especially to the West. There are lack of incentives, primarily monetary and shortcomings in the intellectual property rights. “Respect for intellectual property is an important (and vital) element for driving the growth of software sector in Bangalore, both in services and emerging software product areas” (Bill Gates addressing software developers in Bangalore: <http://rediff.com/money/2002/nov/13gates1.htm>).

Opportunities

Presence of computer-savvy population

Due to the presence of numerous research and educational institutions, Bangalore has always attracted a highly skilled and computer literate population. This “intellect class” migration has created a atmosphere conducive for fostering numerous small-time computer institutes which have potential to bludgeon into major players for human resource development of the region. The nascent Centre For Development of Advanced Computing (C-DAC) and National Centre for Software Technology (NCST) have potential for grassroots development for skilled IT labor in less-technical but nevertheless high-growing jobs like medical transcriptions, data entry, etc. This high-skilled labor could be utilized in rejuvenating the manufacturing trade in Bangalore too. The manufacturing sector, whose establishment or expansion had been slower in comparison to the IT sector due to various obstacles, could emerge stronger if entrepreneurs had clear perceptions of opportunities.

Local commitment of native-foreign professionals

Due to the downturn in the economy in the West, skilled IT professionals are looking to head back home to India and primarily to Bangalore. Due to the grassroots efforts of local entrepreneurs and aggressive marketing strategies by the government, Bangalore seems a viable option for the professionals returning home. The young age of the demographic profile of Bangalore still helps retain its youthful spirit and makes it an ideal place to settle considering the quality of life aspects.

Emphasis on Education

The government of Karnataka has undertaken several programs based on primary education while emphasizing on information technology in the school level curriculum. The Yuva.com program initiated by Department of Information Technology, Rural Development & Panchayat Raj is a scheme to help train educated unemployed youth in IT skills. The non-profit Azim Premji Foundation is committed towards working for universalization of pre-school and primary education in Bangalore City. Its partner-in-service, Akshara has set-up a vast network of 1200 pre-school centres in the city over the past year covering nearly 20,000 children. Such programs create a wide base for future labor workforce development and show a long-term perspective.

Threats

Over-reliance on IT

The government's zeal for further IT-capable jobs may signal neglect for its primarily rural population. Bangalore, MSA area wise is only 28% urban and most of its population is based in manufacturing and agricultural industries. The tremendous growth notwithstanding, there has been a general deceleration in Industrial activity in the country, which, over the last few years, has had its impact on the industrial sector of Bangalore too. The setback to the Asian economies added in no small measure, to the problems of the core sector industry such as steel, cement, automobiles etc. The technology drive recessions can undermine the entire region's economy and make it susceptible to drastic measures.

Increased competition

Since the model of Silicon Valley had been replicated to some extent in India in the form of Bangalore region, similar clones began to sprout up all over the country. The primary competitors like Hyderabad, Pune, Noida, etc have begun to pose a serious threat to the supremacy of Bangalore as a capital of IT industry in India. In recent times, Hyderabad, backed by vociferous regional development strategies with strong political backing, has become the darling of the foreign investors and home to many industries. Microsoft set up its only software production facility outside of United States in Hyderabad and was graced by the visit of Bill Gates twice in last couple of years. In view of major outsourcing contracts coming to India, several states are vying to attract the potential companies to setup base with added incentives. The intellectual property rights debate and global competition have further compounded the need for a new and radical approach to industrial development for the region of Bangalore in face of increased competition.

Economic Development Strategies For Silicon Valley, CA

As one of the most successful examples of Economic Development in the 20th century, it is difficult to make recommendations to the Silicon Valley region. However, there should be continued support of the cluster economy as it adapts and progresses to accommodate new technologies and commercial applications of those technologies. The way that this can be accomplished is by:

1. Educational and Training Programs

These programs should be aimed at growing the labor force that will support the new business opportunities in the next wave of growth. For example, biotechnology requires many mid-level skilled employees to work as lab workers, etc. While these jobs do not require college degrees, some specialized training at a vocational school or junior college is helpful. By supporting the creation of these training opportunities, Silicon Valley can ensure that their labor force is prepared and ready for the demands of the bio-nano and info-tech industries of the future.

