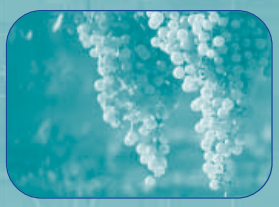
CALIFORNIA
REGIONAL ECONOMIES PROJECT

INNOVATION, PRODUCTIVITY, AND CALIFORNIA'S PROSPERITY






INNOVATION, PRODUCTIVITY, AND CALIFORNIA'S PROSPERITY

A Monograph of the
California Regional Economies Project
September 2004

Prepared By
Collaborative Economics

With Assistance from
Center for the Continuing Study of the California Economy

CONTENTS

PREFACE

PURPOSE: THE CALIFORNIA REGIONAL ECONOMIES PROJECT

The California Regional Economies Project provides California's economic and workforce development system with information about changing regional economies and labor markets. The Project is a joint effort of the California Workforce Investment Board and the California Economic Strategy Panel. The Project was initiated in response to these challenges:

- California's economy is under-performing relative to its potential-we have tremendous talent, world-class companies, and a tradition of innovation.
- California lacks an economic and workforce investment strategy that focuses on regional strengths and opportunities, and connects state and local efforts for maximum impact.
- Local and state policymakers lack reliable and timely information about emerging industry and job opportunities, making good investment and policy decisions difficult.

The Project develops information that measures the performance of California's regional economies. This information provides a key resource in economic and workforce development planning, and a bridge connecting economic and workforce policies and programs at the state and regional levels.

Through its products and forums, The California Regional Economies Project fills a need for better information that can:

- improve specific decisions about state, regional, and local workforce investments and policies;
- connect state, regional, and local economic and workforce investment strategies;
- focus state, regional, and local marketing efforts on areas of regional economic advantage and opportunity;
- inform policy and investment decisions of government so that they promote, rather than discourage economic innovation and competitiveness; and,
- help individuals navigate their own transition to new employment opportunities.

PHASE I OF THE PROJECT: PRODUCTS AND FORUMS FOR USERS

During 2003-4, information was compiled for each of the nine California Economic Strategy Panel regions-Northern California, Northern Sacramento Valley, Greater Sacramento, Bay Area, San Joaquin Valley, Central Sierra, Central Coast, Southern California, and the Southern Border Region (see following map).

Each of these reports was presented at a regional forum, and discussed with the regional user community (e.g., employers, workforce investment boards, local economic development organizations, local education and training institutions, local government agencies, and other interested community leaders). At each forum, users had the opportunity to discuss the findings and suggest priorities for further cluster analysis (see following chart).

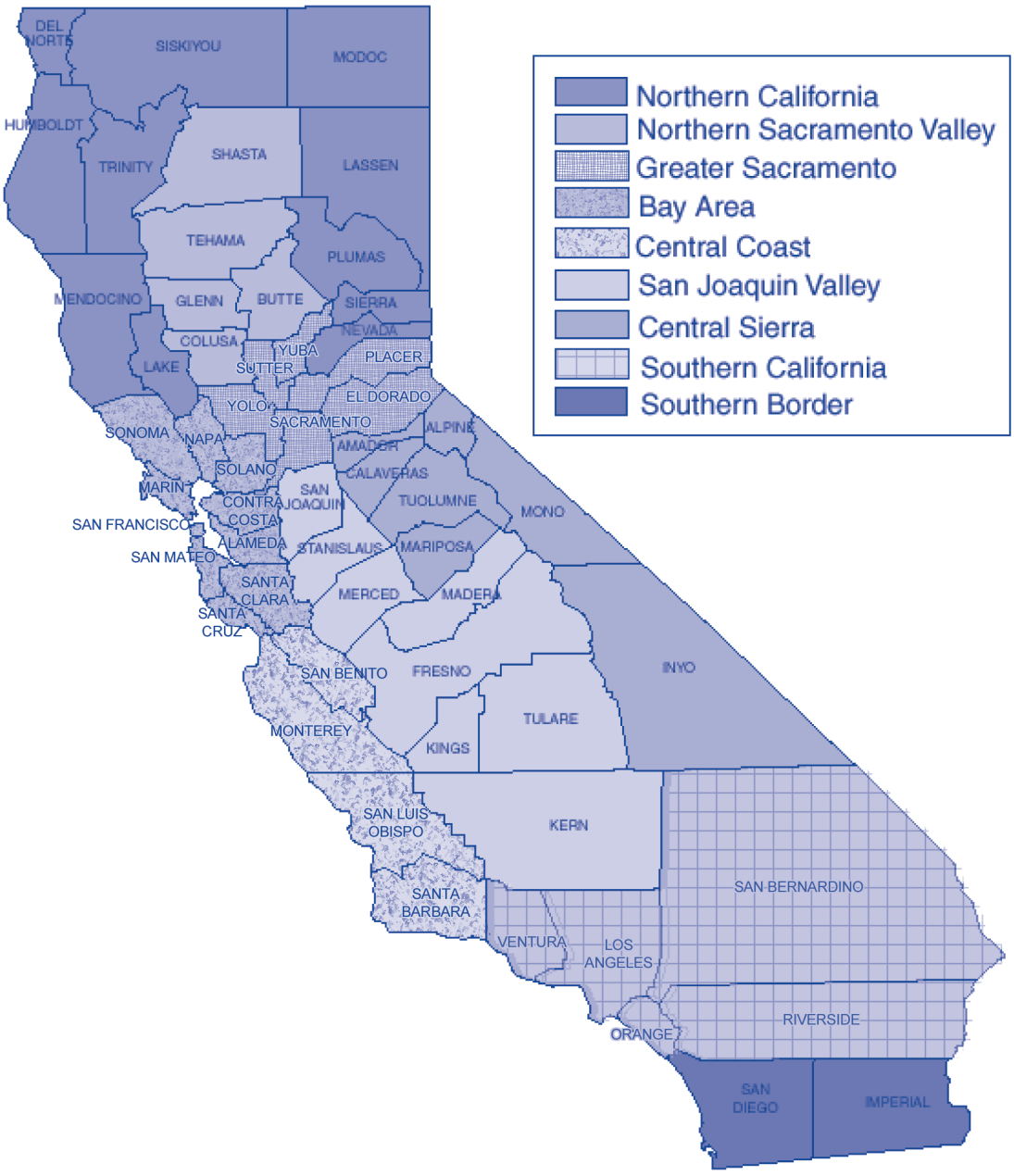
In addition, the Project compiled multi-region, cross-cutting Cluster of Opportunity reports. The focus for these reports was based on recommendations from the user community at regional forums and analysis of trends in the regional data. As a result, the Project focused on industries and occupations involved in:

- *Health Science and Services* (across all nine regions of California)
- *Manufacturing Value Chain* (the value chain of design, production, and logistics sectors in the five most urban regions of the state)
- *Regional Experience/Infrastructure* (in the four most rural regions California)

