BORDERLESS INNOVATION

CATALYZING THE COMPETITIVENESS OF THE SAN DIEGO-BAJA CALIFORNIA REGION

A REPORT BY

SAN DIEGO DIALOGUE

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DEVELOPED IN COLLABORATION WITH

CENTRIS

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WELLS FARGO

GOBIERNO DEL ESTADO
DE BAJA CALIFORNIA

Acknowledgements

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It is also important to acknowledge the significant contributions of leading thinkers and practitioners on both sides of the border throughout the development of this report. Early on, Nathan Christian of Wells Fargo Bank; James Clark of the San Diego Regional Chamber of Commerce's Mexico Business Center; Marney Cox of SANDAG; Jessie Knight of the San Diego Regional Chamber of Commerce; Julie Meier Wright of the San Diego Economic Development Corporation; John McNeece of Luce Forward Hamilton & Scripps LLP; Richard Sinkin of InterAmerican Group; Secretary Sergio Tagliapietra Nassri from Baja California; the Hon. Steve Padilla, Mayor of Chula Vista; and Duane Roth, CEO of CONNECT, provided valuable insights. With their input, the San Diego Dialogue's Steering Committee, chaired by retired San Diego Community College District Chancellor Augustine Gallego, reviewed and commented on our progress at a *Forum Fronterizo* Council meeting in the Summer of 2005.

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Over a year's time, we and our Mexican colleagues organized a series of roundtables from which we were able to gather informed opinions about the opportunities and challenges facing the crossborder region, as well as insight into data sources and case studies that might be valuable to this report. Hundreds of individuals participated in these roundtables; however, a few were especially helpful and took the time to provide additional insights or engage in activities related to this initiative and we would like to thank them for this. They include: Philippe Charat of Maricultura del Norte, Gerardo de la Concha of Medtronic, Kevin Harris from Silicon Space, John Riley from BC Manufacturing, Dr. Gerardo Toledo of Diversa Corp., Eduardo Valtierra and Edna Patricia Hernández from CANIETI, Rodolfo Valtierra from DJ Orthopedics and Stephen Walker of BC Abalone.

Finally, we would like to acknowledge the continuing significance of the San Diego Dialogue's founding Director, Dr. Charles Nathanson, to our work. With his passing in 2003, the San Diego Dialogue Steering Committee determined that the best way to honor his voice and his vision was to revisit the great promise of the crossborder region. This report is dedicated to that vision and to the early contributions Chuck Nathanson made to the realization of a region with borderless potential.

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Executive Summary

Over the last 20 years, each side of the San Diego-Baja California border region has grown in extraordinary ways. Both have added more than 100,000 jobs in what are considered high value added globally competitive clusters; both have experienced growth and diversification of business services and managerial "know-how;" both have significantly expanded research institutes and higher education institutions and both enjoy a level of prosperity that exceeds that of other regions in Mexico and the United States. In spite of this extraordinary parallel growth, there have been few deliberate efforts to identify the economic synergies in the crossborder region or to develop integrated economic development strategies. The question that lies at the heart of this report is: "Given what the data is telling us about the dynamic trends on both sides of the border, why have there not been more deliberate efforts to collaborate and jointly market these assets, in order to significantly enhance the global competitiveness, not only of Baja California, but of San Diego County and the high-tech clusters within the two regions?"

This report presents data collected from a wide range of individuals, companies and organizations involved in high value-added technology, R&D and manufacturing activities on both sides of the border. It identifies a number of untapped capabilities and opportunities which could stimulate new kinds of industry partnerships and institutional alliances beneficial to both Baja California's economic growth and the continued competitiveness of San Diego's high tech economy. The research reveals that, in fact, there are many promising areas of collaboration. Most particularly, in biomedical devices, biotech and marine biotechnology, aerospace and defense. Data in this report also suggests that additional clusters which may have potential for collaboration and joint marketing include: software, recreation and sporting goods, and automotive.

The report describes the potential complementarities between the R&D, supplier and manufacturing capabilities that exist on both sides of the San Diego-Baja California border in these key clusters, which properly leveraged, could a) contribute to keeping and attracting good companies in need of manufacturing partners to Southern California and b) contribute to the attractiveness and growth of Baja California's existing manufacturers and suppliers, by exploiting the proximity to the extraordinary research and development clusters in Southern California.

Three "big ideas" emerging from the report are:

I. There is a need for aggressive and collaborative marketing efforts describing the high value added crossborder clusters in the region, focused on the high tech and biotech industries interested in the physical proximity to all the components of the innovation ecosystem — from R&D to manufacturing and distribution.

II. Leadership from both sides of the border needs to come together and work collaboratively to significantly expand the research, technical assistance, professional and workforce education programs essential to assuring sustainable growth and competitiveness.

III. New social and institutional mechanisms are needed to move the crossborder region beyond symbolism into action – action which involves shared leadership, co-investment, and well-orchestrated programs that build the competitiveness capacity of the cross-border region.

Even though the economic evidence and initial crossborder data presented in this report make a strong argument for a more dedicated effort to foster a dynamic and competitive Innovation Corridor of the Californias, the report emphasizes that there are a number of major challenges. The most significant of these is assuring a secure and efficient border that enables frequent and rapid border crossings.

The report concludes with a number of specific recommendations which address such things as:

- Creation of a Crossborder Innovation & Competitiveness Center
- Launching a crossborder program to foster scientific & technology relationships, awareness of research and commercialization of discoveries
- Providing ongoing research and analytical reports on crossborder clusters
- Working with Baja California to establish crossborder clinical research as a precursor to growing a transregional biopharmaceutical industry
- Promoting private investor networks in the Californias
- Promoting "smart border" technologies and infrastructure
- Expansion of existing and new crossborder education and research linkages
- Harmonization of economic, health and education data
- Convening a high-level working group to assess the feasibility of a Californias model based on the successful INBio program
- Exploration of broader, non-technological economic linkages

It is time for a broad coalition of interests and organizations to come together around a set of common goals and strategies, vis-à-vis crossborder economic development. The information and analysis presented in this document is a first step in starting a regionwide conversation and action plan for building the Innovation Corridor of the Californias.

Introduction

> "We cannot underestimate the importance of our states working together in order to find regional solutions to the challenges we face....Economic prosperity and security in the region depends on a close coordination between our states. Government, the private sector and citizen-based groups all have a role to play."
>
> Joint Statement by the Governors of Baja California, Eugenio Elorduy and California, Arnold Schwarzenegger
> September 23, 2005

San Diego County in California and Baja California in Mexico each represents a unique region in its country. Both have experienced extraordinary economic transformation and population growth over the last three decades, with today's populations approaching 3 million in Baja California and 3 million in San Diego County. The proximity of the economic transformations and population growth characterizing San Diego County and Baja California has resulted in the border between the two nations being the most frequently crossed border in all of North America. In addition, the San Diego-Baja California border region represents an area of great prosperity, with high employment, diverse economic opportunities and dynamic, increasingly high value-added industries — in contrast to many border regions around the world. The San Diego-Baja California region is a unique and exciting place poised to provide leadership for how two nations can collaboratively build mutually beneficial economic clusters and social institutions.

TerraColor satellite image courtesy of Earthstar Geographics.

"...As a region, we cannot decide whether or not to globalize... What we can decide is whether we wish to collectively, proactively engage with the global economy by pursuing steps in the public and private realms that will enhance our well-being as citizens of San Diego and Baja California."

San Diego Dialogue
The Global Engagement of
San Diego-Baja California (2000)

This report synthesizes a growing body of evidence pointing to the promising potential for economic development in the crossborder region, leveraging the developments of the last 30 years on both sides of the border. Both regions have invested significantly in growing their higher education institutions, research centers and medical enterprises. San Diego County has developed an extraordinary array of scientific research, R&D and technology development institutions. Baja California has similarly developed increasingly high-value-added manufacturing capabilities and supplier networks. Both regions front the Pacific Ocean and share an ecology that enables a quality of life unparalleled in many other parts of the world.

Despite such progress, there have not been more deliberate efforts to collaborate and jointly market these assets to significantly enhance the global competitiveness of high technology clusters in the binational region. The core question that motivated this report is: "Are there untapped capabilities and needs on both sides of the border that could stimulate new kinds of partnerships and alliances beneficial to both Baja California's economic growth and the competitiveness and sustainability of San Diego's high-tech economy?"

