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Responding to Global Challenges:

A Findings and Strategy Brief

August, 2007

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Summary Strategic Recommendations

Over the past several months, New Economy Strategies has conducted extensive research into global innovation best practices resulting in the production of seven case studies. As the attached case studies have demonstrated, there are new global challenges to California's dominance in innovation-intensive industries. Globalization has allowed for greater international economic integration, increased trade, and the exchange of ideas and talent. This has in turn resulted in the accelerated transfer of foreign technologies and the technological know-how to develop and operate these technologies, which has resulted in more competitive economies and stronger societies. As developing economies continue to gain knowledge and expertise, they will work to build the necessary innovation capacity in the form of R&D facilities, an educated and skilled workforce, government support and funding, and intellectual property protection. Consequently, emerging economies will continue to play a bigger role in the development of new technologies, including the introduction of advanced industrial design and manufacturing.

While globalization is something that cannot be controlled, policymakers in California and the California Innovation Corridor (CIC) should look at how they can best anticipate and actively respond to globalization through active policy choices. These choices, however, may be difficult to discern as what may be good for a company or shareholders may not be acceptable for a region, state or country. This is demonstrated by the recent quote of the Chairman of Intel, Paul Otellini, who said, "Our goal in China is to support a transition from 'manufactured in China' to 'innovated in China.'"[1] How California's economy will be impacted by the dual challenges of both the business model of globally networked firms and the economic development strategies of other nations is not fully clear. There is no question, however, that there will be a profound impact.

In order to continue its tradition of success in innovation, the CIC recognizes the need for a new regional innovation model. To this end, New Economy Strategies has identified several areas for consideration in the innovation model:

#1: Better track and monitor innovation metrics in California

#2: Increase California's focus on adult and continuing education programs

#3: Increase California's offering of advanced certification programs

#4: Explore and adapt the role of large public-private technology parks and infrastructure

#5: Continue to improve availability of seed and pre-seed capital

#6: Examine how California can more fully leverage the new global outsourcing model to make its companies and workforce more competitive.

#7: Promote proactive state and federal policies toward technology competitiveness (particularly relating to homeland security restrictions, such as ITAR and H1-B visas)

#8: Continue to leverage California's large market size to boost the location and manufacture cutting-edge products within the state borders (including advanced materials, nanomaterials and stem cells)

#9 Develop a mechanism, a 360° "radar" of knowledge-action-metrics that can address the inevitable economic, political and social shocks that California will face in the coming years.

[1] "Intel plans $2.5 Billion Chip Factory in China" Associated Press, March 26, 2007. Retrieved from: http://www.washingtonpost.com/wp-dyn/content/article/2007/03/26/AR2007032600210.html

Overview

Background

Facilitating innovation capacity has become a top priority for both developed and emerging nations. There has been a marked shift away from economies focused primarily on natural resources to those dependent on knowledge and technology. Advanced economies are dependent on the establishment and development of knowledge-based sectors, and in this way, innovation drives both economic and social prosperity. Developing and sustaining the capacity to innovate is critical for a region, state or nation to remain globally competitive.

To this end, regions seek expertise that is attuned to the culture and mindset of the local environment, while bringing a perspective from other similar regions throughout the globe. Although each region is different, global competition mandates a clear understanding of the existing assets on which to build a well-developed, prosperous economy. Solutions must address the perspectives of stakeholders from government, industry and the academic communities, but must also be based on international best practices. Implementation of these solutions must engage local champions who will work to engage the various communities in transforming the economy.

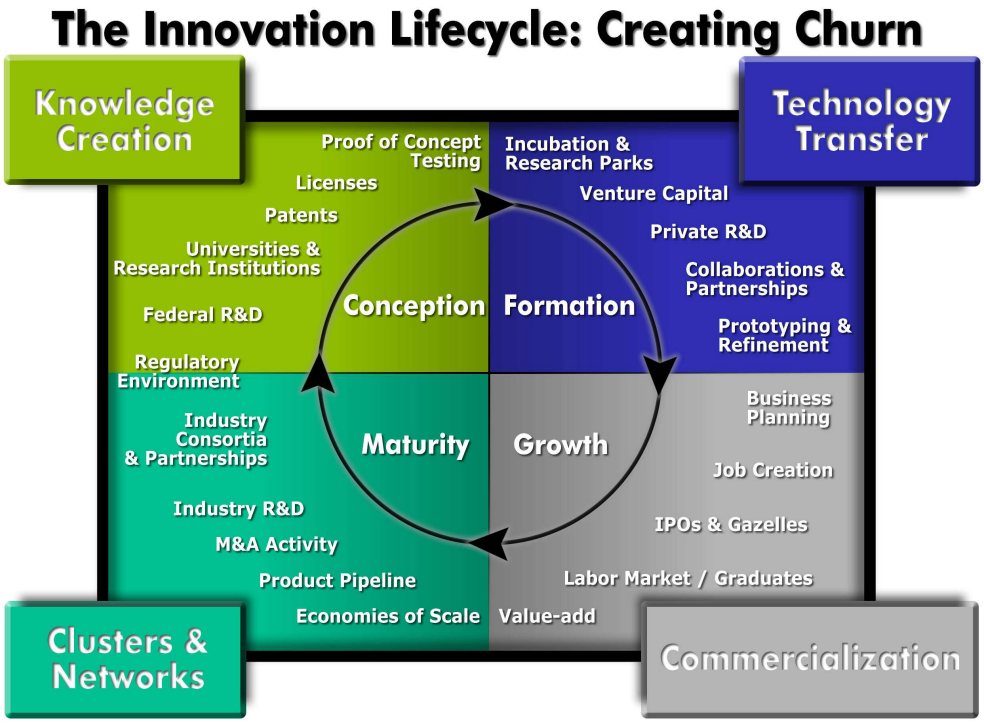
The California Innovation Corridor (CIC), which has long been a leader in innovation, has recognized the need to gain a global perspective on best practices in innovation, and to this end, it has requested the assistance of New Economy Strategies (NES) under the WIRED Advanced Technical Assistance grant. The CIC was also charged and encouraged to share its findings and recommendation as a national "leader in innovation" with other WIRED regions. The statement of work for the project calls for several discrete deliverables in support of the development of a new regional innovation model for the CIC and the state. Completed deliverables include a working definition of innovation, benchmark selection, regional case studies and the production of an innovation gap analysis and strategic recommendations. This "Strategy and Findings Brief" is the final deliverable and provides a comprehensive summary of the process, findings, and strategic recommendations.