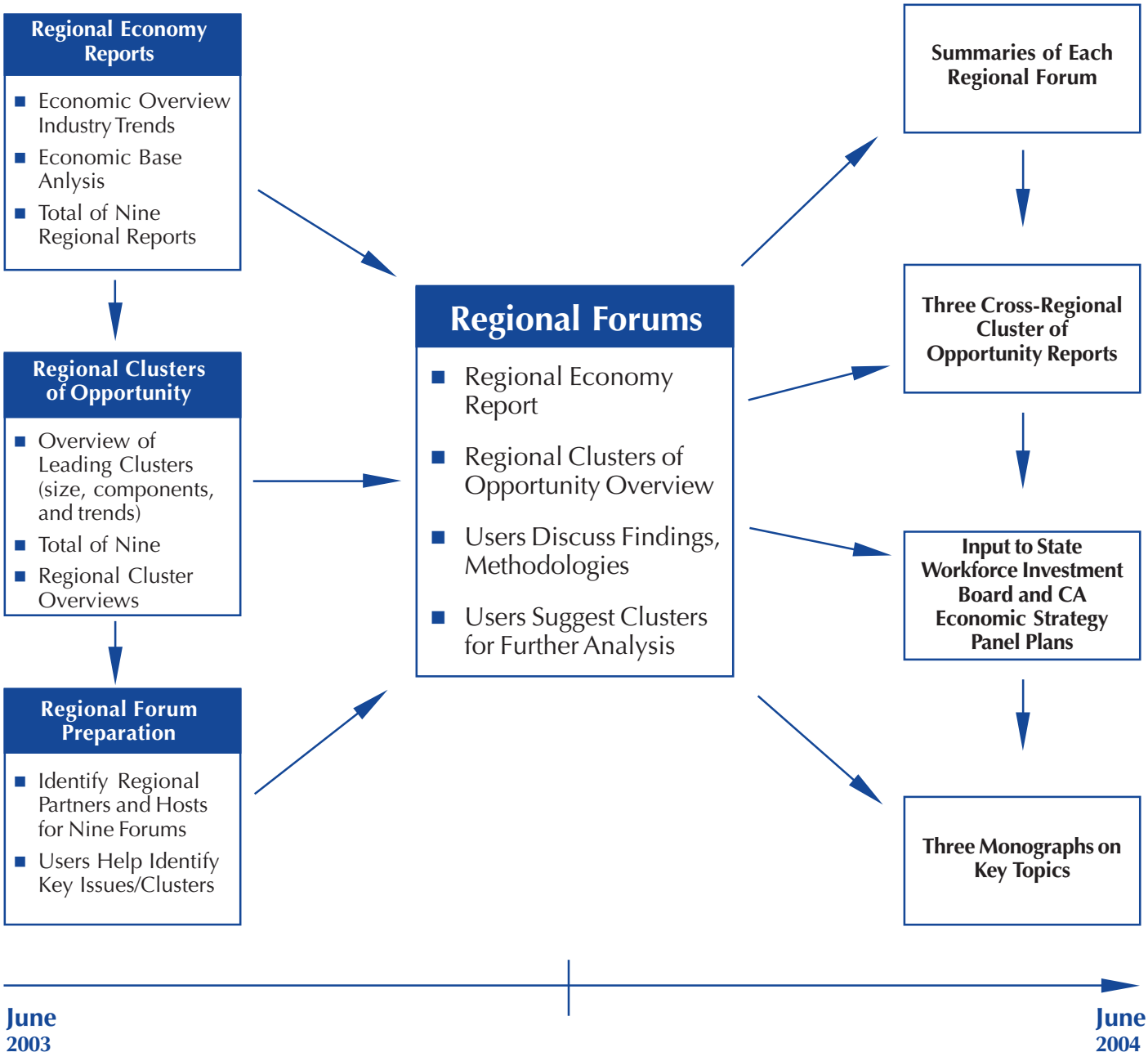
Each region was examined as part of the clusters of opportunity shown below.

Regions	Health Science and Services	Manufacturing Value Chain	Regional Exp/Infra
Northern California	XX		XX
Northern Sacramento Valley	XX		XX
Greater Sacramento	XX	XX	
Bay Area	XX	XX	
San Joaquin Valley	XX	XX	
Central Sierra	XX		XX
Central Coast	XX		XX
Southern California	XX	XX	
Southern Border	XX	XX	

THE PROJECT REGIONS



CALIFORNIA REGIONAL ECONOMIES PROJECT



The Project also produced monographs focused on key policy areas of concern to the regional user community and state-level policymakers. These monographs are focused on:

- *The Conditions of Competitiveness of California's Economy*. This monograph provides a balanced look at California's business climate by examining both cost and productivity factors with a special focus on the role of talent.

- *Innovation, Productivity and California's Prosperity*. This monograph examines the role of innovation in changing industry clusters, the impact of innovation and technology on productivity as well as the impact of productivity on the dynamics of job change.

- *Creating a Workforce Transition System in California*: Based on the regional analysis, this monograph recommends how a workforce transition system could be designed to help workers make transitions both within industries through career progression from entry to mid and higher occupational levels as well as transition across industries through adjustment to structural economic changes.

The monographs reinforce findings from the cluster reports as well-namely the importance of a balanced business climate based on cost and productivity, the imperative of innovation across all industries, and the need for a more effective workforce transition system to support California employers in their drive to innovate and remain competitive in the global economy.

PROJECT TEAM AND SPONSORS

The Project Team includes Collaborative Economics (www.coecon.com), Center for the Continuing Study of the California Economy, (www.ccsce.com), California Center for Regional Leadership (*www.calregions.org*), and J.K., Inc.

The *California Workforce Investment Board* was established in 1998 to provide strategic guidance to the state's workforce investment system. For more information, visit http://www.calwia.org.

The bipartisan *California Economic Strategy Panel* was established in 1993 to develop a statewide vision and strategy to guide public policy decisions for economic growth and competitiveness. For more information visit www.labor.ca.gov.

EXECUTIVE SUMMARY

- *Innovation is the key source of productivity growth and productivity is key to long-term prosperity*. This is the recipe for economic success in the global economy. However, many economists and economic development professionals rarely factor innovation into their thinking about the economy. More often, the economy is viewed as moving in a straight line, with the future much like the past with factor inputs especially capital investment playing the critical role in economic growth.

- *California's prosperity has always depended on productivity growth based on innovation*. Even when California was primarily a resource-based economy in the 19th Century with the Gold Rush, the development of agriculture in the Central Valley and discovery of oil, our state was a leader in mining, seed technology (e.g. Luther Burbank) as well as irrigation and drilling technology. In the 20th Century, California's economy was driven by innovations in motion pictures and defense industries as well as microelectronics, including the invention of the integrated circuit, personal computer, networking and the Internet and now biotechnology. Each of these innovations has led to dynamic surges in the California economy.

- *In the long term, an advanced economy like that of California cannot compete by just lowering costs or increasing inputs. The way to compete and raise our standard of living is to find new and better ways to use natural, human, and capital resources to increase productivity*. Ideas are the primary catalyst for economic growth. New ideas generate growth by reorganizing physical goods in more efficient and productive ways. The ingredients (the physical items) are not as important as the recipes (the ideas). There is also now a much better recognition of the impact of "disruptive technologies" that will transform markets and create new opportunities and the need to respond rapidly. These forces of competition will only increase as India and China increase their production of technology goods, and as Taiwan, Korea and other nation move up the value added production chain.