In 2004 and 2005, San Diego Dialogue and its partners CENTRIS and the Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE), put this question to industry and academic leaders from both sides of the border in a series of technology-focused roundtables. These roundtables were crucial in guiding research into specific "clusters of opportunity" that characterize the San Diego-Baja California region — such as biomedical devices, pharmaceuticals, marine biotechnology and several others. Data was collected from a wide range of individuals, companies, government agencies, universities and organizations, in an attempt to elucidate the significant ways in which San Diego's and Baja California's economies are interconnected. The findings point to the promise of an integrated, world-class R&D, manufacturing and supplier ecosystem in a borderless world. Such an integrated economic development strategy suggests that when "next door neighbors" near-source their talents and capabilities, there are manifest and latent benefits.

While the San Diego-Baja California region holds enormous economic and social promise, the research also identified lingering challenges in developing mutually beneficial economic development goals and policies. Chief among these are building trust and cooperation among the public and private sectors, creating a secure border region and fostering

Companies operating in the crossborder region have benefited in a variety of ways – from reducing logistics costs by being closer to market; improving quality through more dynamic designer/manufacturer interactions; obtaining stronger intellectual property rights than some offshore locations; and benefiting from an educated, bilingual and bicultural workforce. According to the Tijuana Economic Development Corporation and the US Consulate in Tijuana more than 120 San Diego-based enterprises have operations on both sides of the border.

"San Diego is not thinking hard enough about how to benefit from its proximity to Mexico. Baja California lies 14 miles from San Diego, and the two regions inevitably affect each other. Yet, few of the [San Diegans we interviewed] discussed opportunities in Mexico. Those that did tended to do so superficially or to reflect on the fact that Mexico's role is not given sufficient weight in local decision-making: '...There is a lack of a regional partnership involving business, government and universities to create a research zone or innovative region with Mexico'."

Michael Porter
and the Council on Competitiveness
Clusters of Innovation Initiative:
San Diego (2001)

An efficient and secure border crossing is one of the critical components of a competitive crossborder region. However, long delays at the border undermine our competitiveness. Based on an historic annual average of 3% growth over the last eight years, the estimated number of annual northbound trips that will be made by individuals crossing the border into San Diego from Baja California by 2015 could reach between 75 and 80 million – if appropriate infrastructure exists. Already, SANDAG estimates that current border waits cost the region more than $2 billion dollars in economic activity. The incremental impact of even longer border waits adds billions above this loss.

a qualified workforce. In order to realize the many opportunities an integrated strategy could achieve, leadership on both sides of the border needs to commit to exploring new models for partnering and collaboration that leverage existing resources while developing new capabilities. Without new local models, we may not continue to be globally competitive.

Achieving this broad goal implies action. Catalyzing the region's "borderless innovation" potential means creating a bold plan that calls for new mechanisms to foster crossborder programs and relationships; new models for economic analysis and research in science and technology; increased linkages among crossborder research professionals and workforce-training institutions; and the investment by civic and political leadership in efficient and secure crossborder transportation infrastructure. Such a view holds the promise for increased competitiveness and prosperity for the region, as well as the opportunity to build a great Innovation Corridor of the Californias for the 21st Century.

Clusters of Opportunity

The following pages present some preliminary data and suggestions about just a few of the potential "crossborder clusters of opportunity" that appear to exist in the San Diego-Baja California region.

While not comprehensive, the data reveals new information in a binational context about some of the region's major employers and clusters, including:

- biomedical devices;
- aerospace and defense;
- software
- pharmaceuticals & clinical research; and
- marine biotechnology

Several other sectors are also briefly discussed — including the semiconductor industry, the automotive industry, recreation and sporting goods and energy and environmental technologies. While not discussed in depth, these sectors represent promising clues to additional economic synergies between San Diego and Baja California.

While this document focuses on comparing cluster data from 2003 for both San Diego and Baja California, recent data from Baja California's Secretary of Economic Development (SEDECO) indicates that several technology-related clusters are already undergoing strong growth in Baja California. SEDECO's cluster data suggests aerospace employment in 2005 exceeds 7,400 workers; automotive industry employment is over 28,000; and medical device manufacturing employment is over 27,500. The SEDECO data also includes other clusters which, though not part of this study (electronics, logistics, and plastics), illustrate the diversity of Baja California's industrial sectors.

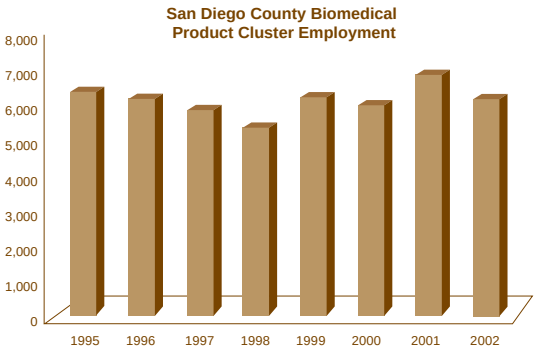
This overview of selected high-value-added sectors is followed by a short discussion of some of the challenges that must be addressed in order to move down the path of converting these clusters of opportunity into clusters of prosperity for the region.

Biomedical Devices

"...[A]s many as 40 other states and a dozen countries are making concerted efforts to establish their own life sciences clusters."

California Healthcare Institute/
PricewaterhouseCoopers
Biomedical Manufacturing in California (2004)

While the United States continues to be the world's largest manufacturer and consumer of medical device products, the production and assembly of these devices is increasingly moving to locations around the globe. According to the U.S. Food and Drug Administration (FDA), there were nearly 9,000 registered foreign medical device manufacturers in 2003, a 14.5 percent increase over the previous year. More than one half of these manufacturers are located in Taiwan, China, Germany, Canada and the United Kingdom. Notably, the number of firms in China grew the quickest: 36.7 percent between 2002 and 2003.

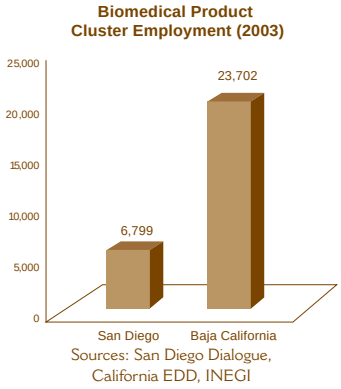


Sources: San Diego Dialogue, California EDD

Over the last decade, Mexico also has become a leading location for non-U.S. medical device manufacturing and assembly, with more than 240 FDA-registered medical device facilities operating in the country — an increase of 15.4 percent over 2002. As seen in the map below, the largest concentration of companies in this sector — approximately 65 — are in the state of Baja California. Nearly two-thirds of these companies are located in Tijuana.

While frequently lumped in with the larger biotechnology and pharmaceuticals cluster[1] in discussions about economic development, biomedical products are specifically identified by the San Diego Association of Governments (SANDAG) as one of San Diego's 15 most important employment clusters. However, despite its importance, the biomedical products cluster has had little employment growth

Biomedical Devices



Sources: San Diego Dialogue, California EDD, INEGI

during the eight years between 1995-2002 — hovering at around 6,000 employees. With such strengths in life sciences and the health care industry, this situation seems perplexing; however, one reason suggested by SANDAG for this apparent stagnation has been the expansion of these firms outside of San Diego County, in large part because of the need for competitive manufacturing capabilities, which are not available in San Diego. Companies in this cluster start here but grow elsewhere, and one place they are growing is Baja California.

Comparison of official employment data from 2003[2] shows that Baja California's biomedical device industry is approximately three times larger than San Diego's, with more than 23,700 Baja California workers compared to approximately 6,800 in San Diego.[3]

Perhaps most notable are the existing number of relationships that Baja California's biomedical product companies already have with U.S. companies. Of more than 60 biomedical device firms identified by the Baja California government's industrial strategy organization, ProduCen, more than 40 have U.S. parent companies. Of these 40, at least 13 have either a San Diego headquarters or have significant business activity in San Diego County. Some of the firms include Cardinal Health (formerly Alaris Medical Systems), Breg, Coastline International, Continental Laboratory Products, DJ Orthopedics, Avail Medical, Lancer Orthodontics, Nypro and Sunrise Medical. Other world-class biomedical device companies are also present in Baja California, including Augen Opticos, Medtronic, Pall Medical, Smiths and Tyco Nellcor.