Context for the Project

Because words matter, a variety of working definitions of innovation were discussed by the NES/CIC team at the start of the project. One central concept that we sought to capture was the notion that innovation is the "transformation of ideas and knowledge into new processes and services."[2] Another important notion is that the regional innovation model is comprised of a series of inputs, including infrastructure, talent, and investment, and outputs such as new products and services. Innovation takes place in a specific policy context that is often dictated by government authorities and is facilitated by a series of intermediaries that range from informal networks to formal policy-setting bodies. A further discussion of innovation can be found in the working paper *Towards a New Regional Innovation Model for the California Innovation Corridor*, prepared by NES in February 2007.

[2] Adapted from Edward Maleki in *Technology and Economic Development* Essex, England : Longman, 1997

One lens for viewing the interaction between these factors is what New Economy Strategies defines as the ***Innovation Lifecycle***. Through this model we can identify best practices, evaluate them, and ultimately insert them into regional economies that face innovation gaps. The "Innovation Lifecycle" captures the interrelation and hand-off between the multiple elements that lead to the successful development and growth of industrial firms. It has four quadrants that chronologically move from Knowledge Creation through Technology Transfer and Commercialization to incumbent Clusters and Networks. The graphic displays the additive role that is played by inputs such as patents and venture capital, which serve to further drive the innovation process.

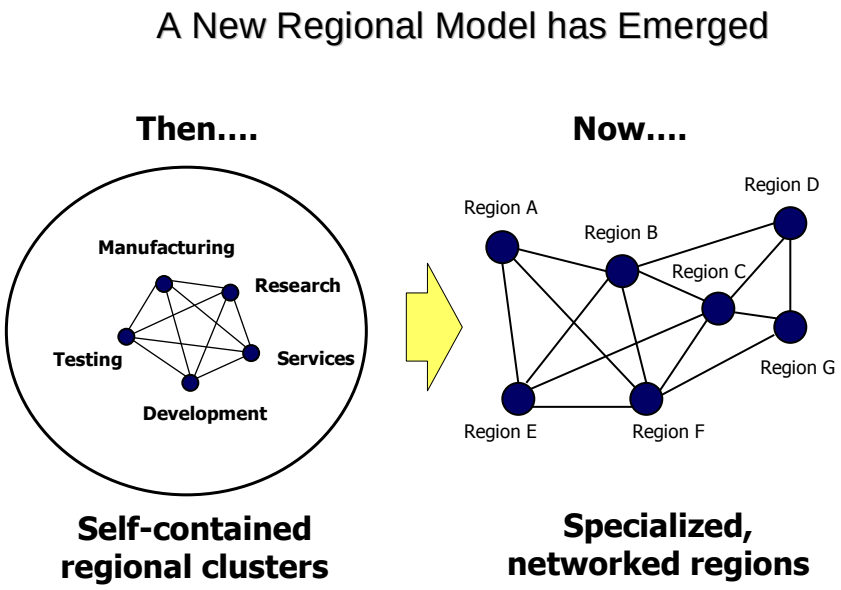


Created by New Economy Strategies, LLC

As was briefly discussed in the working paper, *Towards a New Regional Innovation Model for the California Innovation Corridor,* produced in February, the CIC is strong in many of the assets that are integrated in the Innovation Lifecycle. These assets are primarily located in and around the coastal cities of San Francisco, San Jose, Los Angeles, and San Diego. Other parts of the region, such as the Inland Empire, have lower concentrations of what can be labeled "innovation assets", which may include universities, government labs and private firms that invest in research and development. The variety and disparity in assets throughout the region are not individually addressed in this study, but rather, the region is examined as a single entity in terms of assets, programs, and policies that affect the process of innovation. We recognize that due to the size of California and the CIC, attention must also be paid to sub-regions and local communities within the corridor. Where possible, we have identified regional circumstances or programmatic efforts that align with the larger goals of the corridor.

Additionally, increased global economic integration, inexpensive communication and the rapid flow of knowledge has led to the replacement of the traditional cluster model (where industries agglomerate in regions) with a more networked model of "hubs and nodes." In this model, a firm may locate its research and development in one region, manufacturing in another region and headquarters in a third region. This model is especially prominent in the defense and pharmaceutical industries, where more than 60% of production is located in Puerto Rico, despite

research being conducted in a few primary locations. While this paradigm shift has impacted the private sector, it has also affected countries, states and regions where these firms are located, especially as networked firms pay less attention to national boundaries.[3] This trend can include both offshoring, where business units are moved overseas, and outsourcing, where business functions are performed by a firm external to the primary company.



When this schema is applied to the CIC, we see that while there are still strong industry concentrations in the region, each sub-region does not need to have all of the innovation assets in order to compete globally. However, given this context, more attention may need to be paid to the coordination of relevant assets.

One of the primary goals of the Technical Assistance for CIC has been to assess global practices in the context of California, which may include regions that have faced similar challenges or those that have achieved success in similar or related industries. After examining each of the selected benchmark countries and regions, NES has identified a list of focus areas for improvement or consideration in California. For each focus area, we offer best practices found in the regional case studies. It is the aim of this project to provide insight that will enable policy makers to make informed choices about the allocation of resources in the promotion of innovation capacity. Our observations and recommendations will require additional research and discussion by the CIC team and should be introduced into other strategic planning efforts for further vetting.

[3] *Hubs and Nodes or: How I learned to stop worrying and love globalization.* In Press. R. Seline and Y. Friedman World Future 2007 Proceedings.