- *Overall, California's economy in terms of jobs growth and productivity growth has performed rather well during this national period of slower job growth*. California is about at the national average in job growth and above the national average in productivity. To maintain a rising standard of living it must continue to compete based on innovation and productivity. California's productivity has been historically higher than the U.S. on a statewide base, with some of its regions such as the Bay Area, including Silicon Valley, well above the national average.

- *While each region has a different set of industries and must compete globally in its own way, every region and industry needs to become more innovative based on increasing productivity*. This is true for agriculture and manufacturing as well as professional services, tourism and entertainment and health care as well as so called "high tech" industries such as information and biotechnology. In fact, in today's world there are no longer any "high tech or low tech" industries, only innovative or non-innovative firms. Those firms that are not innovating are not likely to survive in the global economy.

- *What is the secret of innovative regions?* The answer lies in the dense and flexible networks of tight relationships among entrepreneurs, venture capitalists, university researchers, lawyers, consultants, highly skilled employees, and others who know how to translate ideas into new products and services fast enough to stay on the edge of the innovation curve. These complex networks continually connect people with good ideas and test the changing market, always searching for the next innovation.

- *Innovation is a social process*. It rarely occurs because a single individual or firm takes an idea to market. Instead, it involves many people playing many roles in a dynamic collaborative process built around creative teams and face-to-face interaction. Creative work, as opposed to routine production, requires close proximity. Innovation is not a linear process, but an active process of learning through trial and error. Networks speed up the innovation process by connecting people across boundaries and accelerating learning.

- *California's regions face the twin challenges of economic growth and workforce investment as they compete in the global economy*. One goal is to promote economic growth by supporting industries that will generate high paying jobs based on productivity and innovation. Another important goal includes ensuring that California's workforce has the skills that will match the opportunities generated by a growing economy. Workforce investment strategies should be designed to help all people achieve career mobility whether they are starting at entry-level or mid-level occupations within growing industries. A high growth strategy will need complementary workforce strategies that help people prepare for the jobs of the future and make the transitions that will be inevitable in a fast changing innovation-based, global economy.

- *It is important to remember that critical investments were essential at each stage of California's economic progress*. First, there were investments in railroad construction and then in water systems for agriculture in the Central Valley and aqueducts for Southern California. Next there were investments in the defense and aerospace industries as well as the early developments in the microelectronics, computers and software industries. For example, the Internet evolved from a defense-funded project; our leadership in biotechnology has been stimulated by National Institutes of Health investments. In addition, California invested in the Master Plan for Higher Education, which provided the world's best public system of research and learning that has helped to develop and draw top talent to our state to support our technology leadership.

- *Thus, innovation and investments have gone hand in hand in the economic progress of California, combining the efforts of entrepreneurs who are seeking new opportunities through innovative products and services and are supported by critical investments of technology, human infrastructure and capital infrastructure.*

- *A good business climate for California requires both critical investments that add to productivity as well as policy reforms that will reduce the cost of doing business* such as changes in the worker compensation system. While direct costs should be reduced through policy reform, California will have to continue to compete on innovation as well cost to maintain its high standard of living based on rising productivity. Productivity is a function of investments in people and technology as well as financial capital. California's historic productivity advantage has compensated for our relatively higher cost to help maintain our competitiveness.

- *California must commit to a pro-innovation, high productivity economic strategy that promotes shared prosperity for all of its people*. This is the only way we can compete and raise our standard of living in every region of the state. Every industry can become more innovative and increase its productivity by adopting new technologies, improving its organization of work, and increasing the skills of its workforce. A pro-innovation, high-productivity economic strategy has several critical elements that should be developed and implemented at both the state and regional level.

- *Investing in research and development* is especially important in critical technologies including information, bio and nanotechnologies as well as energy and environmental technologies at the state's universities and national labs. This will require both federal and state funding and a continued commitment to excellence in both fundamental and applied research.

- *A focus on R&D excellence also requires continued public-private collaboration because we know that innovation requires strong partnerships among universities, industries, financial institutions and entrepreneurs to promote commercialization of new ideas and technologies*. California has made these commitments in the past through its world-class university systems and more recently through its support of centers of excellence in specific fields such as biotechnology. More needs to done working closely with regions, industries and universities. The recent California Council on Science and Technology report on Nanotechnology provides a roadmap for that opportunity. Life science and biotechnology are additional areas where roadmaps already have been developed and now need to be actively supported.

- *Investing in people is also critical*. Productivity depends on the skills of people who develop and apply technology. Skills are required at all occupational levels within each industry if it is to continuing increase its productivity through innovation. A pro-innovation economic strategy requires a new kind of workforce support system that helps people manage inevitable transitions due to fast changing industry and region conditions. The key characteristics of this new workforce transition system are described in a separate monograph.

- *Just as California made the critical investments in water and transportation systems that helped to build the industrial economy and later created the world's leading public university system, California and its regions now need a long-term investment strategy for growth and prosperity that recognizes that we must compete globally on the basis of innovation and productivity growth.*

I. INTRODUCTION

California's prosperity has always depended on productivity growth based on innovation. Even when California was primarily a resource-based economy in the 19th Century with the Gold Rush, the development of agriculture in the Central Valley and discovery of oil, our state was a leader in mining, seed technology (e.g. Luther Burbank) as well as irrigation and drilling technology. In the 20th Century, California's economy was driven by innovations in motion pictures and defense industries as well as microelectronics, including the invention of the integrated circuit, personal computer, networking and the Internet and now biotechnology. Each of these innovations has led to dynamic surges in the California economy.

It is therefore a paradox how little a role innovation plays in most discussions about economic development. Maybe it is because innovation is so unexpected and produces such unanticipated results that many economic development professionals and economists believe the future will be much like the past, following well-known paths. However, the reality is that innovation and productivity have been the critical and continuing sources of prosperity in California's economy.

The primary focus of most discussion in economic development is job growth. While the quantity of jobs is very important and a useful and well understood measure of the health of an economy, a better measure of long term economic success is productivity growth that generates increasing per capita income. This is reflected in the "quality" of jobs, including such measures as real wages. It is now increasingly clear that innovation is the key to productivity growth.

While increasing productivity in the short run may lead to job losses in specific industries or even "jobless" economic growth during times of cyclical recessions due to declines in overall demand, over the long term a state or region especially with high factor input costs, including high wages and land costs, must compete on increasing productivity based on innovation. Macroeconomic policies including sound monetary and fiscal policies are important to maintaining overall demand and addressing business cycles. However, if California wants to maintain its high standard of living, its industries and its regions must compete on quality and innovation and not simply low cost.