While kit assemblies and plastic products make up a substantial part of what is being produced in Baja California, an initial survey of 16 companies found an astounding variety of products either embedded with high technology or manufactured with a high-technology process, including:

photochromatic eye lenses	oxygen sensors	RFID bracelets
ceramic encasing for pacemaker circuitry	rechargeable batteries for heart defibrillators	disposables for cardio bypass surgeries
needleless I.V. connectors	nebulizers	catheters
anesthesia circuits & bags	masks (trach, aerosol, etc.)	airways
keratome knifes for LASIK surgery	glass encapsulated chip thermistor	enteral feeding devices
precision thermometer	cardiac jackets	gas sampling lines
leg, knee and foot ankle braces	arm slings	O.R. scissors
infusion pumps	clipguns for veins/arteries	diagnostic kits (dengue fever, HIV)

HIGH OR LOW VALUE ADDED BIOMEDICAL MANUFACTURING? A CLOSER LOOK.

While the technological intensity of Baja California's biomedical device companies is dictated either by parent companies (in the case of wholly-owned maquiladoras) or by customers (in the case of contract manufacturers), many of these companies are operating in world-class manufacturing facilities. During the course of this study, 16 firms were interviewed, with nearly all having ISO 13485 or 9000/9002 quality certifications and more than half operating with Class 10,000 or 100,000 clean rooms onsite. One of these is Alaris/Cardinal Health, which recently completed a 200,000-square-foot facility developed with Burnham Real Estate.

Most plant managers felt their capabilities in Baja California exceeded the current levels of engineering or design for what they are manufacturing. In addition, nearly all reported a collaborative interaction between the Baja California engineering staff and their parent companies, and close to one-quarter reported "two-way" interactions related to the products' design as affected by the manufacturing process. Also, beyond the broad variety of products being manufactured or assembled, several plants also offered additional services such as contract manufacturing, contract sterilization (including e-beam sterilization) and ultrasonic welding of products.

High-tech? According to Rodolfo Valtierra, plant manager for DJ Orthopedics' Tijuana facility, "If this isn't high-tech, I don't know what is. We use advanced laser cutting equipment and have wireless networks in the facility to allow constant communications and data flow between management and our production lines." Vista-based D.J. Orthopedics' facility is a 2004 recipient of Industry Week's "Best Plant" award in North America, with their lean, just-in-time operations resulting in a stronger competitive position. This has allowed the company to bring a product line back from China, reduce overall costs of their products and increase their U.S.-based sales and management staff to accommodate their growing business. In addition, intellectual property rights in Mexico have given them stronger protections over their product designs.

A further example of enhanced competitive capabilities in Baja California can be seen at Medtronic's facility in Tijuana. Among the products produced there are heart stents made from advanced memory metals, cardiac surgery kits and blood pumps used in open heart surgery. This facility is also unique among all of Medtronic's global manufacturing facilities in that it is the only location where Medtronic products are coated with the anti-infection enzyme heparin to ensure biocompatibility. The Mexican-run facility has also developed its own software in-house to manage customized orders from initial phone calls to final shipping.

Biomedical Devices

The existing concentration and capabilities of these biomedical device companies in Baja California suggest a ready opportunity for regional economic development efforts in joint marketing and other cluster-strengthening activities. In addition, San Diego and Baja California companies appear to have a largely untapped opportunity to become one of the major hubs of biomedical device design, manufacturing and global marketing in the world.

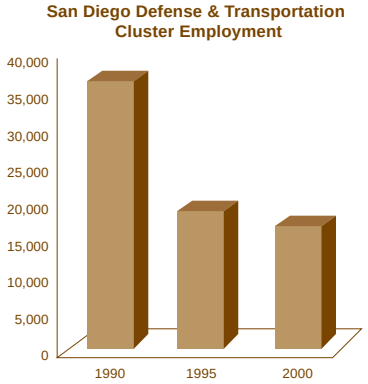
This opportunity extends throughout Southern California. As seen in the map on the left, within approximately a 100-mile radius of downtown San Diego — from Ensenada through Irvine, east to Mexicali, and including parts of Los Angeles and Riverside Counties — there were more than 40,000 individuals working in biomedical device companies in 2003.[4] More than half of these employees were located in Baja California. At the center sits the capital of this potential crossborder cluster: the San Diego-Tijuana metropolis.

Aerospace & Defense

"Baja California may have the potential to re-invigorate San Diego's aerospace industry."

This bold statement comes from one of Baja California's maquiladora industry pioneers, John Riley of BC Manufacturing. This visionary perspective suggests how an emerging cluster in that state might hold synergistic potential for San Diego and perhaps all of Southern California.

In the early 1990s, San Diego saw a dramatic decline of its defense & transportation cluster from federal defense budget cuts. Many firms closed or moved their San Diego operations during the 1990s — taking with them 20,000 jobs — while others diversified into related technology clusters, such as software, electronics and non-military related transportation.



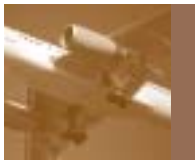
Sources: San Diego Dialogue, California EDD

Despite the turmoil, aerospace and defense-related activities remain a cornerstone of the regional economy. San Diego is home to more than 80 military facilities, making it one of the largest military complexes in the world. Defense-related activities make up 8 percent of San Diego's gross regional product, and the county was ranked fourth in the United States in FY2004 for Department of Defense (DoD) contracts awarded ($5.1 billion in value). Defense spending on a regional basis is even more impressive: DoD contracts amounted to more than $16.9 billion in Los Angeles, Orange and San Diego counties alone in FY2004 — nearly 8 percent of all defense spending in the United States.[5] Additional industry consolidation makes it likely that aerospace and defense-related clusters will continue to grow in both Southern California and San Diego, presenting the potential for crossborder manufacturing synergies.

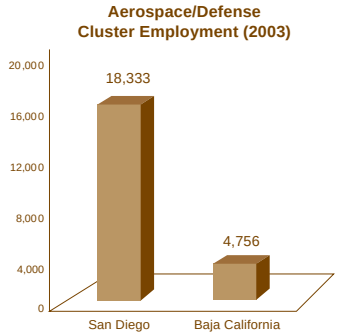
Two examples of recent business expansions in San Diego's aerospace industry include Chula Vista-based Goodrich Aerostructures' multibillion-dollar contracts with both Airbus and Boeing, as well as a significant increase in new orders for General Atomics Aeronautical Systems' unmanned aerial vehicles — making it one of the leading manufactures of UAVs in the world.

Aerospace/Defense: Taking Off?

San Diego's aerospace/defense cluster is just beginning to rebound from the previous decade's losses. As shown in the graph on page 15, cluster employment in 2003 was approximately 18,300, an increase from about



Aerospace & Defense



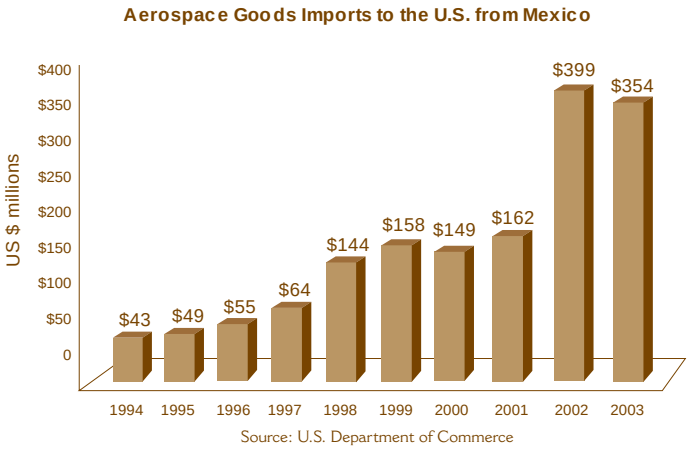
Sources: San Diego Dialogue, California EDD, INEGI

16,000 in 2000. Employment is spread out among nearly 300 firms, including SAIC, General Atomics, NASSCO, BAE Systems, Cubic, Goodrich Aerostructures, L-3 Communications and Northrop Grumman. These companies provide a broad range of services, among them systems integration, ship building and repair, avionics and electronics, research and development, wireless communications and unmanned aerial vehicle design and manufacturing. Also shown in the comparative employment graph, Baja California's economic census data puts the number of aerospace and defense-related workers at a relatively significant number: 4,750, or about one-quarter of the size of San Diego's.