Regional Benchmark Case Studies

In conjunction with NES, the CIC team members selected 7 global regions against which to benchmark the California Innovation Corridor:

- Boston
- India
- Finland
- Singapore
- Israel
- Brazil
- Korea

In addition, a gap analysis of the CIC was conducted. The Corridor is comprised of 13 counties: Alameda, Santa Cruz, Santa Clara, Monterrey, San Luis Obispo, Kern, Santa Barbara, Ventura, Los Angeles, San Bernardino, Orange, Riverside and San Diego.

In each of these regions, an extensive inventory of assets, programs, and industry strengths were evaluated. They include national, state and local programs, academic institutions and industrial concentrations. The supporting PowerPoint slides provide highlights of the successes, challenges, and best practices in innovation specific to each of the countries or regions.

When evaluating each of the benchmark regions, we have used the following set of questions as a guide. While it is difficult to provide a complete picture of the region due to limitations on time, data and information, we feel that the PowerPoint slides present a relatively robust picture of global challenges and best practices. Questions used to examine each of the regions were as follows:

- What are the region's industry clusters that are relevant to California and are performing well?
- How have the region's primary industry clusters evolved over the past 10-20 years?
- What policies, conditions and assets have contributed to the successful growth of the cluster?
- What obstacles were overcome?
- What role have universities played in cluster development?
- What metrics does the region use to track its "innovation economy"?
- Did the regions follow a pre-existing model or did they develop their own?
- What organizations / intermediaries oversaw the model's implementation?
- What can California learn from the case study and possibly adopt?

The following is a short summary of each of the regions examined:

Boston

Boston was the only benchmark region from the United States that was selected. It was chosen on the basis of its strong ranking in many innovation metrics such as federal R&D funding, patenting, and SBIR grants. Boston is known for its strength as a center for research and development, primarily due to its large concentration of higher education research universities. It is also home to many leading companies, with firms such as Genzyme Corporation and the Novartis Institutes for the Biomedical Research helping to establish a leading Life Sciences cluster in the area. NES was particularly impressed by the region's practice in tracking innovation metrics. This initiative is led by the John Adams Innovation Institute, a division of the Massachusetts Technology Collaborative, which publishes an annual Index of the Massachusetts

Economy that provides valuable data on innovation metrics and benchmarks the state against other "Leading Technology States" such as California and New York.

India

India was chosen as a benchmark region based on its extremely strong growth since the liberalization of the economy in the early 1990s and the growth of its software sector. Areas of strength include IT (primarily software and consulting services) and life sciences (pharmaceuticals, agricultural biotechnology, and enzymes), and the country brings innovation to other sectors of the economy by providing cost-saving business process outsourcing services to the manufacturing and financial services sectors. While innovation has been promoted by a variety of government sponsored programs, growth has been strongly supported by its venture capital community. Total venture capital in India has grown from less than $20 million in 1996 to over $1 billion in 2005. The country's top best practice has been its success in growing its IT and services sector through the development of a strong pipeline of engineers and computer scientists. The Indian Institutes of Technology, a network of seven independent universities focused primarily on science and technology, are known throughout the world for producing high quality engineering and computer science graduates.

Israel

Israel was chosen as a benchmark region based on its reputation as an innovation economy as well as successes in life sciences and defense sectors. Metrics that speak to the strength of its innovation capacity include high levels of R&D spending (3.6% of GDP, which was 2nd in the world in 2004), strong venture capital activity (among the largest recipients of venture capital per capita in the world), and a strong presence of well-established multinational companies (3rd largest number of NASDAQ listed companies after the U.S. and Canada). Israel's strong venture capital community has been a driver of its success in innovation, supporting a multitude of entrepreneurs and start up companies. Israel's success in attracting foreign investment is a best practice, with a strong network of agencies promoting Israel abroad as an essential investment opportunity. As the country continues to enjoy success in innovation, start-ups are increasingly able to receive venture capital funding from Israeli VC firms. Current estimates indicate that there are now over 80 Israeli VC firms with over $10 billion under management.

Singapore

Singapore was chosen as a benchmark region based on its rapid growth and reputation as a center for business and innovation. Singapore has tremendous strength in a number of industries including life sciences, electronics, media and broadcasting, and finance. It has also developed particular expertise as a semiconductor foundry, and it currently accounts for over 10% of the global production of semiconductor wafers. More than any other factor, Singapore's government has played a central role in innovation and growth. From its generous R&D funding support to the establishment of world class technology parks (such as the Singapore Science Park), the government has been a key player behind innovation investments. The Singapore Science Park has come to be known as one of Asia's premier R&D hubs and its vast size and global nature make it the top best practice for the country.

Finland

Finland was the only European country selected as a benchmark region, chosen for its history of innovation in telecommunications. It has hosted a series of "firsts" in telecommunications, including the world's first Global System for Mobile Communication (GSM) network in 1992, and has produced world-class companies in the industry such as Nokia. Nokia has been a primary driver behind innovation in Finland, subcontracting with an estimated 300 companies and fueling growth and innovation throughout the telecommunications cluster. Another important driver of innovation in Finland is its strong culture of education. Finland consistently ranks among the top countries in the world for the strength and quality of its education system, especially at the university level. It also has an extensive adult education system that continues to retrain its workforce. At the forefront is Dipoli, a Lifelong Learning Institute through the Helsinki University of Technology that is considered one of the premier continuing education institutes in Europe and is identified as a best practice from Finland.

Brazil

Brazil was chosen as an international benchmark region based on its identity as the largest economy in Latin America and its particular success growing its domestic aerospace industry, with expertise in a wide variety of areas ranging from design and manufacturing to aerospace support services. It is home to the world's third largest aerospace company, Embraer, which is a leader in commercial and military aircrafts. In addition, Brazil has increasingly been recognized for its long-standing support and recognition for research and production in biofuels. Success in innovation in Brazil has largely been driven by government policy, from large R&D injections into universities and private businesses to significant credit lending to business in key high-tech industries. The government has also been responsible for vast improvements in the higher education system in recent years, with significant progress in both the quality and quantity of public universities. The government's strong commitment to and generous support for selected industries including Aerospace, Defense and more recently Clean Technology and Biofuels is the best practice that has been selected from Brazil.