While each region has a different set of industries and must compete globally in its own way, every region and industry needs to become more innovative based on increasing productivity. This is true for agriculture and manufacturing as well as professional services, tourism and entertainment and health care as well as so called "high tech" industries such as information and biotechnology. In fact, in today's world there are no longer any "high tech or low tech" industries, only innovative or non-innovative firms. Those firms that are not innovating are not likely to survive in the global economy.

II. TWIN CHALLENGES OF ECONOMIC GROWTH AND WORKFORCE INVESTMENT

California faces the twin challenges of economic growth and workforce investment as it competes in the global economy. One goal is to promote economic growth by supporting industries that will generate high paying jobs based on productivity and innovation. Economic development should focus on this goal as measured by rising per capita income.

There is another important goal which include ensuring that California's workforce has the skills that will match the opportunities generated by a growing economy. Workforce investment strategies should be designed to help all people achieve career mobility, whether they are starting at entry-level or mid-level occupations within growing industries. These industries might including health care, construction, logistics and professional services as well as the high productivity growth industries that are often the primary focus of economic development organizations.

Changing demographic and education levels determine the skills base of the workforce. Investments in labor supply need to match with the demands for economic growth within specific industries and regions. Growing mismatches leads to structural unemployment, which can be as big a long-term problem for some regions as cyclical unemployment.

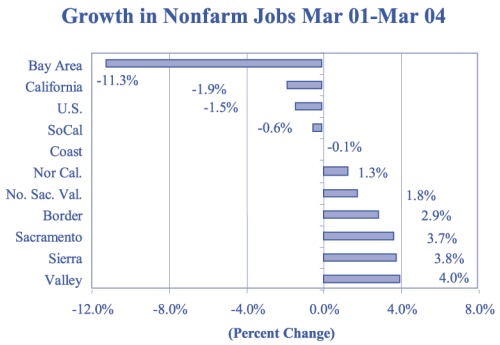
Both goals are important as the foundation of any state or regional economic strategy that focuses on promoting shared prosperity: growth with opportunity for all. This monograph makes that point that without strong innovation strategies that promote productivity and growth, jobs will not be created for the workforce of the future. A high growth strategy will need complementary workforce strategies that help people prepare for the jobs of the future and make the transitions that will be inevitable in a fast-changing innovation- based, global economy. This type of flexible workforce strategy is addressed in a separate monograph. An innovation-based economic strategy needs supportive policies and a strong overall competitive business climate as well, and that topic is addressed in a third monograph in this series.

Together, these monographs point toward policies for California's economic and workforce strategies of the future.

III. WHAT WE LEARNED FROM THE CALIFORNIA ECONOMIC REGIONS PROJECT

Based on the nine regional economic analyses and regional forums, the California Regional Economies Project learned about the dynamic nature of the California economy and what has been driving industry change at the "micro" level. While most of economic discussion takes place at a macro level (e.g. the overall economy or jobs are growing or declining) or the one digit industry level (e.g. manufacturing is declining), this Project allowed a much more in-depth, "disaggregated" look at the California economy by region and by industry. We learned once again that California is an economy of regions and that individual industries within each region are driven by different markets, technology and global forces.

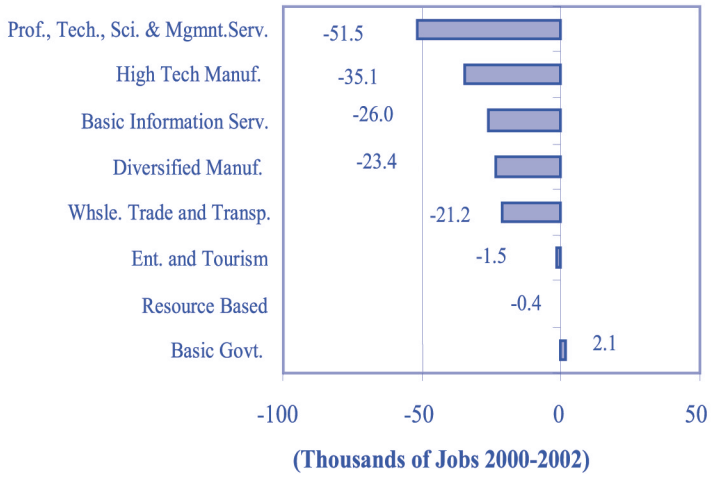
In particular, we learned that employment change in California has varied widely since economic downturn of 2001 with most of the job losses concentrated in the Bay Area. Most other regions have done better. While Southern California has lost jobs, California overall has done about as well as the nation in terms of jobs. In the early 1990s recession, California's job losses were concentrated primarily in Southern California. This time, job losses have been concentrated in the Bay Area, with over 400,000 jobs lost in this region since 2001. The rest of the state lost under 300,000. Accordingly, the following section will focus on these dramatic changes in the Bay Area. However, it is important recognize that similar structural changes have been occurring in other regions as manufacturing industries transform, especially in Southern California where direct production jobs have been lost especially in Los Angeles while jobs in other parts of the manufacturing value chain as well as services have been growing in the region, especially in the Inland Empire and Orange County (the subject of a separate cluster study), while the agriculture economy continues to restructure in the San Joaquin Valley.



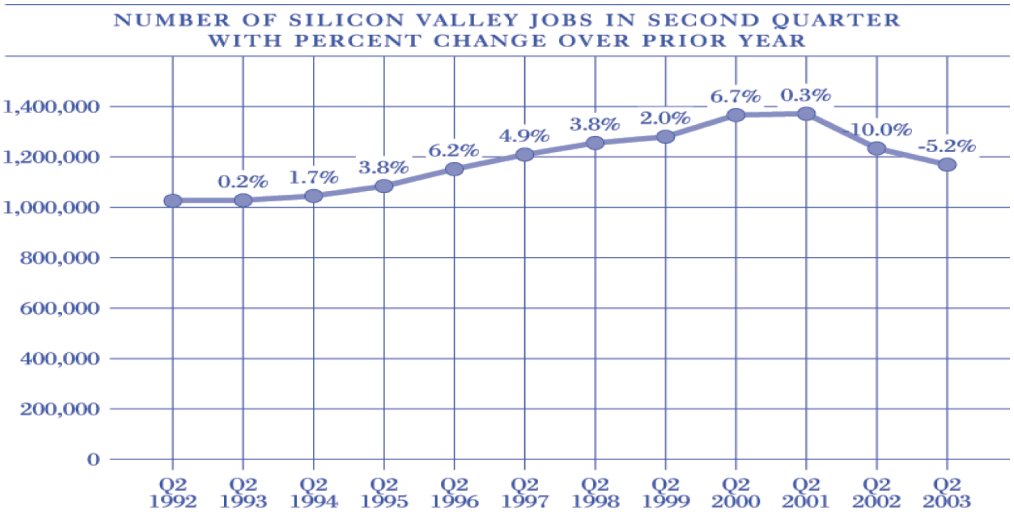
What explains this dramatic loss of jobs in the Bay Area region? Part of the explanation has been the national recession that has slowed job growth nationally and within California. However, the regional difference is primarily a result of the specific mix of technology intensive industries in the Bay Area and its nature as a prototype of a high productivity, innovation-led regional economy.