2. Interdisciplinary R&D

As noted above, there is significant support for these types of institutions, especially within the colleges and universities in the area. There are two important components of this, which must be remembered. First, there needs to be significant communication and networking between those in the R&D institutions and the working community. Second, for those leaving the R&D arena at graduation, there needs to be significant entrepreneurial support for them to create new businesses with their new knowledge.

3. Communication between governments, non-profit, and private institutions

One of the reasons behind Silicon Valley's success is its communication and support between many types of institutions. Governments and non-profits facilitate the environments where the private industries can flourish, and the private sector repays them with tremendous support. This communication must continue so that governments and non-profits can continue to provide the missing links and create environments, which will support the enterprises, which will take the area into the future.

In addition, there should be some attention paid to the diversification of the economy. An economy that dominated by a single cluster is somewhat vulnerable to new competition and economic downturns. Therefore, Silicon Valley should attempt to generate or attract some business opportunities, which are not part of the cluster. This is difficult because many of the companies in the area are able to offset the high cost of doing business in the area with the benefits of being in the area. These new companies, not part of the cluster, will not receive those benefits, but must still suffer the high costs. Perhaps some incentive packages would be appropriate in this case.

Recommendations & Economic Development Strategies for Bangalore, India

1. Empowering small-business IT firms

Analyzing the socio-economic profile of Bangalore and being mindful of the opportunities and threats of the region, building regional innovative capacities and addressing social inequality can and should be linked, as both essential to maintaining Bangalore as a central site for global innovation and establishing informational industries as engines of broader development. It was addressed earlier in this paper that Bangalore was being too over-reliant on information technology but this threat can be transformed to a position of strength by empowering the IT sector at the grassroots level. "The growth of the economy will depend on the dynamism of the private sector enterprises with high-value outputs, minimal environmental impact and the ability to generate direct employment as well as indirect growth of services" (Heitzman, 1999). The long-term viability of IT-centered development initiatives "outside of fostering targeted IT industries or infrastructure lies in the sustainable initiatives require the reformulation of social and political relations around an "information society" that will foster long-term regional growth" (Eischen, 2001). Developing sustainable IT initiatives will generate a well-paced economic development trend that would inspire knowledge-driven global-networked innovation-centric environment.

The concentration of IT infrastructure and promotional incentives to industrial parks and schemes directed towards attraction of foreign capital and outsourcing firms may spark off a digital divide between social classes, regions or even neighborhoods, as

inequalities around education, quality of life, basic services and infrastructure are reinforced. The overall social transformations linked to industrialization generally – the rise of a middle-class, urbanization, consumerism, increased gender equity, expanded literacy, social movements – that have accompanied high-technology hardware industrialization (Lubeck and Eischen 1999).

It is imperative to empower this middle class to generate innovation and develop knowledge-driven strategies that could translate into regional development. The repercussion of similar kind can be felt in the Silicon Valley where often low standard of local education clash with demanding high-skill jobs rendering local population to isolation. “If such policies do not exist, the risk is that social and economic development will remain relatively stagnant, while new institutions and targeted investments link small sections of the society to the global economy” (Eischen, 2001). The concentration of policies geared primarily towards empowering 80,000 high-tech workers in a region with over 4 million people, most of them under the poverty line and living in slums.

The strategy for empowering human resource development for regional innovation can be directed primarily towards two stakeholders, one, the graduates of the resident research and educational institutes and two, the rural youth of the surrounding region. After the liberalization phase of India’s economy, Bangalore region underwent a major transformation. There was tremendous job loss and outright shrinkage in the contracting opportunities for small and medium firms but the large public sector firms made a smooth transition. This undermined the capabilities of small business and shifted the balance in favor of either public sector firm or relocating multinationals. “Entrepreneurs from small business emerged from government supported institutions and utilized their contacts to understand merging markets inside and outside those institutions to create new businesses” (Heitzman, 1999).