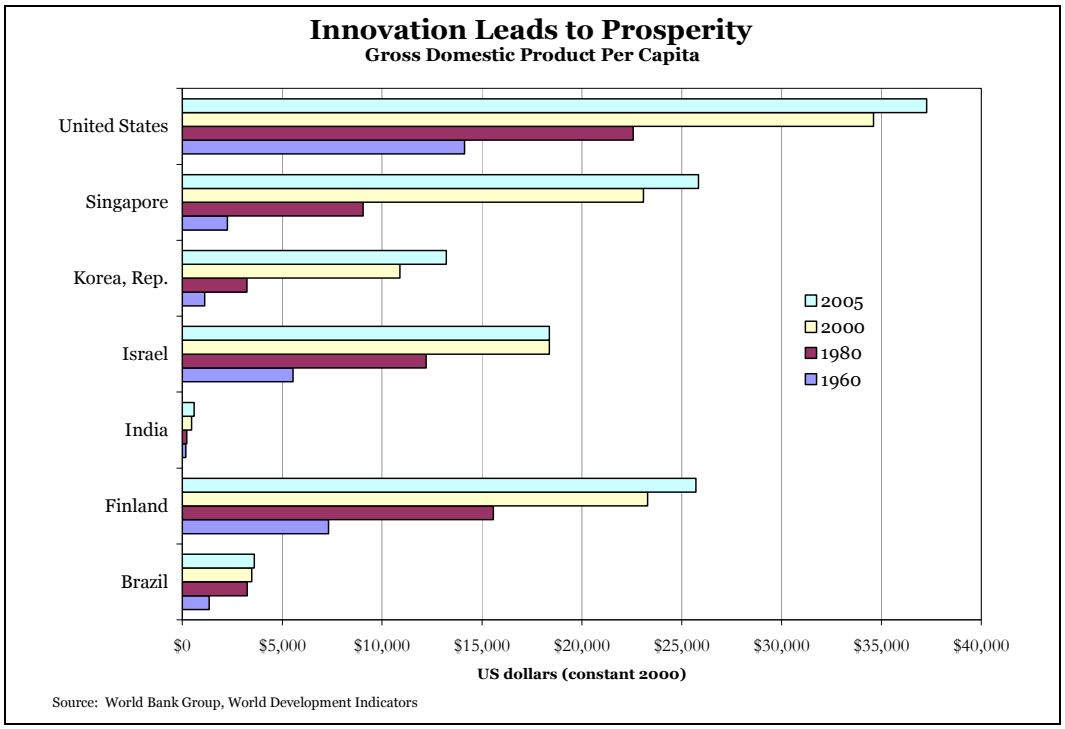
Korea

Korea was picked as a benchmark regions based on its tremendous growth and its strong telecommunications infrastructure, including one of the highest broadband penetrations in the world. Korea is emerging as a world leader in electronics, IT, and pharmaceuticals, and it is home to several leading companies including Samsung Electronics, LG Electronics, and Hyundai. Similar to Brazil and Singapore, Korea's strong growth and success in innovation is primarily attributed to its government's proactive innovation policy. To promote the transition into a knowledge society, the government launched Vision 2025, a comprehensive plan to improve scientific and technological competitiveness in Korea comparable to G-7 nations by 2025. To this end, it has enacted initiatives in nearly every high-tech sector, with the most ambitious initiative known as U-Korea IT839, a strategy designed to promote a digital society in Korea. U-Korea IT839 is expected to have a tremendous impact on the IT industry and its convergence with other sectors, and therefore, it has been chosen as the best practice from Korea.

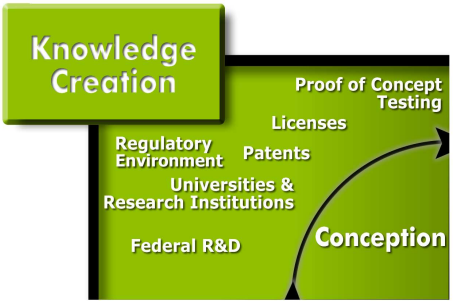
Overall Takeaway: Innovation Leads to Prosperity

In looking at each of the global benchmark regions that were studied, it became evident how much progress was made by many countries, both in the developed and developing world, in the expansion of their innovation infrastructure over the last several decades. While some innovation assets in these countries, such as universities, may be long-standing, the large majority of programs were developed over the last 50 years. World War II and the Cold War served as important catalysts for economic development in the United States, with Boston and Silicon Valley benefiting from the establishment of federal labs, defense contractors and their related supply chains.

In all of the countries examined in this study, expansion in the infrastructure for innovation has been accompanied by a dramatic increase in national income. Korea and Singapore have moved from being among the world's poorest countries to now ranking among the world's top 50 countries when ranked by per capita income. The chart below shows the dramatic increase in the standard of living in many of these countries, as measured by GDP per capita. Additional economic data is available in the attached summary data matrix.



Infrastructure for Innovation: Knowledge Creation



The first stage in the Innovation Lifecycle is **Knowledge Creation**, which includes the generation of new knowledge and intellectual property. Knowledge Creation occurs in the research and product development stages of a firm's growth, and it is highly dependent on a region's innovation infrastructure. Other sources of knowledge creation are government-sponsored research and contract research programs that may be performed at government facilities, universities and private firms.

Knowledge Assets

The California Innovation Corridor, comprising 500 miles from the San Francisco Bay to the Mexico-U.S. border, is home to some of the most advanced and productive innovation infrastructure in the world. The region is home to hundreds of colleges and universities including some of the premier research universities in the country such as the University of California System (most notably, Berkeley, Los Angeles and San Diego) and the California Institute of Technology. The region is also home to leading federal laboratories such as the UCLA Laboratory of Structural Biology and Molecular Medicine and the Lawrence Berkeley National Laboratory. In total there are 25 national labs or their equivalent in the state of California, the majority of them are located in or near the CIC region.