That number is likely to grow — and quickly. According to the U.S. Department of Commerce, Mexico is the ninth-largest supplier of aerospace goods and equipment to the United States.[6] As seen in the graph below, the value of these goods totals more than $350 million, having grown nearly tenfold from 1994 to 2003. While Mexico is not considered an aerospace powerhouse compared to Canada, France or the United Kingdom, the growth of the country's aerospace industry highlights the strategic decisions firms are making in global sourcing options. As noted recently by a representative from Boeing, approximately 700,000 people worldwide were involved in some way through supply chains in the development of the Boeing 777.[7]

Baja California has the highest concentration of aerospace-related component and equipment manufacturers in Mexico — including such firms as Honeywell, Delphi Connection Systems, Gulfstream, C&D Aerodesign, Mexmil and Suntron. In addition, the state is home to manufacturers with defense-related subsidiaries, suppliers or contract operations, such as NASSCO (ITM division), Cubic, MAGNETIKA, Seacon Global, GKN-Chemtronics and Chelton (a division formerly owned by REMEC Defense & Space).

Not only low-tech products are being produced for the aerospace/defense sector. Components for such well known weapon systems as the TOW and Longbow missiles are made in Baja California, as are a variety of electronics, wiring harnesses, airplane



Source: U.S. Department of Commerce

California's Employment Development Department data show that San Diego lost more than 19,000 manufacturing jobs between 1990 and 2004. More than 90 percent of these manufacturing job losses were concentrated in "Aerospace Products and Parts Manufacturing."

Aerospace & Defense

Global Technology Regions
Aerospace & Defense

São Paulo, Brazil
Montreal, Canada
Toronto, Canada
Paris, France
Toulouse, France
Düsseldorf-Cologne, Germany
Hamburg-Kiel, Germany
Munich, Germany
Haifa, Israel
Tel Aviv, Israel
Tokyo, Japan
Kobe, Japan
Madrid, Spain
Edinburgh, UK
London, UK
Manchester, UK
Atlanta, US
Dallas-Ft. Worth, US
Denver, US
Los Angeles, US
Norfolk, US
Orange County, US
San Diego, US
Seattle, US
Tucson, US
Wichita, US

Source: San Diego Dialogue Analysis of Technology Industry Sources

interiors and underwater connectors used in naval applications. Major aerospace-related companies are also operating in other regions of Mexico, including GE's engineering center in Querétaro, Mexico, which employs nearly 500.

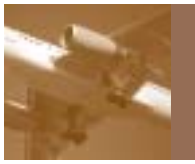
Mexico's Secretariat of Economy has embarked on an ambitious effort to promote aerospace investments in Mexico, as reflected by recent trips to Milan and the Paris Air Show, at which companies and representatives of Baja California were present. Mexican and U.S. officials at the federal level are also in the process negotiating a Bilateral Aviation Safety Agreement (BASA). Existing Federal Aviation Administration (FAA) regulations require critical aerospace products manufactured in Mexico to be inspected in the United States as well; the BASA would allow certain Mexico-based manufacturers to have their goods certified at production lines in Mexico, which would streamline the process and reduce expenses. An estimate by the U.S. Department of Commerce predicts that implementation of BASA could spur up to $1 billion in aerospace exports from Mexico to United States. For the San Diego-Baja California region, BASA's impact could be profound.

BASA, BC Manufacturing, and Baja's Aerospace Future

"In aerospace, we really have to look at the long-term." So states John Riley, long-time maquiladora industry executive at BC Manufacturing, and a promoter of aerospace and technology investments in Baja California. "The BASA certification from the FAA gives outside validation that we have the skills needed for ultimately attracting manufacturers of critical flight components. Long term, though, I like to think that within twenty years we'll be manufacturing finished commercial aircraft here."

Given Baja California's proximity to Southern California (one of the largest concentrations of aerospace companies in the world), and the fact that the runway at Tijuana's airport is the second-longest in the region (after Miramar, which is a military installation), such a vision might be possible. "The fact that we already have skilled workers here manufacturing some aerospace products is a start, but we also have support from the Federal, State, and local government agencies to make this happen," Riley emphasizes.

"My hope is, to really accelerate this opportunity, that Baja California and Southern California develop a regional approach – more of a synergistic effort where both sides gain something, and industry grows in partnership with Baja. I live in San Diego, but I know that both sides will benefit if we do this together."



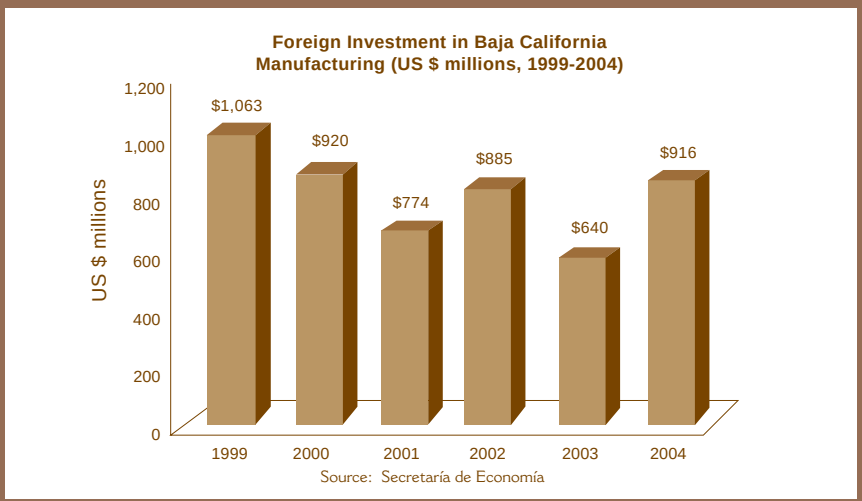
POTENTIAL SYNERGIES

Compared with biomedical devices, the crossborder integration among aerospace/defense & transportation companies in the San Diego-Baja California region is limited to only a handful of companies. Although NASSCO, Cubic, Chelton and GKN Aerospace-Chemtronics have a presence on both sides of the border, most companies operate only on one side. In part, this may be due to military contracting restrictions; however the extent of this remains to be determined. Better leveraging of complementary capabilities, such as engineering and design in San Diego and advanced manufacturing in Baja California, could give the region a major competitive edge.

Coordinating additional workforce education and training focused on this sector could provide a major boost to that competitiveness. Already, San Diego State University and UCSD offer a joint graduate degree in Engineering Science/Applied Mechanics as part of their Aerospace Engineering program,[8] allowing students to take advantage of the faculty and resources of both institutions. A crossborder aerospace engineering program could enhance and expand the highly qualified labor pool for firms on both sides of the border. A precedent for such programs has already been set by the MEXUS degree program (SDSU/UABC/CETYS/Southwestern College), as well as engineering education partnerships between Arizona State University and Tec de Monterrey.

FROM A VARIETY OF PERSPECTIVES, BAJA CALIFORNIA HAS BEEN ABLE TO REMAIN COMPETITIVE AND KEEP ATTRACTING FOREIGN INTEREST, DESPITE WIDESPREAD ACCOUNTS OF THE MAQUILADORA INDUSTRY'S DOWNFALL.

AS A STATE, BAJA CALIFORNIA HAS RECEIVED THE THIRD-LARGEST AMOUNT OF FOREIGN INVESTMENT IN THE COUNTRY AFTER THE FEDERAL DISTRICT AND NUEVO LEON. AS SEEN BELOW, BETWEEN 1999 AND 2004, BAJA CALIFORNIA ATTRACTED AN AVERAGE OF $866 MILLION IN FOREIGN INVESTMENT EACH YEAR (NEARLY $5.2 BILLION TOTAL) IN MANUFACTURING FACILITIES ALONE.