The state should seek to reinforce this entrepreneurial spirit of breakaway companies by spelling out supportive policies and providing networking opportunities in order to generate local growth. This can prevent the out-migration of highly skilled labor leaving the public sector firm and moving out of Bangalore in search of better wages and more interesting projects. “With the Indian R&D and markets still in infancy, the most effective strategy will be to establish joint ventures for technology transfer or to accumulate capital by landing low-end contracts that bring in foreign exchange” (Heitzman, 1999).

This strategy would bode well to nurture regional innovation through joint partnerships to garner most of the outsourced projects from the West³. After establishing a strong reputation and grasp of the market overseas, independent processes of technical innovation and market capture could occur. The first stage would be in providing offshore and onsite consultancy on corporate projects mostly in the US by use of “inexpensive” but well-trained software engineers but slowly diversifying to development of own business software products for niche markets. This applies to internal development of new, high value products applied to the Indian market or to an international niche market. This model is influenced by the success story of Infosys, an Indian software company based in Bangalore, which grew from having revenue of US\$ 0.024 million in 1982 to US\$ 9.4 million in 1997 and a personal worth of \$ 500 million.

³ Over the next 15 years, 3.3 million US services industry jobs and \$136 billion in wages will move offshore to countries such as India and China. India will become the US' primary trading partner in South Asia because of the huge amount of services' trade (Forrester Research).

“Liberalization has challenged government agencies to provide, at public expense, the service and labor that would allow private enterprises to operate with no guarantee that they would remain in one place” (Heitzman, 1999). Thus it is imperative for the government of Bangalore to emphasize the incentives offered not only to multinational companies but small local software businesses too in order to prevent them from moving base. Their continued confidence in not moving from Bangalore would rest on improvement in infrastructure that will support current operations and enhanced functionality needed to cooperate in multinational cooperative setting. Private enterprises can in turn provide inputs for their own services and infrastructure at a neighborhood level.

The presence of numerous institutes should continue serving as incubators for development. Universities and Research institutes should cooperate and collaborate with prestigious overseas organizations to build and implement scientific research programs for technology innovation and development of new products.

The second aspect of this strategy is in developing the rural youth to partake the technology boom in the region. Presently there exists a wide digital divide between the haves and have-nots i.e. between the highly skilled technical engineers from the localized institutions and the rural population not having access to IT. The first step would be to take the technology to the village and creating more accessibility for utilization of information technology in the daily lives of the rural people. In a nutshell, Internet access will be provided to all villages to close the digital divide between the urban and the rural. Through the Internet and new IT tools, a higher degree of knowledge workers among our villagers would effectively be created. Creation of a knowledge-based economy and an informed society will narrow the socio-economic gaps at the root cause. More specific objectives would be to train the youth in the low-end technologies like data entry, medical transcription and thus seek employment at the call centers located around Bangalore. The Government can also establish a “People’s Bank” and a “Village Fund” to provide access to capital for local entrepreneurs to establish their own enterprises. This strategy is heavily based on regional and sub regional networking to bring together the talent pool available in order to foster innovation at a rural level.

Such programs can be aimed at developing the IT industry, at both the rural and urban stage with the full participation of five elements: business, government, education, scientific research, and overseas Indians. This strategy thus aims at developing a “knowledge-based rural and urban economy”, empowered with “fundamentally strong agricultural and SME sectors, as well as a vision of improved regional cooperation, all rely to a large extent on the development of a strong IT support sector” (Keynote Address: Thaksin Shinawatra, Prime Minister of Thailand, 2001). India (most likelihood Bangalore) has five forces (Business Line, December 6) that can be exploited to support the transformation to a strong-weak model. The five forces are “demand, resources, savings, talent and trust”. These forces are exemplified in this strategy and can be nurtured to sufficiently increase purchasing power parity to ring in enhanced economic growth.

The over arching goal can be to rapidly extend the use of IT into every socio-economic area of the city, making it a key factor in raising the competitiveness, through low cost modernization, improving management outcomes and administration mechanisms,

developing education and training and proactive integration to achieve superior results and foster entrepreneurial spirit.