One of the primary drivers of the success of these assets is the region's ability to attract a large portion of federal funding for R&D, which totaled nearly $4.5 billion in 2005 See Slide Six, Federal R&D, of the CIC Overview Slides. While funding in the CIC has dropped since a record high of nearly $7 billion in 2001 primarily due to cuts in Aerospace and Defense-related funding, the region remains one of the most heavily funded in the country. In addition, during this same five-year period when total federal funding fell, SBIR (Small Business Innovation Research) funding grew steadily, demonstrating healthy growth of smaller firms engaging in very early-stage research. In fact, businesses in the region have played an increasingly important role in innovation in the region, reinvesting greater shares of their profits in research and development in order to remain competitive. Top investing corporations in the region include innovators like Hewlett Packard, Cisco Systems, Amgen Inc, and Sun Microsystems. Among publicly traded companies in California in 2005, corporate R&D was $78 per $1,000 of corporate sales. This compares favorably with other *Leading Technology States (LTS)* as defined by the John Adams Institute.[4]

Programs

As important to innovation are the programs designed to promote innovation and competitiveness in the region. Political jurisdictions — whether they are national, state or local -- play an important role in creating and funding policies that support innovation within their geographies. California has many successful programs designed to meet this goal. There are several statewide programs that are multidisciplinary in nature such as the UC Discovery Grant program, which is a three-way partnership between the University of California system, the state of California, and local industry sponsors that finances and supports research projects in a variety of disciples including bioengineering, nanotechnology, and telecommunications. There are also several programs that target new and emerging sectors such as renewable energy, biotechnology,

[4] INDEX of the Massachusetts Innovation Economy, 2006.

and stem cell research. In addition, there is a growing research focus on converging sectors such as biotechnology, information technology, and nanotechnology.

What can California learn from other regions?

#1: Better track and monitor innovation metrics in California
NES recommends that CIC consider creating and maintaining a database of innovation metrics that can be used to monitor progress of the CIC WIRED initiative and to test some of the suggested best practices. This data can also serve an education and marketing function by illustrating to Californians how important innovation is to the economy, and by showing outsiders what California has to offer. Data should be collected at the state, regional, and local level.

Currently there are some strong efforts in this area. Joint Venture: Silicon Valley Network has published since 1995 an Index of Silicon Valley providing data on the economy, innovation, education and social issues. However, the reports focus primarily on Santa Clara and San Mateo Counties and does not treat linkages to the San Francisco Bay Area and California as a whole. Other studies may look at efforts in Los Angeles or San Diego. These regional efforts should be better linked to state-wide efforts being managed by the government in Sacramento.

> **Best Practice: John Adams Innovation Institute—Greater Boston**
> In addition to providing funding to support start-up enterprises, the John Adams Innovation Institute, a division of the Massachusetts Technology Collaborative, publishes an annual Index of the Massachusetts Innovation Economy. Editions have been published for the last 10 years that provide valuable innovation metrics for the state of Massachusetts and other "Leading Technology States" such as California, New York, and New Jersey.

#2: Increase California's focus on adult and continuing education programs
California faces the prospect of replacing many highly skilled baby boomers that are currently in the workforce. One way to address this challenge is to increase the capacity of the adult education system to provide a greater number of continuing education programs at community and technical colleges and universities throughout the state. Continuing education programs are essential for professionals in the workforce who are seeking to advance their careers, and they are a critical part of ensuring that the workforce remains skilled and competitive.

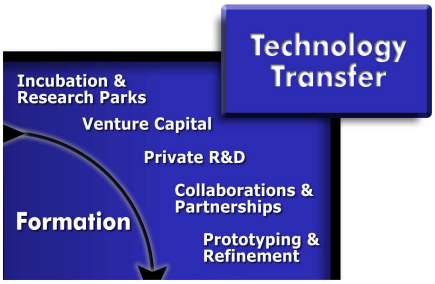
> **Best Practice: Dipoli—Finland**
> Diploi, the Lifelong Learning Institute of Helsinki University of Technology, is one of the premier continuing education institutes for engineering in Europe. It works with companies to provide specifically designed programs for training in engineering and management and may serve as a model for bridging the gap between formal academic programs and training that takes place within firms.

#3: Increase California's offering of advanced certification programs
While college degrees remain an important focus in education, greater promotion of training and certification programs is essential for creating a skilled pipeline of workers. Certification programs can help address unemployment and under-employment, and they can also provide a viable opportunity for integrating low-skilled workers into the knowledge economy in California.

> **Best Practice: Technical Education in India**
> India has a large, well organized network of technical institutions that offer a wide range of certification courses. According to India's Department of Higher Education, the country contains 357 Industrial Training Institutes, with the capacity to serve over 1.5 million people in over 200 different industries. In addition, India has a large capacity to serve mid-level professionals that require advanced knowledge of applications, with over 290 polytechnics located throughout the country. The scale and scope of India's technical education system has helped ensure the skilled workforce required to grow the economy.

India's role in the ability to define certification standards is due to some extent to the role of the All India Council for Technical Education (AICTE), the central body responsible for overseeing education in India's 1,346 engineering colleges. Technical education in the United States is far less centralized, with a smaller role played by the Federal and State Governments. While the AICTE has been operating in India since 1945, the National Skills Standards Act was only passed in the U.S. in 1994 to help facilitate the development of voluntary skills and certifications standards.

Infrastructure for Innovation: Knowledge & Technology Transfer



The next stage in the Innovation Lifecycle after Knowledge Creation is **Technology Transfer**. Once the innovative discovery has been captured as a patent, license or improved process, it can move from the lab to the marketplace. Important inputs in this part of the process include venture capital, incubation, and academic-industry partnerships. A key challenge at this step is bridging the gap between researchers and developers, compelling them to cooperatively identify valuable technologies and foster their development.

Knowledge Transfer is an area of particular strength in California and, more specifically, the CIC. In a 2006 tech transfer ranking by the Milken Institute based on patent, licensing income, and start-ups, three of the top four universities were in California. MIT was first, followed by the University of California system, California Institute of Technology, and Stanford University. In addition, three UC schools (Berkeley, San Francisco, and San Diego) and Stanford were among the top ten universities in the world in terms of biotechnology patents issued from 2000 to 2004, with UCSF tied for first with 219 patents. All 10 UC schools were ranked in the top 100.[5] The UC system was also the most successful university in the country in licensing income, averaging about $100 million annually from 1997 to 2003.