The Bay Area's innovation based, high productivity industries have been going through a boom/bust cycle in employment. We are learning that innovation does not move in a straight line of economic progress. In particular, Silicon Valley added 357,000 jobs between 1992 and 2000 during the Internet boom, but has lost 202,000 since 2000. Silicon Valley employment is now returning to pre boom levels.

Change in Bay Area Economic Base



Silicon Valley Jobs Return to Pre-Bubble Employment Levels

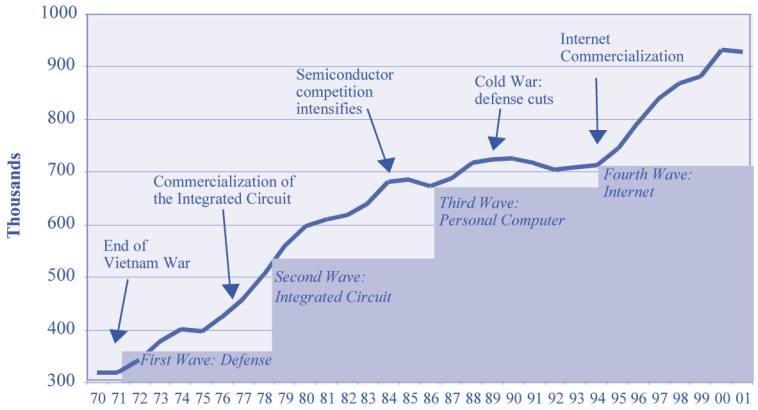


Source: California Employment Development Department

This has happened before as the region experienced a series of innovation waves as a result of the introduction of new technologies such as the integrated circuit and microprocessor, the personal computer, and the Internet as well as the impact of defense spending in the 1960s and the 1980s.

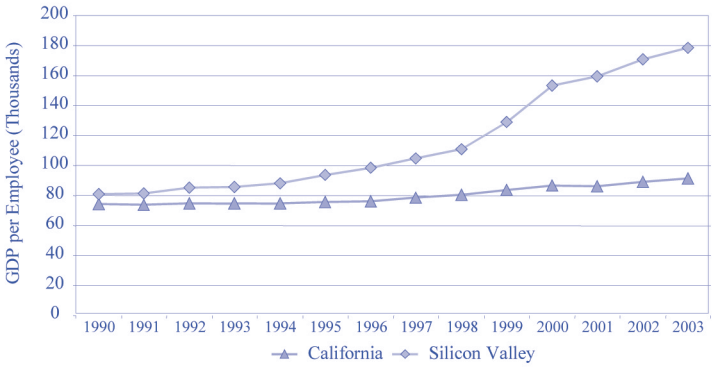
These waves have generated "boom-bust-build" cycles with bursts of employment growth followed by declines when either new technologies become commodities (e.g,. the Japanese learned about making semiconductors in the 1980s or the Internet bubble burst) or demand declined (e.g., after the Vietnam and Cold Wars). However, at the end of the cycle the employment levels where higher than before.

Silicon Valley Employment Waves: A Boom, Bust, Build Pattern



In a seeming paradox, even with employment losses since the Internet bubble burst, regional output and productivity in Silicon Valley has continued to grow. This is an important finding. In fact, while Silicon Valley lost more than 200,000 jobs since 2000, the region's productivity has been increasing rapidly.

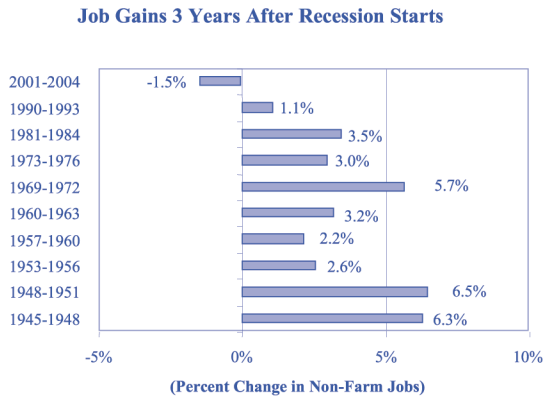
Silicon Valley's Long Term Advantage: Highest Productivity per Employee



Source: Economy.com

In fact, productivity has been rising across the nation during the entire period of slow job growth since 2000. This has lead to discussions about both "jobless recovery" and the "paradox of productivity." When productivity grows faster than economic demand, jobs are not created because production can be met by output growth without adding more employment. Firms learn how to do more with fewer workers. We have clearly seen this in the Bay Area since 2000 as a microcosm for what has been happening to the nation.

Since the end of the national recession in 2001 with rising output, jobs have not been growing as fast as prior recoveries.



One explanation has been the sustained growth of productivity. Some of the important questions this raises include:

- when will the "jobless recovery" end?
- at what rate will job growth increase?
- have there been some fundamental changes in the structure of the economy?
- what will be the new drivers of future growth?

Some important answers that can shape policy can be found in the relationship between innovation, productivity and prosperity.

IV. RELATIONSHIP BETWEEN INNOVATION-PRODUCTIVITY-PROSPERITY

Innovation is the key source of productivity growth and productivity is key to long-term prosperity. This is the recipe for economic success in the global economy. However, many economists and economic development professionals rarely factor innovation into their thinking about the economy. More often, the economy is viewed as moving in a straight line, with the future much like the past with factor inputs especially capital investment playing the critical role in economic growth.

Robert Solow, the Nobel Prize winning MIT economist, was one of the first modern economists to recognize the importance of technology and innovation in economic growth when he found that over half of productivity growth was explained by technology that promoted more efficient use of capital and labor. Simply adding more land, capital and labor reached diminishing returns at some point in modern economies.

Returning to the earlier thinking of Joseph Schumpeter, we are now rediscovering that economic development results from a process of "creative destruction," where new technologies replace the old in a endless stream of innovation. Innovation comes in unexpected waves based on new discoveries that ripple through the economy creating continued surges of growth.

WHAT IS THE SECRET OF INNOVATIVE REGIONS?

How did Silicon Valley make continual leaps across technology waves over four decades, moving from leadership in integrated circuits in the 1960s to leadership in personal computers in the 1970s, in software in the 1980s, and the Internet in the 1990s? All these innovative leaps occurred in the face of rising costs, growing competition, and the rapid diffusion of technology. The answer lies in the dense and flexible networks of tight relationships among entrepreneurs, venture capitalists, university researchers, lawyers, consultants, highly skilled employees, and others who know how to translate ideas into new products and services fast enough to stay on the edge of the innovation curve. These complex networks continually connect people with good ideas and test the changing market, always searching for the next innovation.

Why did San Diego become a hotbed of bioscience and digital communications start-ups in the 1990s while Houston-with its much greater concentration of assets, including the world-renowned Houston Medical Center, NASA Space Center, Rice and Baylor Universities-produce only one-fifth as many entrepreneurial firms in the same fields? An important reason may be that San Diego learned how to stimulate an entrepreneurial environment by actively connecting its assets through formal and informal innovation networks; Houston has not done this as effectively. Assets by themselves are not enough in the innovation economy.

