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# Lightening Bolt Challenges:

## Obstacles and Opportunities Unearthed in the Global Benchmarking of Regional Innovation Capacity

Prepared for

### California Innovation Corridor WIRED Region



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## **Overview**

In a study performed on behalf of the WIRED California Innovation Corridor (CIC), New Economy Strategies LLC of Washington, D.C. looked at innovation capacity in both the 13-county CIC region, along with several global regions.. We were continually struck by several “lightening bolts”- social, economic and demographic challenges – that have a clear impact on innovation capacity and economic development both domestically and globally.

Lightening bolts are an appropriate metaphor for the challenges faced by the California Innovation Corridor. They are a singular event that is both powerful on their own but also have a profound impact where they strike. Just as lightening also poses a threat unless mitigated, so do the challenges that face regions in California and elsewhere.

The global challenges identified below are powerful in their own right and also have a profound impact across communities, regions, states and countries. In our study we highlight some of these “lightening bolt challenges” and outline a set of strategic responses for consideration by California and the CIC. Observing, addressing and mitigating these challenges are some of the most important responsibilities that economic development officials will have to face in the years ahead. Furthermore, California’s role as a bellwether region in the U.S. makes these challenges and responses a potential national model and set of best practices for other WIRED regions.

Lighting Bolt Challenges include:

- The new business model under globalization where the outsourcing of strategic elements such as research, engineering, product testing, and marketing as well as manufacturing and operations is becoming the norm
- The development of a solid middle class in emerging economies resulting in increased spending power both at home and abroad
- U.S. technology-based exports and strategic partnerships are being limited through the strict application of the International Traffic in Arms Regulations (ITAR) on U.S. businesses and academia
- Dramatic changes to world demographics- including international migration, educational attainment and the imminent retirement of often highly skilled “baby boomers” in the US, which number over 82 million individuals creating a global war for talent
- The large degree to which international trade is open, resulting in an unprecedented flow of information, capital, goods, people and skills – the result of several decades of support for free trade
- The complexity of managing technology transfer and intellectual property in a globalized arena, often leading to legal and financial conflicts as well as reduced commercialization success in the United States

Though the work of the California Innovation Corridor Initiative (CIC) has been initially limited to a \$15m budget – small when measured against the pool of

capital in California, now the world's eighth largest economy and a global center of innovation – the WIRED project can have a significant impact through the implementation of a series of responses to the “lightning bolt” challenges that have been identified in our asset mapping and benchmarking exercise. For the recommendations identified below to be fully successful, however, they require further investigation, broader communication and coordination, and continued attention to sustainable response and action.

Most notable about this collection of strategic recommendations is their relevance to a region so highly regarded by scientific, technical and economic leaders worldwide as already competitive. Our study underscores the reality that to remain creative and innovative, a region must constantly focus on vital details that could easily be taken for granted or overlooked when crafting a new strategy. Continuous innovation means continuous improvement- not only for enterprises, but also for regional collaborators as well.

#### **Selected Strategic Recommendations from the CIC WIRED Region Analysis**

- Focus on the commercialization of emerging skills and competencies through increased attention and linkages of adult education and advanced certification programs
- Improve the availability of localized pre-seed, early stage capital and the managerial talent to grow enterprises
- Leverage California's large scale markets and global networks in response to outsourcing and offshoring business models
- Promote proactive state and federal policies towards technology competitiveness
- Explore the role of technology parks and other collaboratories of innovation
- Improved monitoring of SWOT and GAP analysis and better innovation metrics

The following ultimate goal emerged through discussion among CIC WIRED leaders regarding solutions to monitor, gauge and anticipate trends. In turn, statewide efforts around innovation capacity building have identified the accumulation and integration of data into a continuous intelligence knowledge “system” as a critical next step.

#### **Ultimate Goal: 360° Radar for Knowledge-Action-Metrics**

- To develop an aligned, coordinated design of the response to the Bolts and create an anticipatory knowledge or competitive intelligence system of qualitative and quantitative datapoints
- Assumption of transitioning regional thinking: from Sectors to Competencies, from Informal Networks to Formal Relationships, from single source Rote Understanding to Interdisciplinary Knowledge (Know How, What, Whom)
- Strengthening Regional and Sub-Regional Networks through Ties to Business and Markets, Ties to Technologies, Ties to Market-Makers

## **Background Perspective on the California Innovation Corridor**

For over a century, starting with the Gold Rush of 1849, California has been one of the primary examples of the dynamism of the U.S. economy. Currently California has a Gross State Product of over \$1.6 trillion and comprises around ten percent of the total GDP of the United States. It is known for its leadership in innovation and the success of many of its industries, including Information Technology, Biotechnology and Aerospace. The economy of California, particularly the coastal corridor which stretches from the San Francisco Bay to San Diego, is increasingly driven by innovation and is part of a globalized system that depends on knowledge as one of its primary inputs.