Another key element of the Technology Transfer quadrant is the venture capital (VC) needed to finance the commercialization of new discoveries. The level of VC investment in a region is often a good indicator for the amount of entrepreneurial activity in a region. California has always had high levels of VC activity, and it continues to be a center of global VC investment. From 2000 to 2005, there was almost $70 billion in VC investment in the CIC, with over 1800 firms active in the region (See Slide Seven, Venture Capital, in the CIC Overview Slides). Strong VC networks exist throughout the region, which play an important role in linking entrepreneurs with sources for knowledge and capital. VC networks are active in a variety of activities, from organizing workshops and networking opportunities to publishing funding and resource guides for entrepreneurs.

What can California learn from other regions?

#4: Explore and adapt the role of large public-private technology parks and infrastructure

California has a long history in the development and successful use of research parks. These include Stanford Research Park, which was established by Stanford University in 1951 and has been home to many of the most notable companies of the Silicon Valley, including HP and Cisco Systems. Other relevant facilities have been run by private firms include Xerox PARC, which was subsequently spun-off into a private research and development firm in 2002. One of the primary government research facilities in Silicon Valley is NASA Ames Research Center, located in Mountain View.

While the region is home to a large number of national research laboratories, universities, and high-tech corporate corridors, the state might not remain competitive when compared with the size and scope of parks being developed in other regions of the world. Technology parks are essential to the innovation process by providing the optimal environment for developing new

[5] "Mind to Market: A Global Analysis of University Biotechnology Transfer and Commercialization," Milken Institute Research Report, 2006.

technologies and processes. Technology parks are also an important component of global branding for a region.

Two particular challenges in the establishment technology parks are the high cost of land and challenges in governance. Though work may be done at research parks affiliated with universities or industry, they are often not able to assemble and direct all of the resources that might be marshaled in the same way that other countries have done with government coercion. The question should be: What role can be played by federal, state and local authorities in coordinating science park policy so that there are strong outcomes?

> **Best Practice: Singapore Science Park**
> Singapore, where the government has played a central role throughout all levels of the innovation lifecycle, has a particularly strong infrastructure for technology transfer. A series of technology parks have been founded that co-locate academic institutions and industrial facilities. Chief among those is the **Singapore Science Park**, recognized as one of Asia's premier R&D centers and technology hubs. It consists of three different parks with a vast array of customized facilities created to support work in a variety of fields from medicine to media, and it contains Asia's first R&D facility specially designed to meet the needs of telecommunications companies.

#5: Continue to improve availability of seed and pre-seed capital

Early stage venture capital investment is essential for growth in many start-up companies, yet it is often difficult to obtain given the high level of risk associated with the early stages of businesses. While firms in California have traditionally had a strong history of risk-taking and success in attracting venture capital, they are beginning to face increased competition as more opportunities for investment appear abroad. Just as capital flows in the debt and equity markets have increasingly looked to chase higher returns abroad, venture capital investors are looking to dedicate a significant portion of their portfolio to international investments and to later-stage enterprises.

An additional challenge that the start-up community has to face is the so-called "Valley of Death" that exists between pre-seed funding and profession stages of venture capital investment. (There have been multiple studies of these funding gaps, including work by the Center for Venture Research at the University of New Hampshire.) In order to remain competitive in the equity marketplace, California and the CIC should increase its focus on attracting and retaining pre- and seed-stage venture capital investors, both domestic and foreign, to support and grow the start-ups that have the potential to be drivers in the regional economy. There is a parallel to the leadership role of SBIR (Small Business Innovation Research) funding in California. While California has enjoyed great success with Phase 1 & 2 SBIR grant funding received by companies, limited funds are granted to companies for Phase 3 of their research, suggesting that commercialization opportunities are being left under-exploited.

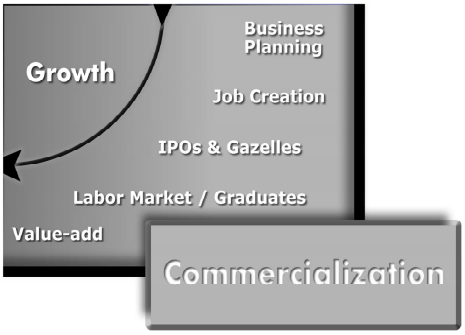
An additional problem evolving on the U.S.'s and California's horizon are the challenges related to the current U.S. patent policies. A number of briefings, reports, and forums among the research and commercialization communities have raised red flags regarding slow assignments at the U.S. Patent and Trademark Office (USPTO), the recent rulings and legal actions between ownership and protection, as well as the impact of non-resident/ foreign filings in the U.S. versus quickly emerging international patent systems. The CIC and its partners must be part of the analysis and debate as the current patent scenarios will both directly and indirectly influence funding cycles and the nature of early investments in the ill-protected environment of intellectual property management.

As with many of the other best practices, one challenge is how to address the governance issues of state investment in the development and commercialization of California technologies. While pre-seed and seed funding comes from multiple sources, including private investment firms, and state retirement funds, including CALpers, the state is more constrained in its investment role

than other countries such as Israel and Singapore. The state should look to convene all relevant stakeholders in a roundtable event to address some of these challenges.

Best Practice: Availability of seed and pre-seed venture capital—Israel
When measured on a per capita basis, Israel has more VC funds under management than any other country. There is currently over $1.5 billion in capital available, with over $2.5 billion raised between 2004 and 2006. One important aspect of Israel's strong VC program is its support for early seed companies, which is critical to the early development process of start-up firms. In 2006, $138 million of funding was provided to Seed Stage companies, which accounted for 8.5% of total venture capital funding. This is a significantly larger portion than the portion allocated to Seed Stage VC investments in the CIC (only 2.2% in 2005). In addition, the country boasts several programs to support pre-seed capital. One such example is the **Tufna Program**, which provides pre-seed grants and business development services to high tech entrepreneurs, helping them obtain private seed money, venture capital funding and corporate partners.