Innovation and the successful entrepreneurs that drive innovation are embedded in regional networks that connect assets in ways that create wealth and opportunity for both firms and individuals. *Innovation is a social process*. It rarely occurs because a single individual or firm takes an idea to market. Instead, it involves many people playing many roles in a dynamic collaborative process built around creative teams and face-to-face interaction. Creative work,

as opposed to routine production, requires close proximity. Innovation is not a linear process, but an active process of learning through trial and error. Networks speed up the innovation process by connecting people across boundaries and accelerating learning.

The key to understanding innovation is the power of these regional networks that allow individual entrepreneurs to connect in new ways. In a seeming paradox, successful entrepreneurship today requires an innovative, collaborative region.

WHAT IS INNOVATION?

There is now a growing awareness that innovation is the key to success in the today's economy. Continuous reinvention is required to keep pace with the rate of change that we now face. Any person, organization, or place that resists change will inevitably fall behind.

What is innovation? Literally, it is the act of making changes. It involves introducing new ideas and new way of doing things. Peter Drucker defines innovation as follows:

> *Innovation* consists of the purposeful search for changes and the opportunities that such changes might offer.

Drucker maintains that innovation and entrepreneurship go together. Entrepreneurs innovate, and innovation is the specific instrument of entrepreneurship. Drucker says also, "The *entrepreneur* always searches for change, responds to it and exploits it as an opportunity." Drucker, like the economist Joseph Schumpeter, sees innovation and entrepreneurship as the engines of change in the economy. They are the source of wealth creation and the generator of opportunity for individuals and society.

WHY INNOVATION IS CENTRAL TO ECONOMIC GROWTH

The key to prosperity is increasing productivity. Productivity growth is the basis for rising real wages for workers, increasing returns to shareholders, and increasing per capita income for a region and the nation.

The basis for increasing productivity is innovation. In the long term, an advanced economy like that of the United States cannot compete by just lowering costs or increasing inputs. The only way to compete and raise our standard of living is to find new and better ways to use natural, human, and capital resources to increase productivity.

Stanford economist Paul Romer has developed a "new growth theory" that provides a way to understand the central role of innovation in advanced economies. In new growth theory, ideas are the primary catalyst for economic growth. New ideas generate growth by reorganizing physical goods in more efficient and productive ways. For Romer, the ingredients (the physical items) are not as important as the recipes (the ideas).

> Recipes (new ideas) combine ingredients (natural, human, capital resources) in new and different ways to yield more valuable economic results. The recipes come from the innovation process.

What conditions support innovation where new ideas are generated and existing ingredients translate into higher-value outcomes?

The McKinsey Global Institute has confirmed the importance of innovation in a series of industry reports over the past decade, summarized in the book the *Power of Productivity* (University of Chicago, 2004) by former Global Institute Director, William M. Lewis. Based on studies of nine major industries, this research has found that:

- productivity growth measured by GDP per capita is key to prosperity
- economic growth was essential to regional success and at the core of productivity
- economic growth was the product of continuous innovation in the face of competition by organizing work in more effective ways.

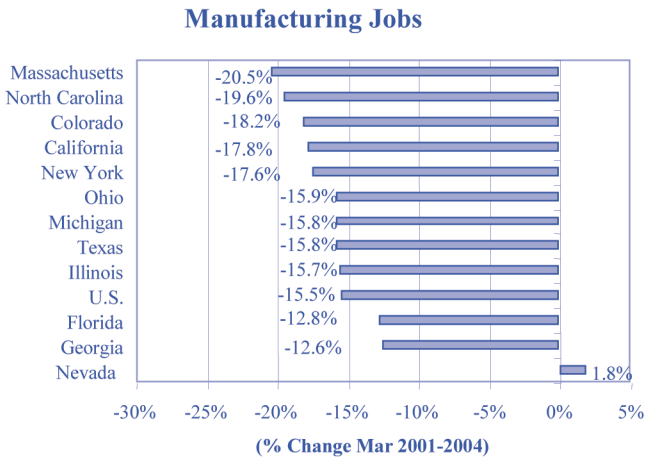
In fact, their studies found that the *how work is organized* was even more important than *technology* in explaining productivity gains as seen by the success of lean production methods of Toyota in auto manufacturing.

Michael Mandel, the Economics Editor of *Business Week* has described the importance of what he calls "exuberant growth" to long term prosperity: "we call innovation driven growth *exuberant growth*, because large scale innovation is usually accompanied by excitement and sense of exploration" (*Rational Exuberance*, Harper Business, 2004). He makes that case for pro-growth, innovation-led economic strategies that promote long-term prosperity. He also recognizes that exuberance will lead to boom-bust cycles that we need to prepare for through both our economic and workforce strategies.

How then do we address the fundamental "productivity paradox" which lies at the heart of so much unease about the economy and the concerns about job growth? While it is clear that output has been rising as a result of innovation and productivity, when do we get the benefits of job growth?

In the 1990s, jobs began to grow in the mid decade after a recession as output began to increase faster than productivity. Even as productivity continued to rise at the end of the decade, demand continued to rise fast enough to create jobs.

Between 2001-2003, a "jobless recovery" could be explained largely by the growth of productivity that was faster than demand. This has now begun to change, with the overall growth of the U.S. economy in 2004 and jobs are increasing again.
However, productivity affects industries in different ways. Most affected today have been the manufacturing industries, especially the production workers within manufacturing. Much like agriculture in 19th and 20th Century, the U.S. has been producing more output with fewer workers. The loss of manufacturing production jobs is happening in all states due to productivity, not just in California.



Both structural and cyclical changes explain these job growth patterns. While changes in overall macro demand remain critical to employment, some sectors are growing faster than others. For example, there has been a shift from goods manufacturing production employment to service employment in all advanced economies. Today, in advanced economies, employment in service industries accounts for 70-75 percent of all employment, manufacturing production accounts for 20-25 percent, with agriculture less than 5 percent. Some service sectors such as health care and business services are growing faster than other sectors in advanced economies. These structural changes are important to understanding how both productivity and economic growth will generate both jobs and prosperity in the future. The cluster of opportunity studies on manufacturing and health care in this series analyze the causes and consequences of these structural changes in more depth.

A controversial topic at the current time is the impact of "offshoring" or outsourcing of jobs to other countries, especially India and China. While outsourcing has been occurring for many decades in manufacturing, so too has "insourcing" of jobs (e.g. foreign investment in the U.S. in auto manufacturing). Nonetheless, offshoring has been a difficult issue for people.

One recent study of the impact of the outsourcing of IT software and services on the U.S. economy and the IT industry by the econometric firm Global Insight (2004) makes an important point about productivity, innovation and prosperity and their impact on jobs during times of structural economic change. Simply put, this study found that because of the productivity gains of outsourcing the lower-cost IT jobs, other sectors of the US economy would grow faster and the net effect would be that outsourcing would create twice as many jobs as jobs lost, with an increase in real wages across all industry sectors. Industries such as health care, business and professional services as well as manufacturing and construction would gain additional higher paying jobs due to the increased productivity gained from lower cost information technology. While there will be winners and losers in this restructuring of jobs, the key will be helping individual workers better manage these transitions. This is the subject of a separate monograph on managing workforce transition.