Finally, the creation of regional marketing materials that highlight the capabilities of aerospace companies on both sides of the border could boost awareness of the potential for crossborder collaboration in the industry. Such joint economic development efforts, and a rethinking of our aerospace strengths compared to other regions, could launch a broad range of important activities.

Software

The demand for new and more diverse forms of software applications continues to grow, and although the United States continues to the be largest single market — and the largest provider — of software and computer services in the world, that situation is changing with the emergence of skilled information technology professionals throughout the world. Countries that typically come to mind when discussing the future of the software industry are the United States, India, Ireland, Israel and China.

That list is growing, with more countries becoming adept at developing highly educated workers, regulatory structures that promote software and IT industries, governmental investments in telecommunications infrastructure, and focused efforts to attract the higher-level R&D activities of multinational firms. India is clearly the model for such efforts; some estimates show that Indian software and IT company exports will grow from $9.5 billion in 2003 to more than $50 billion by 2010, with an additional 2 million IT professionals being educated during that time.

But India is hardly the only success story. The accelerated outsourcing of IT services around the globe holds promise for work across many borders, including Mexico's. According to a 2003 outsourcing survey[9] of 252 corporate IT managers in the United States, Mexico is attracting the same level of attention as Ireland and China. The IT managers reported outsourcing to firms in the following countries: India (38 percent), China (6 percent), Ireland (5 percent) and Mexico (5 percent).

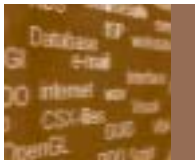
Mexico's Emerging IT Capabilities

These survey results provide a glimpse into Mexico's potential as a source for software and IT services. Despite estimates that fewer than 1,500

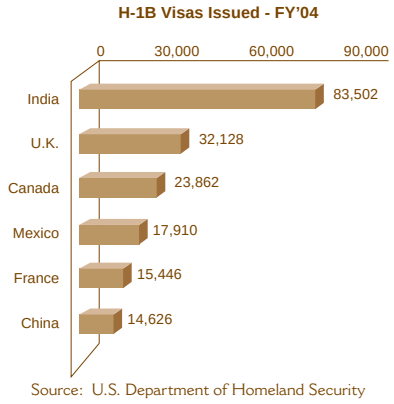
Global Technology Regions Software

Montreal, Canada
Toronto, Canada
Vancouver, Canada
Beijing, China
Guangdong, China
Shanghai, China
Helsinki, Finland
Bangalore, India
Calcutta, India
New Delhi, India
Cork, Ireland
Dublin, Ireland
Galway, Ireland
Tel Aviv, Israel
Jerusalem, Israel
Tokyo, Japan
Oslo, Norway
Islamabad, Pakistan
Manila, Philippines
Singapore
Seoul, South Korea
Stockholm, Sweden
Cambridge, UK
London, UK
Oxford, UK
Austin, US
Boston, US
Dallas-Ft. Worth, US
Silicon Valley, US
Seattle, US
Washington, DC, US

Source: San Diego Dialogue Analysis of Technology Industry Sources



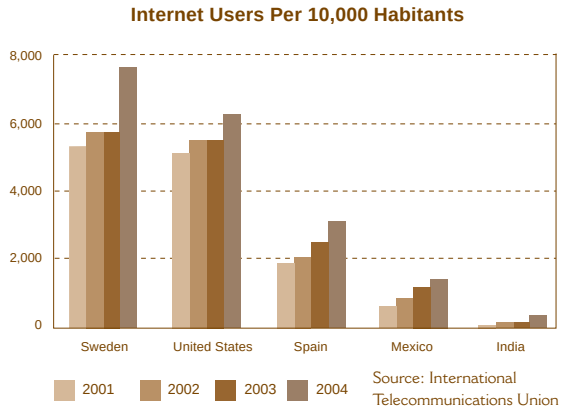
Software



Source: U.S. Department of Homeland Security

software/IT firms operate in the country,[10] many large American IT companies such as Accenture, EDS, IBM, Microsoft and Sun have a presence in the country, as do numerous smaller firms. Another indication of Mexico's growing capacity to provide highly qualified information technology workers is the large number of H-1B visas garnered by Mexican professionals. In 2004, Mexican professionals received the fourth-largest number of H-1B visas, behind India, the United Kingdom and Canada. These visas are often used as a metric for measuring the inflow of skilled workers (including IT and other high-tech professionals)[11] and, combined with more specific data on TN and L-1 intra-company transfer visa data, can provide a more complete understanding of skilled Mexican professionals that are working in the United States.

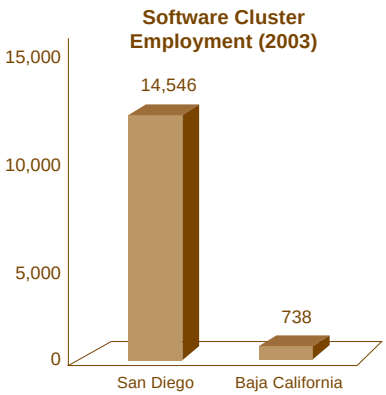
Those figures are likely to grow as use of information technology and the Internet continues to expand in Mexico. The number of Internet users nearly doubled in Mexico between 2001 and 2004, and is more than four times the level of users in India. Mexico is currently at the same level of internet usage that Spain was in the year 2000.



Source: International Telecommunications Union

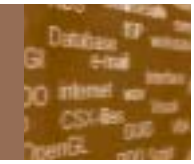
A Crossborder Software Cluster

The software industry has played a major role in San Diego's economy since it emerged as a byproduct of defense-sector work in the 1980s. Its broader definition as the Software and Computer Services cluster[12] by the San Diego Association of Governments makes it one of San Diego's most important industries and a key driver for many local businesses.



Sources: San Diego Dialogue, California EDD, INEGI

Baja California's emerging software cluster — formally recognized by the February 2004 birth of the nonprofit Cluster de Tecnologías de Información y Software de Baja California — had only a fraction of the employment in San Diego in 2003, with approximately 800 employees in Baja California software firms vs. nearly 15,000 employees in San Diego County. Although these estimates likely undercount the actual number of IT professionals given the cross-cutting nature of these skills throughout a variety of industries, the difference in employment within this cluster is nonetheless significant. Similar to the situation with biotechnology, employment disparity poses a challenge in the short term to catalyzing a true crossborder cluster; however, recent

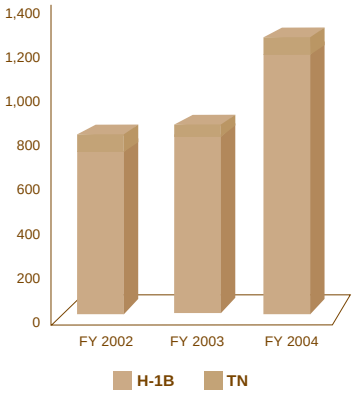


Software

software-related education and business development activities in Baja California suggest the potential of mutual benefit for the coming years.

Careful scrutiny of this issue reveals a broad range of potential opportunities and existing activities in the San Diego-Baja California region, starting with people and human infrastructure. As discussed previously, the issuance of H-1B visas by the United States is often used as an indicator of the supply of skilled, high-tech workers. According to the U.S. Consulate in Tijuana, more than 2,700 H-1B visas were issued there for Mexican citizens during fiscal years 2002 through 2004.[13] In addition, approximately 230 TN visas — referred to as the "NAFTA professional visa" and covering many of the same job classifications of the H-1B — were also issued in this time period.

H-1B & TN Visas Issued By U.S. Consulate in Tijuana



Source: U.S. Consulate in Tijuana

A supply of skilled professionals is essential for growing a crossborder software cluster, and a proactive educational strategy has been one of the core success factors often cited in the development of the Indian, Irish and Israeli software industries.[14] Combined, San Diego and Baja California graduated more than 1,300 students in 2004 with software-related degrees from a handful of major institutions: UCSD, San Diego State University

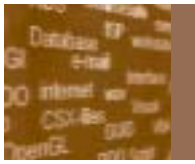
Silicon Space Grows With the Border

SILICON SPACE Building e-Business Success℠

"We've worked with developers in India, Pakistan, Baja California and Central Mexico," explains Kevin Harris, chief operating officer of Silicon Space, a San Diego-based software firm that develops innovative products and services that allow companies to better communicate and collaborate through Web-based technologies. "We've found our relationship with Mexico has proven to be successful and is helping us to grow our company in San Diego."