Infrastructure for Innovation: Commercialization



In the next stage of the Innovation Lifecycle, innovative discoveries that have been incubated and financed are taken to market. Businesses are supported as they grow, expand their services, develop new markets and compete for customers. Critical to this growth are several inputs including a strong pipeline of graduates, with both general and specific skill sets, and professional services such as law firms, accountants and consultants who can provide guidance for growing companies. Additionally, access to capital markets provides firms with additional growth financing. Debt financing through bank loans or the issuance of bonds allows owners to grow their businesses without giving up control, while equity offerings provide currency for acquisitions, incentives to retain valuable employees and obtain value for the firms they have created.

The CIC region contains several business incubators that support start-up and early stage high-tech companies in their path to commercialization. They offer a variety of support services including business consulting, mentoring, and access to networking opportunities. In addition, business incubators play a large role in helping companies obtain additional funding from venture capital investors. While many incubators support start-up companies in all fields, there are several that target specific industries or fields of research such as environmental technologies, space technologies, or international business.

Another critical aspect at this stage in the innovation lifecycle is providing a pipeline of workforce to support and grow new businesses, especially those in emerging industries. This requires the establishment of workforce training programs that work closely with industry and are well integrated into the innovation process. One such example of excellent cooperation between industry and education is the Applied Biological Technologies Initiative, a $1.2 million initiative that aligns community college education with biotech workforce needs. The initiative is led by six training centers who oversee training at local community colleges and partner with biotechnology firms, local schools, universities, public agencies and associations. As the largest system of higher education in the world, the California Community College System is comprised of 109 campuses, 64 approved educational centers, and 20 separately reported district offices, and it has the potential to be a tremendous training resource for local businesses.

What can California learn from other regions?

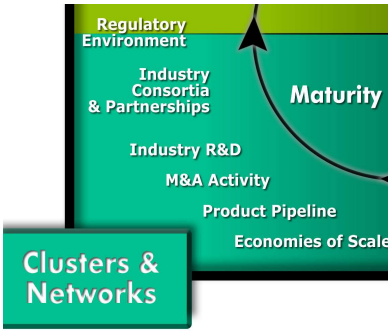
#6: Examine how California can more fully leverage the new global outsourcing model to make its companies and workforce more competitive.

Globalization compels domestic companies to integrate outsourcing and off-shoring as permanent elements of their business models in order to remain competitive. As California is increasingly challenged as a central location for creativity and innovation, it must anticipate this reality. Though California has a strong trade and export base, it needs to develop a better international networking model that can be leveraged to gain access to new supplier and consumer markets. The key question to be studied is how can a networked business model become an asset for California, rather than a liability? How can loyalty to the region be sustained in the face of networked innovation building?

Best Practice: Outsource Competitor/Partner — India

More than almost any other country in the world, India has taken advantage of globalization to grow its IT industry, primarily in the areas of software and consulting services. Low transnational telecommunications costs and a large pool of increasingly skilled, low-cost, English-speaking workers have been two of the most important factors in the success of the IT industry. This strong pipeline of workers is a direct consequence of India's well connected network of higher education institutions and a hold over from the country's role in preparing the world's computers for the Y2K phenomenon. The Indian Institutes of Technology (IIT), a group of seven independent universities around the country, are recognized worldwide for excellence in engineering and computer science education, and they are an important component in providing a highly skilled workforce to grow the IT industry and continue to draw high-tech firms to the country. There are many links between this challenge/ best practice and that of best practice #3 that deals with engineering and certification technology standards. California and the CIC have to find a way to stay a central hub in technology in a world of numerous nodes.

Infrastructure for Innovation: Clusters and Networks



The final stage of the innovation lifecycle involves companies that have reached maturity. Firms look to develop new lines of products and expand their presence into multiple markets. They will be spending a significant percentage of their revenue on marketing and distribution and ideally will continue to invest in industrial research and development to ensure new product pipeline. Companies at this mature stage may choose to spin-off divisions into new firms or merge with or acquire other firms in order to gain new markets or product lines and to ensure continued growth. Public-private partnerships take the form of industry consortia that exchange information and set common industry standards. Some partnerships go so far as to jointly leverage of public funding sources for specific research partnerships. Good federal policies become increasingly important to mature firms and state policies start to affect where firms choose to locate new plants or regional offices. Trade associations bring new awareness to issues that are important to an industry and offer networking opportunities for companies' technical and marketing talent.

California, as part of an advanced economy has many mature companies. Firms such as Intel and Northrop Grumman have a great deal of embedded knowledge about their markets and spend prodigious amounts of money in defending market share through innovation and product development. Several of CIC's largest high-tech companies are among the top companies in the world in terms of R&D investment, according to the 2006 EU Industrial R&D Investment Scoreboard. Intel ranks 12th, Hewlett Packard 24th, and Cisco 30th.

It is important that the innovation infrastructure to support mature firms is in place as they seek to develop new technologies. Examples of such infrastructure include regional trade associations and established public-private partnerships, providing important regional connectivity and knowledge-sharing networks between important actors in the local economy. Examples of successful private-public partnerships include **California Institutes for Science and Innovation**, which have received over a billion dollars for research in critical fields including bioengineering, nanotechnology, and telecommunications.

Government plays an important role in supporting the development of new technologies by setting a region's science agenda and funding specific initiatives in targeted sectors. Examples of important government policies in California include the **Stem Cell Initiative** and the **Governor's Research and Innovation Initiative**, which provided almost $95 million in funding for research in key sectors including cleantech, biotech, and nanotech. An important part of this initiative is its support for California's bid to build a $200 million Petascale Supercomputer, which will further strengthen California's position as a leader in high tech research.

What can California learn from other regions?