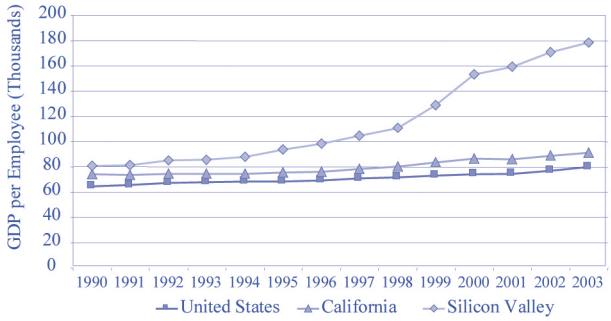
According to William Lewis of the McKinsey Global Institute, "productivity really is the engine of growth." Innovation is the key to productivity and leads to higher wage jobs. The recipe for innovation is building strong networks that generate and share ideas that lead to rapid commercialization. At the center of this phenomenon are people working in teams: the organization of work and higher worker skills are critical to a high productivity, innovation based economy.

V. EXPLAINING CALIFORNIA'S RECENT PERFORMANCE

California's recent economic performance echoes its history. Most of the recent job loss has been concentrated in one region-the Bay Area and especially Silicon Valley-that has gone through an innovation led boom-bust cycle, and one industry-manufacturing-which has been affected by major changes in productivity.

Overall, California's economy in terms of jobs growth and productivity growth has performed rather well during this national period of slower job growth. California is about at the national average in job growth and above the national average in productivity. To maintain a rising standard of living it must continue to compete based on innovation and productivity. California's productivity has been historically higher than the U.S. on a statewide base, with some of its regions such as the Bay Area, including Silicon Valley well above the national average.

Productivity in U.S., California and Silicon Valley



As we have seen, California's innovation economy has traditionally moved forward in a series of "surges" that have generated jobs based on productivity in response to the forces of competition, new technologies and changing markets. Innovation and entrepreneurship have been the hallmarks of California's economic history. Entrepreneurs have continued to find innovative ways to achieve new opportunities. The discovery of gold stimulated westward migration to California and supported the building of the railroads, which connected our state's Great Valley agricultural products to our national economy.

As noted earlier, in the early 1900s, the birth of Hollywood, followed by the growth of defense and aerospace industries during World War II, spurred the growth of the Southern California economy. Later the creation of the microelectronics industry in Silicon Valley during the 1960s drove the economy of Northern California, and subsequently evolved from personal computers in the 1980s to software and the Internet in the 1990s. At each stage of the state's economic progress, entrepreneurs saw new market opportunities and found innovative ways to serve those markets.

However, critical investments were essential at each stage of California's economic progress. First, there were investments in railroad construction and then in water systems for agriculture in the Central Valley and aqueducts for Southern California. Next there were investments in the defense and aerospace industries as well as the early developments in the microelectronics, computers and software industries. For example, the Internet evolved from a defense-funded project; our leadership in biotechnology has been stimulated by National Institutes of Health investments. In addition, California invested in the Master Plan for Higher Education, which provided the world's best public system of research and learning that has helped to develop and draw top talent to our state to support our technology leadership.

Thus, innovation and investments have gone hand in hand in the economic progress of California, combining the efforts of entrepreneurs who are seeking new opportunities through innovative products and services and are supported by critical investments of technology, human infrastructure and capital infrastructure. In the past California's public investments anticipated growth and preceded private investments. This was case with the Master Plan for Higher Education as well as California's water and highway systems. This has not been the case recently.

Global competition is forcing California firms to create innovative products and adopt process innovations to increase productivity and quality. These innovations have included total quality management in the 1980s, flexible (lean) production and just-in-time methods in the 1990s and movement toward continuous innovation and rapid design and prototyping of new products in this decade.

Not all innovations have to be viewed as "high tech." In fact, an important recent example of innovation in California's regions can be found in the water technology cluster in the San Joaquin Valley Region.

- After identifying that the region had over 90 water technology firms employing more than 2,800 workers, an industry group was formed to promote technology development, training and exports to the $6 billion worldwide market in irrigation and agricultural and turf systems and the $40 billion worldwide municipal water systems market.
- An analysis of innovation assets in the region prepared for the Fresno Collaborative Regional Initiative found that 38% of all Federal R&D awards to universities in the region are now related to irrigation related research. Together, water technology and agricultural technology accounted for 40% of patents in the region.
- Building on the traditional irrigation strengths of the region, the industry group is helping to establish an International Center for Water Technology at California State University, Fresno with assistance of the federal government.

Clearly, in the San Joaquin Valley Region, innovation has focused on new opportunities building off its traditional agricultural strength.It is also the case that we need innovation across all sectors including health care, education and the public sector. In fact, the opportunities for productivity gains in all sectors are clear as a result of changes in the organization of work and the introduction of new technologies. The separate cluster paper on opportunities for health care suggests how the convergence of health sciences and health services are creating an innovative model of personalized medicine.

At the same time, there is now a much better recognition of the impact of "disruptive technologies" that will transform markets and create new opportunities and the need to respond rapidly. These forces of competition will only increase as India and China increase their production of technology goods, and as Taiwan, Korea and other nations move up the value-added production chain.

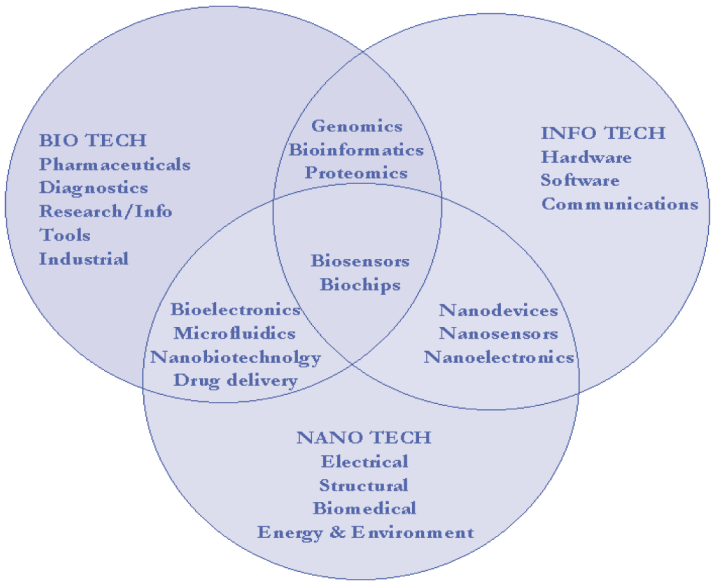
In addition to process innovation and productivity improvements in existing information technology industries and the introduction of new products such as wireless communications, we can expect a convergence of information, biotechnology and nanotechnology that may spark a new wave of product and process innovation in California in the near future.