Founded in 1996, Silicon Space has become one of Southern California's premier e-business professional services companies, with clients that include Hewlett-Packard, the U.S. Navy, Disney, Toyota and Intel. Less known is the fact that nearly one-quarter of the company's staff is from Tijuana — including both developers and managers. For Silicon Space, finding skilled workers and software firms from the broader binational region has helped it to better succeed in the global market.

"With 25-30 percent of our staff either living in Mexico and/or speaking Spanish, crossborder development projects don't need to overcome cultural or time-zone differences. Travel between ourselves and Mexico-based firms is simple and cost effective and, as such, we can interact personally with greater ease than if we had to travel to Southern Asia. The result is a product that better serves the needs of our clients at a competitive cost."



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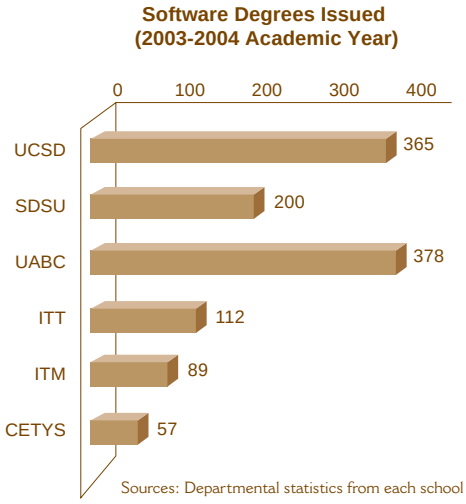


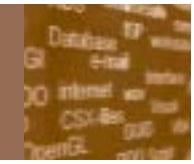
(SDSU), CSU San Marcos, the University of San Diego, Universidad Autonoma de Baja California (UABC), Instituto Tecnologico de Tijuana (ITT), Instituto Tecnologico de Mexicali (ITM), CETYS Universidad, CICESE, and the Tecnologico de Baja California (TBC). As shown at left, UCSD and the three campuses of UABC graduated nearly the same number of students with software degrees in the 2003-2004 academic year (approximately 370 from each institution).

What specific skills and competencies are Baja California's major universities developing in young IT professionals? A survey conducted for San Diego Dialogue in May of 2005[15] found the following:

- C, C++, Visual Basic, Java, PHP, Unix/Linux, .Net, and SQL appear to be standard fare at all of the major universities and institutes in Baja California, with some programs also offering training in Delphi, AS400, Macromedia, HTML, XML, Flash, Oracle, MPI, PVM and others;
- All of the campuses in the survey had high-speed Internet access, with nearly half also stating that the campus had wireless Internet onsite, as well. All campuses had computer labs, most of which had more than 50 computers.
- Nearly all of Baja California's information technology programs have exchange programs with foreign universities, although with the exception of SDSU, CSU San Marcos and a few other universities in the CSU system, most were with European or Canadian universities.

Additional institutional support for accelerating the development of the nation's software industry comes from Mexico's federal government, which launched the ProSoft program (Programa para el Desarrollo de la Industria de Software) to promote the Mexican software industry, support internships for university students to gain private-sector experience, and to develop legal standards that encourage the growth of e-commerce, among other activities. Additionally, ProSoft is helping domestic software firms achieve the quality certifications necessary in the global market and develop business with firms in the United States and Europe. With Baja California being one of the regions in Mexico targeted by ProSoft, such activities could also open up new avenues for partnerships with San Diego firms.

While more research is necessary to determine the number and quality of software professionals being educated at other institutions within the region (as well as the number of San Diego-based graduates that are commuting from Baja California), it is clear that the region is producing an increasing number of skilled IT workers on both sides of the border that can be leveraged to support not just growth in employment, but also competitive



Software

opportunities that are not currently being pursued. Over the next decade, San Diego software companies will find a larger number of Baja California firms and individuals whose bilingual skills and connections to Latin America can create new export opportunities. Likewise, Baja California software entrepreneurs can tap into the broader industry experience and U.S. networks that San Diego firms can provide. Companies from both sides of the border may gain valuable technical and strategic capabilities that they would not otherwise have, leading to business partnerships that are next door rather than offshore.

> "Low-cost countries — not just China and India but also Mexico, Malaysia, Brazil, and others — are turning out large numbers of well-educated young people fully qualified to work in an information-based economy."
>
> Geoffrey Colvin
> Fortune (Aug. 1, 2005)

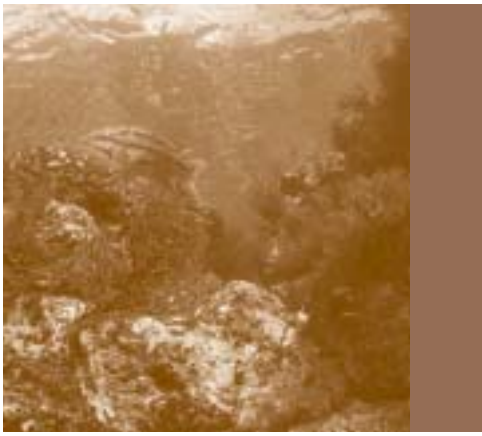
SOFTWARE DEVELOPMENTS NEXT DOOR IN BAJA CALIFORNIA

While much of this section has focused on the emerging capabilities of IT professionals from Baja California, there are also a growing number of significant software developments in the private sector. For instance, Samsung SDS has been operating one of its e-Data centers in Tijuana since 2001. With nearly 80 employees, this center provides support to Samsung's global IT integration services through SAP, ASP, .Net, and open-source programming. Many of their employees received degrees in computer science and IT networking from Baja California universities, including UABC, CETYS, and Iberoamericana.

Beyond such multinational examples, Baja California's indigenous software/IT companies include Medida, which creates wireless sensors that use embedded software; Intuare, a co-operative of 80 programmers that offer a wide range of services; Grupo Tress, a leading provider of human resource software for Baja California's maquiladora industry; and Arkus, a developer of corporate Web portal solutions and services.

Some of IT's largest firms are taking notice. San Diego-based Science Applications International Corporation (SAIC) was recently hired by the Cluster de Tecnologías de Información y Software de Baja California for technical assistance to provide hands-on training and coaching to increase the software development capabilities of the local industry, and to more effectively market into the United States.

Also, in June of 2005, IBM announced the launch of a new open-source software technology center at the Mexicali campus of CETYS Universidad. This new center will dedicate the first nine months to training participants in the use of open-source software, and then will focus on incubating new companies and creating work opportunities with international firms.



Marine Biotechnology

"[B]iotechnology has the potential to shift the world's fish supply from an uncertain and threatened wild food source to an agricultural analog cultivated through mariculture and fresh water aquaculture. The exploration, study, and harvesting of marine genetic resources through biotechnology are expected to produce important commercial applications, including improved diagnostics and pharmaceuticals, increased production of ocean foods, novel energy sources, and the engineering of micro-organisms to control and eliminate environmental contaminants."[16]

The U.S. Biotechnology Industry
US Department of Commerce/Office of Technology Policy

So stated a report about the U.S. biotechnology industry in 1997.[17] More than eight years later, however, few of San Diego's regional biotechnology companies have explicitly focused on this potential source for new discoveries, despite a growing number of new compounds being derived from the ocean. Marine biotechnology — the nexus between marine science and biotechnology — refers to a variety of activities, including genetic engineering of marine organisms and the development of pharmaceuticals or other industrial products from agents or chemicals found in such organisms.

This biotechnology niche needs to be explored for its strong growth potential and the biomedical solutions it may harbor. Of all the clusters of opportunity presented in this report, marine-based biotechnology is the only one in which the binational region holds distinct and inherent advantages, given the presence of unique biodiversity and natural marine resources, as well as the research capabilities in the life sciences they have developed for the crossborder region.