While the U.S. generally, and California specifically, have been principal drivers of the global economy for much of the last century, there are now several strong challengers to U.S. supremacy. Other countries have looked to adopt U.S. best practices around technology development and management and have benefited from better government, access to capital and increasingly educated populations. Given all of these factors, California is currently at an inflection point- it must effectively respond to the challenges of technology, integration, institutional transformational and, of course, globalization in order to ensure that its economy can continue to be a world leader. California is also an important example for other states and regions, as it has had to confront transnational issues such as, immigration, the skills gap, and high business and residential costs longer than many of its peers.

Some of these challenges have been taken up by the efforts of the “California Innovation Corridor” (CIC), an initiative of more than 100 partners, including the California Space Authority and the Bay Area Economic Forum. The Corridor comprises a 13 county region that stretches along the Pacific Coast from Alameda County to San Diego County. With a 3 year, \$15 million grant from the U.S. Department of Labor under the WIRED program, the CIC is working to develop initiatives around the three primary strategic goals: Innovation Support, Industrial Rejuvenation and Talent Development.

As part of this effort, New Economy Strategies was directed to study global innovation best practices and develop strategies for the California Innovation Corridor. In this paper, we encapsulate that work and highlight for the economic development community relevant challenges and global best practices. While it is clear that globalization and its related challenges can not be controlled, we look to begin the conversation about how those challenges can best be managed.

### *Development of the California Economy*

When gold was first discovered in Northern California in 1848, the ensuing Gold Rush led to the first of many transformations that the state has experienced over the last century and a half. California’s economy subsequently moved from one dominant industry to another: first agriculture, oil and mining; then motion pictures and defense. In the mid 20<sup>th</sup> century, electronics innovations became

central and played a role in the development of the integrated circuit, personal computer and the Internet.<sup>i</sup> Reliance on a few primary industries resulted in significant economic corrections from time to time but also gave the state “first-mover advantage” in the establishment of new industries, which often boasted large profit margins. Thoughtfully, the state invested a substantial percentage of its tax revenue in the development and support of the one of the best public university systems in the nation, if not the world. What has become clearer after analysis and reflection is the underpinning of California’s economy- no matter the industry sector- is a simple truth: knowledge and competencies. The real competitive advantage is the cluster of know-what, know-how and know-whom that can be aligned swiftly to newer, innovative technologies.

### *Challenges to the Economy*

In recent years, however, California has faced challenges, which have come from both home and abroad. California has had to respond to incentive battles with other states, such as Arizona and Utah, which are looking to attract jobs (more than 350,000 manufacturing jobs were lost between 2001 and 2005).<sup>ii</sup> Its state corporate income taxes are at the high end of the spectrum, and California has a significant challenge in housing affordability.

California has also been faced with demographic challenges. There are an estimated 2.6 undocumented immigrants in the state. Of the 37 million total residents of the state, it is estimated that nearly 10 million are foreign-born.<sup>iii</sup> The fact that over 7% of the state population is estimated to be undocumented and over 25% of the population is foreign born means that there are substantial challenges around social integration, let alone healthcare and education costs. One benefit of California’s large immigrant community is that it has helped the state develop business linkages with other countries and is directly responsible for the establishment of the venture capital community in India and Israel.

There are significant challenges around the skills gap that is developing between the retiring baby boomers and the immigrants who will comprise much of the workforce in coming years. Two of the primary workforce issues deal with the decline of graduates in science, technology, engineering and math (STEM) among native-born Americans and the fact that many immigrant workers often arrive with little to no skills. High-skill immigrants, who arrive under H-1B visa status, may have the required technical skills but may not become permanent residents, especially as their home economies’ are becoming magnets for innovation and growth too.

From abroad, California has been challenged by the dramatic increase in research and development in countries such as Singapore, Israel and China and the outsourcing and offshoring of jobs to locations such as India. Government plans to co-locate research functions along with production facilities have resulted in the attraction of innovation-intensive business functions away from California to both developed and developing countries. This is best captured in the recent statement by Paul Otellini, the Chairman of Intel, that “Our goal in China is to

support a transition from ‘manufactured in China’ to ‘Innovated in China.’”<sup>iv</sup> It is also unclear how the presence of multiple research units of U.S. firms could cannibalize the allocation of resources towards private research and development in the United States.

There are other macroeconomic challenges that California faces along with the rest of the United States. There has been slow growth in wages, with real average weekly wages in 2005 at the same level as in 1965. The U.S. currently has a large fiscal deficit and has experienced a 15% rise in inequality over the last 30 years, as measured by the GINI index.<sup>v</sup> The trade deficit is currently running around \$60 billion per month, with a total trade deficit of \$758 billion for 2006.<sup>vi</sup> These deficits have been made possible through the investment of foreign currency reserves by countries such as China and Japan in U.S. treasury markets. Currently it is estimated that nearly \$2 trillion is held of U.S. treasuries by those countries alone.<sup>vii</sup> Increasingly countries have followed the lead of places such as Norway and Singapore in the establishment of Sovereign Wealth Funds that invest foreign exchange or oil revenues in business and real estate assets. This trend indicates that foreign countries see the role of the state as central to business growth and economic development by investing in knowledge and entrepreneurship, and have little philosophical (or legal) objection to taking a direct taxpayer-funded equity position in businesses at home and abroad.