In this next wave, innovation is likely to occur near the intersection of disciplines. For example, we can expect major advances in biotechnology to converge with information technologies and create new opportunities in the emerging fields of bioinformatics,

biomaterials, and biochips. The commercialization of nanotechnology holds the potential to revolutionize chip and computer manufacturing while creating a new foundation for further developments in information and biotechnology.

The mapping of the human genome was a historical milestone that required new tools at the intersection of bio and information technology. Using sophisticated computational methods has opened the door to entirely new medical products and services. Years of significant investments by the National Institutes of Health are now beginning to pay off in commercial applications. The market for biotechnology products was $16 billion in 1996 and is estimated to double to $32 billion by 2006.

At the same time, nanotechnologies are being recognized as a foundation for advances in both bio and information technologies. Nanotechnology refers to the manipulation of matter at the atomic and molecular scale (where the objects are 0.1 to 100 nanometers in size, hence the term). Nanotechnology it is a multi-disciplinary field that borrows from physics, engineering, molecular biology, and chemistry. It has been pursued very actively in university, government and commercial laboratories worldwide for more than 15 years and yielded a set of building block materials, tools, and techniques that are being applied in a variety of industries including bioscience (as tools for drug discovery and delivery), information technologies (as a next generation to microprocessors and self-assembly) and materials (as new carbon fibers and high performance composites).



The market potential of these converging technologies is substantial. Based on an analysis of existing estimates, McKinsey has shown that the cumulative market for converging info-, bio-, and nano-technologies could top $1 trillion in about a decade.

Could these innovations along with advances in energy and environmental technologies drive productivity and prosperity in California to new levels? This will require investing in people to equip them with the skills required for these new opportunities and investing in the infrastructure necessary to support the entrepreneurs who need and will need access to the technology and capital required to make this vision a reality.

We are not yet prepared for these opportunities. Our current investment in human and technology infrastructure are not adequate to the challenges ahead if we are to continue to be on the leading edge of an innovation-based economy that creates increasing productivity growth, leading to high-wage jobs and shared prosperity.

VI. TOWARDS A PRO-INNOVATION, HIGH-PRODUCTIVITY ECONOMIC STRATEGY FOR CALIFORNIA

Sustaining a vital economy requires state leadership combined with regional and local collaboration to ensure critical investment in the skills and infrastructure necessary for an innovative economy.

A good business climate for California requires *both* critical investments that add to productivity as well as policy reforms that will reduce the cost of doing business, such as changes in the worker compensation system.

While California has an estimated 30 percent higher overall cost of doing business than the nation, it is important to recognize that costs differ widely across different regions of the state, with much lower costs in the Central Valley and rural regions than the Coastal regions. Policy factors such as state-mandated costs are only a portion of higher regional costs, with high housing costs the most important factor in the relatively higher labor cost, especially in the Coastal regions.

While direct costs should be reduced through policy reform, California will have to continue to compete on innovation as well cost to maintain its high standard of living based on rising productivity. Productivity is a function of investments in people and technology as well as financial capital. California's historic productivity advantage has compensated for our relatively higher cost to help maintain our competitiveness.

California must commit to a *pro-innovation, high-productivity economic strategy* that promotes shared prosperity for all of its people. This is the only way we can compete and raise our standard of living in every region of the state. Every industry can become more innovative and increase its productivity by adopting new technologies, improving its organization of work, and increasing the skills of its workforce.

A pro-innovation, high-productivity economic strategy has several critical elements that should be developed and implemented at both the state and regional level.

INVESTING IN RESEARCH AND DEVELOPMENT

Investing in research and development is especially important in critical technologies including information, bio and nanotechnologies as well as energy and environmental technologies at the state's universities and national labs. This will require both federal and state funding and a continued commitment to excellence in both fundamental and applied research.

According to a 2004 RAND report, California is the recipient of $14.4 billion in federal R&D funds and benefits more from any other state from federal R&D support. Recently, the Governor sent the California congressional delegation a letter strongly urging that "federal support for research is made a top priority." In response, a bipartisan coalition of 39 California congressional members sent a letter to top Congressional appropriation committee leaders expressing strong support for federal R&D programs and funding for university research centers. This kind of aggressive advocacy by California for federal R&D is important for the future competitiveness of our economy.

Focus on R&D excellence also requires continued public-private collaboration because we know that innovation requires strong partnerships among universities, industries, financial institutions and entrepreneurs to promote commercialization. California has made these commitments in the past through its world-class university systems and more recently through its support of centers of excellence in specific fields such as biotechnology. More needs to done working closely with regions, industries and universities. The recent California Council on Science and Technology report on Nanotechnology provides a roadmap for that opportunity. Life science and biotechnology are additional areas where roadmaps already have been developed and now need to be actively supported.

INVESTING IN PEOPLE

Investing in people is essential for innovation, especially through workforce investment, education and the organization of work. Productivity depends on the skills of people who develop and apply technology. Skills are required at all occupational levels within each industry if it is to continue increasing its productivity through innovation.

There is another reason to focus on investing in people. Michael Mandel makes the case in *Rational Exuberance* (2004) that "growth oriented policies are unworkable without an equally intent focus on providing more economic security as well. Rapid technological change is inherently threatening to people, because it has the potential to destroy their jobs and overturn their way of life. Therefore, exuberant growth must go hand in hand with economic security. We must give Americans better information and tools to manage the risk they are facing." In short, a pro-innovation economic strategy requires a new kind of workforce support system that helps people manage inevitable transitions due to fast changing industry and region conditions. The key characteristics of a new workforce transition system is described in a separate monograph.

Just as California made the critical investments in water and transportation systems that helped to build the industrial economy and later created the world's leading public university system, California and its regions now need a long-term investment strategy for growth and prosperity that recognizes that we must compete on the basis of innovation and productivity growth.

The appropriate way to make future decisions on both public and private investments is a long-term assessment on return on investment (ROI) based on sound data and informed economic analysis. The information on clusters of opportunities identified by California's regions can provide important input in making these kinds of ROI decisions. How much should be invested in R&D and people should be determined by the specific requirements of industries that have the greatest potential for meeting the economic goals of the state and its diverse regions. A "bottoms-up," regional industry cluster focused, innovation-based economic strategy is not only appropriate given the complexity of the state's economy, but will provide the greatest return on investment in both R&D and people.

The measure of success in the global economy must become rising per capita income and real wages as well as the quantity of jobs. Creating jobs is important for a growing population but if the quality of jobs are not adequate to create shared prosperity, our state's economy will suffer and we will not be able to fund the critical human and physical infrastructure required for our future prosperity.

There is no way to escape the new realities that innovation is the key to productivity growth and productivity is essential for economic growth. Without real economic growth, it is not possible to have long-term prosperity. While there will be dislocations due to boom-bust cycles as we enter waves of exuberant growth fueled by innovation, we need to create a flexible workforce support system that helps people manage the transitions.

Without productivity growth and innovation across all industries combined with an effective workforce transition system, our residents will not have rising, widely shared per capita income, the ultimate goal of economic development. In California, innovation and investments in people must continue to go together and be a high priority for state economic strategy.

GA 894 D