Drugs or Medical-Related Products Developed from Marine Organisms

- Anti-viral drugs (sponge)
- Anti-cancer drugs (sponge, sea hare)
- Anti-tuberculosis agent (sea whip)
- Anti-malarial agent (sponge)
- Bioluminescent calcium indicator (jellyfish)
- Detection of endotoxins/LPS (horseshoe crab)
- Polymerase chain-reaction enzyme (deep sea hydrothermal vent bacterium)

Marine Biotechnology

San Diego and neighboring Baja California are both home to leading marine sciences institutions in their respective counties: the Scripps Institution of Oceanography (SIO) in San Diego and CICESE and Universidad Autónoma de Baja California (UABC) in Ensenada. SIO's Center for Marine Biotechnology and Biomedicine, CICESE's Departamento de Biotecnología Marina, and UABC-Ensenada's Instituto de Investigaciones Oceanológicas, are major centers of expertise in ocean science, whose researchers represent tremendous assets for the regional life sciences industry. Further, these institutions have a long history of collaboration through joint projects such as the California Cooperative Oceanic Fisheries Investigations (CalCOFI), the Investigaciones Mexicanas de la Corriente de California (IMECOCAL), the Southern California Coastal Ocean Observing System (SCCOOS), and many individual research efforts enabled by UC-Mexus grants.[18]

Samples at UABC's marine science laboratory in Ensenada

In addition to research, the binational region has a unique opportunity to draw upon another ocean-related resource: the knowledge and experience of Baja California's aquaculture and mariculture industry. Aside from a handful of companies, very little aquaculture-related activity currently occurs in San Diego. Yet there are dozens of aquaculture companies and cooperatives in Baja California, which compared to San Diego, produced nearly 10 times the value of production in 2002. In addition to the knowledge base that regional aquaculture companies have regarding local marine life, such companies may also be major consumers of products derived from marine biotechnology, such as those used for fish vaccines.

That said, catalyzing a larger marine biotechnology industry requires know-how in biotechnology — a field in which San Diego remains a leader. As seen on the following page, San Diego has more than 20,000 employees in the biotech/pharmaceutical cluster, compared to a small but growing number in Baja California (less than 400, according to official employment statistics). Despite this disparity, Baja California's nascent biotechnology industry is already making significant efforts to grow over the next decade. For example:

- State, local and federal government officials, academics and business people have already formed the Biotech Industry Council in Ensenada, a trade organization dedicated to fostering this sector;
- Baja California universities are developing a growing number of skilled life science and biotechnology professionals in both undergraduate and graduate-level programs. Research institutions such as

Marine Biotechnology

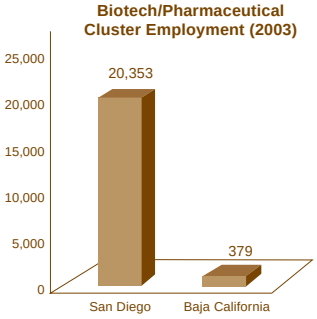
CICESE (Mexico's premier graduate and research institution in marine biology) and UABC-Ensenada are at the core of this effort;

Global Technology Regions
Life Sciences

Sydney, Australia
Montreal, Canada
Toronto, Canada
Shanghai, China
Beijing, China
Øresund, Sweden-Denmark
Paris, France
Lyon, France
Alsace, France
Frieburg, Germany
Munich, Germany
Cork, Ireland
Dublin, Ireland
Galway, Ireland
Tel Aviv, Israel
Tokyo, Japan
Auckland, New Zealand
Singapore
Stockholm, Sweden
Basel, Switzerland
Cambridge, UK
London, UK
Oxford, UK
Boston, US
New York-New Jersey, US
San Francisco, US
Philadelphia, US
Raleigh-Durham, US
San Diego, US
Orange County, US
Seattle, US
Washington, DC, US
Minneapolis, US

Source: San Diego Dialogue Analysis of Technology Industry Sources

- Biotechnology professionals from Baja California have made a growing number of efforts to reach out to San Diego's life sciences industry, including researcher-to-researcher collaborations between San Diego and Baja California institutions and internship programs with San Diego firms.



Sources: San Diego Dialogue, California EDD, INEGI

Local activities involving commercial research and production activities related to marine-based bioproducts and marine biotechnology are also promising. Some of these include:

- San Diego-based Diversa's development of a microbe-derived vaccine to prevent a major infectious disease found in farmed salmon;
- Nereus Pharmaceuticals' advancement into early discovery of pharmaceutical products based on marine microbes that will target cancers and bacterial infections;
- Research at the Scripps Institution of Oceanography into zebrafish genetics and anticancer agents (most recently from bacteria living in a marine invertebrate);
- Research by Ensenada-based researchers into disease prevention for cultivated shrimp, oysters and other farmed seafood.

One way of envisioning the possible synergy between biotechnology and more traditional aquaculture activities[19] is described in the example on the following page. This chart shows how biotechnology, pharmaceuticals and aquaculture interrelate, while also showing possible areas of collaboration in R&D and where new therapies for humans and animals may result.

Looking at the San Diego-Baja California region, there appear to be at least four factors that could provide competitive advantages in marine biotechnology: (1) San Diego's highly developed biotechnology companies;

Marine Biotechnology

INBio – in Baja California

Ocean resources may not be the only diverse ecosystem that could benefit from bioexploration and biotechnology. The varied ecosystems present throughout the entire state of Baja California might also hold opportunities for the discovery of new and useful microorganisms, as well as the establishment of mechanisms for the protection and preservation of those natural areas.

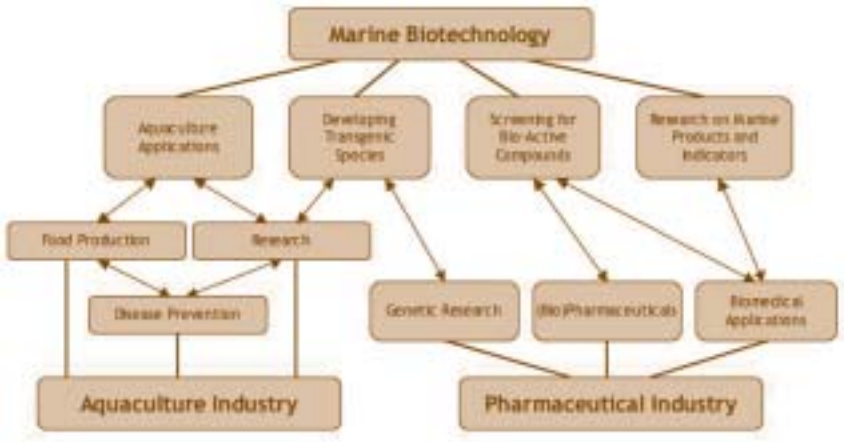
Such a public-private partnership was developed in Costa Rica with the creation of INBio, a nonprofit institute established in 1989 "to support efforts to gather knowledge on the country's biological diversity and promote its sustainable use." Given the largely undeveloped nature of much of Baja California, an effort to create a regionalized version of INBio here in the Baja California-San Diego region might create a unique mechanism to foster the growth of a crossborder biotechnology cluster while also cataloging and creating the means to protect even more of Baja California's environment.

(2) strong university programs in marine sciences on both sides of the border; (3) Baja California's extensive experience with aquaculture and mariculture; and (4) the incredibly diverse ecosystems of the Sea of Cortez and the nearby Pacific Coast. Together, these factors have the potential to create opportunities for food and health-related innovations.

Given the increasing strengths in life sciences in a growing number regions globally, leveraging local natural resources is one way for San Diego and Baja California to remain competitive in the larger biotechnology industry. Already, Japan is widely considered to be a world leader in the emerging niche of marine biotechnology. Domestically, Florida's Center of Excellence in Biomedical and Marine Biotechnology has been "formed to utilize Florida's natural marine resources, academic expertise and industry experience to conduct innovative biomedical and biotechnology research, develop new biomedical products, create jobs, and train a skilled workforce."[20] Australia, Chile, and India are also attempting to promote research and new jobs in this field.

With a concerted effort, San Diego-Baja California could gain a leading position with existing resources. The broader U.S.-Mexico opportunity

Relationship between Marine Biotechnology, Aquaculture, and Pharmaceuticals



Sources: Excerpted from "Prospects for Marine Biotechnology," University of Southern Maine

was noted in the 1999 report, *Building Ocean Science Partnerships,* by the National Research Council and Academica Mexicana de Ciencias:

> *…A research collaboration between the United States and Mexico could yield considerable benefits for both countries, because the United States is experiencing a boom in biotechnology, while some of the most promising locations in which to perform marine biotechnology field research are in Mexico….*[21]

Regional institutions, including Scripps Institution of Oceanography, Hubbs-Sea World Research Institute, CICESE, UABC-Ensenada, San Diego State University and others may hold the key to forging new collaborations in marine biotechnology that would link the region's strengths in life sciences with its natural ocean resources.