#7: Promote proactive state and federal policies toward technology competitiveness (particularly relating to homeland security restrictions, such as ITAR and H1-B visas)

Despite the tremendous size of the economy of the California and its global reach, communities and firms within the CIC still operate within the political confines of the state and the nation. Policies made at the federal level often have unintended negative consequences at the state and local level, ranging from impacts on trade and export capabilities to patent and IP practices. Currently, federal agencies have put in place or are considering additional restrictions on software

products (e.g. encryption), hardware products (e.g. defense technologies), and research (e.g stem cell research). These include restrictions governed by the Directorate of Defense Trade Controls (DDTC) under the U.S. International Traffic in Arms Regulations (ITAR) that govern the export of military parts and the access of foreign nationals to defense- related equipment and data.

An additional area where federal policy has an impact on the economy of the CIC is in immigration policy. California is home to one of the largest populations of foreign-born residents in the U.S., and immigrant communities play a prominent role at both ends of the high- and low-skill spectrum. At the high end of the skill spectrum, federal laws on the provision of H1-B visas have an especially strong impact on the Silicon Valley, where it is estimated that more than half of the electrical engineers are foreign born.[6] There is an extensive debate about the economic impact that visas have— are they limiting the skills required to drive the economy, taking jobs away from Americans, contributing to brain drain, or an effective tool for international development? As we have seen in the benchmark studies, much of the development in international venture capital markets has come from expatriate citizens who have had success in the United States.

At the other end of the spectrum, there is strong demand for unskilled workers in other parts of the California Innovation Corridor. In a recent article in *the Economist*, it was reported that San Bernardino and Riverside Counties have been attracting unskilled Hispanic workers due to demand for manufacturing and warehouse jobs driven primarily by increased trade with China through the ports of Los Angeles and Long Beach.[7] While there may be some short-term benefits in the development of the economy of the Inland Empire, there may be related long-term challenges in working on skills development for these "New Americans".

Given all of these factors resulting from globalization, the CIC will need to have an increased awareness of how these federal and state practices affect innovation generally and the international exchange, production and sale of technology products, specifically. California needs to be prepared to counter restrictive practices, where reasonable, through official policy design or informal business practices. The California Stem Cell initiative is one example of how the state has challenged federal policies to its own advantage. The CIC should play a strong role in supporting state and federal policies that promote technology exports and attract knowledge and skills, particularly in its key industries.

Best Practice: Government innovation policy—Singapore
Singapore's political structure has enabled the government to exercise great control over the nation's economic development policies and use its influence over business to advance its innovation policy. Under its Science & Technology Plan 2010, the Ministry of Trade and Industry has agreed to spend S$7.5 billion ($5 billion USD) by 2010 on R&D efforts in key industry clusters. Of this, S$5.4 billion will go towards public sector R&D sponsored by A*STAR (Agency for Science, Technology, and Research) while the remaining S$2.1 billion will support private sector R&D. This spending level is comparable to California's recent $3 billion stem cell initiative, despite the fact that Singapore is nearly six times the size of Washington DC

Best Practice: Government innovation policy—Korea
Similar to Singapore, Korea's government has played a central role in economic development. Following the financial crisis in 1997 and the subsequent structural reforms, Korea has moved towards a knowledge-based economy. To this end, the Korean government launched Vision 2025, a comprehensive plan to improve scientific and technological competitiveness in Korea comparable to G-7 nations. This three part plan draws on a variety of programs that promote science and technology, improve research infrastructure, and increase manpower. The most ambitious of these programs is U-Korea (Ubiquitous Korea) IT839, designed to promote a digital society in Korea. It seeks

[6] *Deportation Order,* **The Economist** April 28, 2007
[7] *Escape from LA,* **The Economist** March 31, 2007

to develop and release eight new IT services, three infrastructure networks, and nine future growth engines (which consist of designated hardware and software component industries). Estimated to cost around $70 billion by 2010, this strategy is intended to grow the relevant IT industries 15% by 2010. It is expected to increase connectivity among services, infrastructure and growth engines, explore the software sector, and promote convergence between IT and other sectors.

#8: Continue to leverage California's large market size to boost the location and manufacture cutting-edge products within the state borders (including advanced materials, nanomaterials and stem cells)

As the world's eighth largest economy, California has an internal market of over $1.6 trillion that is supported by a population of over 36 million people. Its large and diverse workforce of 17 million includes a wide range of education and skill levels, ideal for supporting manufacturing in the region. As a state, California needs to continue to leverage its large market size to attract and retain production within the state. Some successes can be seen in the automotive industry, where state regulations on emissions have created incentives to manufacture clean energy technologies in the state. Markets for solar cells and fuel cell production are also related to the end user market and the role of state and local government procurement.

Best Practice: Large Domestic Economy of Brazil

Brazil is the largest economy of South America and among the biggest in the world, and experienced rapid growth over the past fifty years. The country boasts several large companies traded on the New York Stock Exchange including Brasil Telecom, CPFL Energia, Embraer, and Petroleo Brasileiro. While the nature of many of these utility-related companies requires that production be located in the country, Brazil has also been successful in retaining employment within the country for its successful large international companies, such as Embraer, where 86% of its 19,265 employees based in Brazil. Continued government support for large domestic manufacturers and subsidies for its domestic biofuels industry has resulted in the development of these globally competitive industry clusters.

#9 Develop a mechanism, a 360° "radar" of knowledge-action-metrics that can address the inevitable economic, political and social shocks that California will face in the coming years.

Given that the California Innovation Corridor possesses an especially diverse economy that is increasingly linked with other nations, the CIC is challenged by the need to anticipate rather than react to the globalization of creative, innovative capacities. As is noted in recommendations 1 through 8, future scenarios for the CIC can be shaped by specific interventions and actions that are vital to the continuity of the regional discovery-development-delivery pathway from ideas to the marketplace. The WIRED initiative provides a unique opportunity for the establishment of a 360° "radar" – a system of information management, knowledge and metrics that continuously captures and refines the region's innovation scenario. A mechanism should be established through the WIRED CIC framework for the first regional knowledge system that assists policy making, resource allocation and other actions at the installation, organization and firm levels. The Corridor should leverage its strength in IT should ensure that the application aggregates data from multiple sources to guide local, regional, state and national policymakers.

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