2. Restructuring of Institutional frameworks

Economic development is driven by the policies of the local governing bodies and the institutional frameworks that guide the local path of growth by adhering to the strengths and opportunities of the region. In the early nineties, Bangalore experienced a large amount of information technology investments but subsequently the interest began to wane. "The apathy of the State Government even in the Electronic City, the lack of infrastructure improvements was reducing information technology inputs" (Heitzman, 1999). The bureaucrats were unperturbed as the flow of projects remained constant but what they missed was that many of these projects represented the implementation of schemes during the previous five years. The advantage of Bangalore was highlighted always as being a location to "exploit cheap labor emerging from institutes of technical education within an urban environment where the cost of externalities was still not high enough to offset the saving in personnel assets".

But dissatisfaction and luring of local firms by competitors threatened the relocation of "offshore-production" companies. The regions of Hyderabad and Pune within India offered greater incentive packages with better infrastructural facilities. Establishment of independent agencies dispersed the decision-making, which isolated the policy process from local conditions and prospective relocators. Thus it is utmost important to restructure the different agencies like the Bangalore Metropolitan Region Development Authority (BMRDA), Karnataka State Electronics Development Corporation (KEONICS) and Software Technology Parks of India (STPI) and form a cohesive decision-making body, which would lead to coordinated policy and common vision.

There also has to be a concentrated effort to invest in infrastructure not only in terms of telecommunications but also to deal with urban problems such as water supply, road congestion. The upheaval in political leadership i.e. changing of three chief ministers within a three year period also does not bode well for political stability and can lead to disruption of plans for economic development. "Operating at the local level is not enough to deal with larger issues of planning, allocation of space and equity and thus require input from larger institutional structures of municipal, district and metropolitan councils" (Heitzman, 1999). It is also important to foster collaboration and cooperation between government, business and scientific research centers to define market objectives for the software and hardware industries, and to encourage investment in new product development and strengthen exports. Collaboration between the political structures and the industry is important in developing commonalities to achieve a shared vision. Due to the scale of the development, it is also important to work with the national Government to formulate and implement complimentary national and city policies to attract investment against the backdrop of regional and international competition. But at the same time, it is important to keep the telecommunication infrastructure up-to-date in order to maintain the competitive level of the region.

The restructuring of political hierarchy is important to establish an organizational mechanism appropriate to managing and strengthening information technology and telecommunications development. This step is essential to break down the barriers of mitigating the issue of corruption amongst "members of bureaucracy who act as

gatekeepers of resources and services". Purely "technologically-proficient" bureaucrats of the three agencies mentioned above should handle the business of economic development. Legally, it is important to protect the products of the companies generated within the region. A sufficiently strong legal environment compatible with other countries must be created in the area of IP protection and "petition Government and the Ministries in order to participate with them in promulgating the regulations essential for intellectual property and e-commerce" (Vietnam IT Development Plan 2001-2005). "The combination of national legacies, regional innovations and private initiatives detail the building of an information region in practice from the ground up" (Eischen, 2001). Part 2 of the project report focused on the primary institutions involved with the IT initiative in the region, a list that included government agencies, educational and research institutes and private companies.

This development strategy is an ideal example of understanding an information economy and adapting its potential to regional political and social issues. Moreover it also "details the essential role of regional governments in building social, economic and institutional synergy around information-focused regional development" (Eischen, 2001).

Conclusion

Bangalore and Silicon Valley are similar yet singular regions, which have experienced excellent economic growth due to apt utilization of information technology industries. Silicon Valley has been the harbinger of this trend and Bangalore, being one of the regions aspiring to be Silicon Valley has succeeded in carving a niche for itself in the developing economy regions. Silicon Valley was the earliest to integrate the technology to its economy, inspiring Bangalore to do the same and succeeding in part due to the many characteristics it shares with its "mentor". This also has resulted in Bangalore being called the "Silicon Valley of the East".

As highly successful cluster economies, Silicon Valley and Bangalore have comparable enviable strengths and opportunities. However, as we have seen, they are not immune to larger problems, setbacks, or downturns. While continuing to support those cluster economies, which have created very high value added over the past 40 years, the area should expend some resources on diversifying their economy to protect themselves and provide a more stable economy in the area. The local government, which has been providing adequate support throughout this period, has been and should formulate policies that standardize norms like the Karnataka IT Policy that serves to reassure foreign institutional investors. Policies such as limitations on high-speed broadband technologies (as in case of Silicon Valley) will not aid the region's economic prospects. Better coordination and technology consultation between the government and the industry should be emphasized so as to avoid a "technology-generation" gap.