### *Strategic Responses*

As the economic development community has begun to understand the impact of global economic trends on local economies, states and regions have looked to develop appropriate responses to the challenges described above. One such effort was undertaken by policymakers in California under the banner of the “California Innovation Corridor”, a region that stretches from the San Francisco Bay to San Diego. This group, led by the California Space Authority and the Bay Area Economic Forum, received a \$15 million, three-year grant from the U.S. Department of Labor that looked to integrate efforts around workforce and economic development. As an element of the CIC WIRED grant, New Economy Strategies provided technical assistance and analysis of global best practices around the regional development and support of innovation capacity.

NES looked at seven global regions: Boston, India, Finland, Singapore, Israel, Brazil and Korea and highlighted both industry clusters that competed with California and academic and government programs that supported innovation capacity. Clearly, other locations have developed world-class strength in specific industries, such as the Life Sciences in Israel, Communications in Finland and IT-Consulting in India. Furthermore, many countries, such as Korea and Singapore have detailed government strategies and benefit from strong government influence, if not command of the economy. Among our findings were the following highlighted best practices and principles, which we organized around a series of recommendations:

### **#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, and should expand upon the highly-regarded Joint Venture Silicon Valley reports.

#### **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 inevitable retirement of millions of 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**

Dipoli, 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 and transitioning previously designed individuals into the knowledge and innovation 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). They are the central body responsible for the 1,346 engineering colleges in India. Technical education in the United States is far less centralized with a 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 1994 to help facilitate the development of voluntary skills and certifications standards. Just as California became a leader in the establishment of environmental regulations due to its market size and activism, the large number of technology firms and prospective students located in the state could provide California with the platform on which to become a leader in skills and certification standards.

#### **#4: Explore and adapt the role of large public-private technology parks, infrastructure and other collaboratories of innovation**

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 technologies and processes. Technology parks are also an important component of global branding for a region's continuous commercialization of ideas locally.

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. Again, the question should be- what role can be played by federal, state and local authorities in coordinating science park policy so that there are more competitive results against the globalization of innovations outside of the California Innovation Corridor.

##### **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: 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 globally 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.

**#6: 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.

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 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.

### *The Challenge of Formalizing Networks and New Innovation Governance*

California's economy has depended for many years on the success of its networks, many of them informal. These may include two friends starting a company in a garage, a chance meeting between an inventor and a VC, or a conversation amongst a group of graduate students. While these informal networks have often served California well, they have also depended to some extent on serendipity.

It was evident from our review of global best practices in innovation capacity that challenger nations have developed more formalized networks. Often these networks are government-led and have resulted in industries and firms that have benefited from strong alignment between government policies and firm success. This *organized dialogue* amongst industry, academia and government over policies for the successful development of innovation capacity has often resulted in success for all three sectors of society.

The challenge for both California and other regions of the U.S. is how to achieve better consensus and coordination on complex and multi-faceted problems, including the globalization of innovation capacity? What may work in a small country such as Singapore may not be feasible in an economically and socially diverse state or region. How can there be both the informal and inventive collaboration that has served the U.S. economy so well, in addition to a more formal structure that can effectively respond to challenges, address shortcomings and efficiently allocate resources? Simply put: California has led national discussions on innovation- the next round of debated and solutions must focus on more modern forms of "infrastructure."

Much of local economic development is focused on business attraction and retention. This often results in incentive wars being waged between states that are looking to boost job growth. Recently, as the role of technology-based economic development (TBED) has been recognized, there has also been increasing competition for academic talent. In the context of the significant global challenges identified above, these beggar-thy-neighbor efforts look increasingly shortsighted. States and regions need to focus on the imminent global challenges and look to develop innovative and comprehensive responses, including the better investment and development of knowledge and competencies.

### *Next Steps*

The California Innovation Corridor and the WIRED initiative are looking to move from identifying problems to developing comprehensive and sustainable solutions. While some of the industries and challenges discussed above are specific to California, there is much that should be shared with other states and regions in the U.S. as a WIRED national best practice platform for mitigating

similar risks and challenges. Given that many of the challenges are complex, we strongly encourage the Corridor, the WIRED community and the state to consider as the critical the creation of a “360° knowledge and innovation radar.”

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<sup>i</sup> Innovation, Productivity and California’s Prosperity. Collaborative Economics, September 2004

<sup>ii</sup> *State policy puts California manufacturing at disadvantage*

Los Angeles Business Journal, August 28, 2006 by Jack Stewart, Wayne Schell

<sup>iii</sup> Pew Hispanic Center, In Opportunities and Challenges for the California Economy. Center for Continuing Study of the California Economy.

<sup>iv</sup> “Intel plans \$2.5 Billion Chip Factory in China” AP, March 26, 2007

<sup>v</sup> *How Countries Compete* Richard H. K. Vietor Boston: Harvard Business School Press, 2007, pp 250-260

<sup>vi</sup> U.S. Census Bureau, Foreign Trade Division.

<sup>vii</sup> IMF