Both the regions have the advantage of the presence of reputed research and educational universities and they have managed to exploit their resources for incubation of innovation for regional good. Innovation has played a major role in the development of the region and has succeeded in created an entrepreneurial spirit amongst the economic players of the region. The most vital aspect and highlight of regional economic development of both the regions is the transfer of technology stemming from these institutions to efficient utilization of human resources which results in diversion of human capital to its most efficient utilization. The regions not only excel in retaining the human resources trained in the regional institutions but also succeed in acting as a potentially

lucrative magnet for job seekers especially those well trained in the information technology sector. The creation of highly specialized and progressive culture that facilitates the application of new technologies into very successful commercial ventures, aided by government and private funding is the selling point of the regions.

This skilled labor is attracted not only due to the prospects in the IT sector but also due to the quality of life experienced in the region. Both regions experience equable and pleasant climate throughout the year and is endowed with adequate natural beauty. The cost of living, though extremely high in Silicon Valley is still competitive enough when the high remuneration is taken into account. Bangalore on the other hand, still is on the lower end of the cost of living index, ranking 140th on the global list of cities. This has made Bangalore a prime choice for the fresh graduates of any educational institution in the region. Though the standard of life now is on a decline for both the regions due to immense migration, this can be explained as the downside of rapid urban development. But at the same time, the local government is aware of the rising problems in common infrastructure and have resolved to take concrete steps to mitigate them. But a control system in terms of resource allocation and development zoning plans, coupled with long-lasting telecommunication infrastructure has to be put in place. This can be achieved by dispersion of economic activity away from the current central hub of the region. These economic zones are currently under development in Bangalore but also have to be supported by transportation infrastructure. The state government is presently considering the construction of a transit corridor to link the three economic zones namely, Electronic City, Peenya Industrial district and fast-growing Bidadi Industrial zone. These developments will not only reduce the pollution levels in the city but will also divert congesting traffic from the core of the residential area of Bangalore. In the case of Silicon Valley, such out-reach developments are supported by the Interstate System and since the Silicon Valley area is not defined, it has potential for far-flung growth. Such outward growth, though can be an administrative nightmare, can arrest rural to urban migration and couple with empowerment of skilled labor with the entrepreneurial spirit can lead to rapid economic growth of the region.

Diversification of technologies in areas such as biotechnology and nanotechnology are crucial to maintain the critical edge in the development of the region. Constant innovation in these areas makes it imperative for the regions to keep up with the added pool of knowledge, making room for the newer technologies. The continued support of the premier academic institutions and encouraging them to maintain their incubator standards for developing knowledge in the region is of utmost importance. Professional networking, so evident in Silicon Valley has to be replicated in Bangalore region though mutual benefits package. Diversification can be achieved not only by concentrating on the higher end technologies but also by encouraging the rural youth to partake in the technology drive. This is achieved by initiating training programs at the grassroots level and thus helps in preparing the next generation of workers for the regional industry. Diversification is important in times of technology recession when efforts in other sectors can bolster the economic condition of the region.

Thus Bangalore and Silicon Valley are riding on the wave of "culture of innovation and entrepreneurship" which has helped it to achieve excellent economic growth. But in order to maintain its current standing against urban sprawl problems, competition and economic downturns, these regions should diversify in areas of applied technology with the help of the incubator institutions. Developing economies like Bangalore will increasingly gain favor of the use of overseas services' potential because of cheaper

labor rates, low cost bandwidth, standardized business application and net-based collaborative tools such as instant messaging. This change can be bolstered by development of telecommunications infrastructure coupled with political will and supportive policies. These changes in addition to consistent intellectual property protections, clear property rights, tariff reductions on services, and supportive liability laws in order to maintain control of dispersed services network would boost the confidence of incoming multinationals.

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