BORDERLESS BIOTECH – A LOCAL EXAMPLE

DIVERSA

SAN DIEGO-BASED DIVERSA CORP. MAY PROVIDE AN EXAMPLE FOR HOW OTHER TECHNOLOGY-BASED COMPANIES IN THE REGION CAN BENEFIT FROM CROSSBORDER OPPORTUNITIES. DIVERSA IS FOCUSED ON THE DISCOVERY AND PRODUCTION OF MOLECULES WITH PHARMACEUTICAL APPLICATIONS, AS WELL AS ENZYMES AND SMALL MOLECULES WITH AGRICULTURAL, CHEMICAL AND INDUSTRIAL APPLICATIONS. THE COMPANY HAS FOUND THAT MEXICO CAN MEET ITS HUMAN RESOURCE NEEDS AND HAS THE ABILITY TO MANUFACTURE PRODUCTS TO WORLD-CLASS STANDARDS.

ONE OF DIVERSA'S SMALL MOLECULE RESEARCHERS, DR. GERARDO TOLEDO, EXEMPLIFIES CROSSBORDER SYNERGIES, HAVING RECEIVED HIS B.S. IN MARINE BIOLOGY FROM THE UNIVERSIDAD AUTONÓMA DE BAJA CALIFORNIA SUR AND HIS PH.D. FROM THE SCRIPPS INSTITUTION OF OCEANOGRAPHY. IN ADDITION TO HIS WORK AT DIVERSA, DR. TOLEDO SERVES AS AN ADJUNCT PROFESSOR AT CICESE IN ENSENADA, TEACHING IN THE MASTER'S PROGRAM THERE IN MARINE BIOTECHNOLOGY, AS WELL AS PLAYING A KEY ROLE IN CREATING A SUCCESSFUL CROSSBORDER INTERNSHIP PROGRAM BETWEEN CICESE AND DIVERSA.

DIVERSA HAS FOUND A PARTNER IN ADDRESSING ITS MANUFACTURING NEEDS BY ESTABLISHING A LONG-TERM ENZYME PRODUCTION AGREEMENT WITH MEXICO CITY-BASED FERMIC, ONE OF LATIN AMERICA'S LARGEST PHARMACEUTICAL AND ENZYME-FERMENTATION FACILITIES. PATRICK SIMMS, SENIOR VICE PRESIDENT OF DIVERSA'S COMMERCIAL PROCESS DEVELOPMENT AND OPERATIONS, NOTED, "OUR MANUFACTURING PARTNERSHIP WITH FERMIC PROVIDES US WITH EXTENSIVE ENZYME-PRODUCTION CAPACITY AND GLOBALLY COMPETITIVE COST OF GOODS FOR OUR GROWING RANGE OF INDUSTRIAL PRODUCTS. FERMIC'S STATE OF THE ART FACILITY MEETS ALL OF OUR REQUIREMENTS FOR PRODUCTION, INCLUDING COST, CAPACITY, QUALITY AND FLEXIBILITY."

RELATIONSHIPS LIKE THE ONE BETWEEN DIVERSA AND FERMIC, AND LINKAGES WITH CICESE, ARE EXAMPLES OF WAYS THE SAN DIEGO-BAJA CALIFORNIA REGION COULD CATALYZE ADDITIONAL DISCOVERY AND MANUFACTURING CAPABILITIES IN BIOPHARMACEUTICALS FOR A MORE COMPETITIVE REGION.

Photo: Sean West, Diversa

Pharmaceuticals & Clinical Research

With sales valued at more than $11.3 billion in 2005, Mexico is the 10th largest pharmaceutical market in the world.[22] In addition, the country's regulatory system has generally encouraged the growth of pharmaceutical manufacturing, primarily for the domestic marketplace. According to industry reports, the existence of world-class manufacturing capabilities and a high degree of intellectual property rights protection has resulted in the growth of approximately 400 pharmaceutical manufacturing companies in Mexico,[23] including some of the industry's largest companies: Pfizer, Cilag, Glaxosmithkline, Schering Plough, Merck and Bristol-Myers Squibb. Nearly 80 percent of this manufacturing, however, is concentrated in Central Mexico (the Distrito Federal and the state of Mexico), and very little research and development is currently done anywhere in the country.

A clear opportunity exists to promote research activities on a crossborder basis that offer benefits to both the interested companies as well as the region's population. San Diego boasts a high concentration of academic institutions and pharmaceutical and biotechnology firms, while manufacturing capacity, strong academic institutions and a large skilled work force is available just across the border in Tijuana.

A Comparison of Reported Diseases/Disorders: San Diego County & Baja California[25]

Selected Diseases/Disorders	Baja CA Cases (2003)	Baja CA Rate Per 100,000 Population	Rank Among 32 Mexican States (2003)	San Diego County Cases (2003)	San Diego County Rate Per 100,000 Population	San Diego County Rank Among California Counties
AIDS (*Cumulative number of cases)	2,971*	106.6	2	12,035*	406.3	5
Amebiasis	4,787	171.8	32	13	0.4	22
Arterial Hypertension	20,433	733.2	NA	NA	NA	NA
Diabetes Mellitus (Type 2)	11,794	423.2	NA	NA	NA	NA
Giardiasis	449	16.1	29	192	6.5	31
Hepatitis A	635	22.8	9	130	4.4	11
Hepatitis C	197	7.1	1	2,724	92.0	30
HIV Positive Patients (*Cumulative number of cases)	1,116*	40.0	NA	4,120*	139.1	3
Tuberculosis	1,330	47.7	1	316	10.7	10
Varicella ("Chicken Pox")	9,865	354.0	14	4	0.1	NA

NA = Not Available

Pharmaceuticals & Clinical Research

According to a recent California Healthcare Institute study,[24] there were 643 drugs from California-based firms in the R&D pipeline as of March 2004, and 417 of these were in clinical trials. The top five targets of California's biomedical companies are cancer, infectious diseases, cardiovascular disease, pulmonary disease/respiratory disorders and diabetes. Notably, most of these diseases or disorders are prevalent in both San Diego's and Baja California's population (see chart previous page).

Number of Clinical Trials Reported to the National Institutes of Health — September 2005

Source: ClinicalTrials.gov

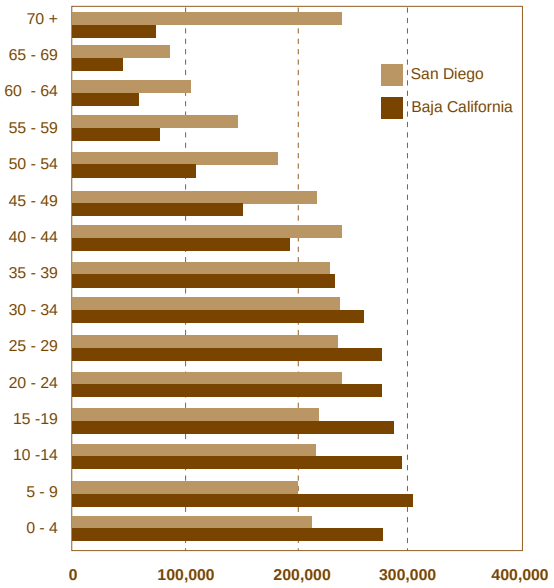
Today, clinical research is often conducted globally, in part to secure the large number of needed trial participants that suffer from various infirmities, as well as to speed up and reduce the costs of clinical trials. Still, the greatest concentration of FDA-regulated clinical research still occurs in the United States. As of late-2005, the National Institutes of Health (NIH) identified at least 12,500 studies in the United States that were either in progress or recruiting for patients.[26] Most of these studies include drug trials being conducted at multiple locations, the highest concentration of which occurred in California (4,154 studies), Maryland (4,040 studies) and New York (3,978 studies). Nearly 1,050 of these studies were in the San Diego region.

As can be seen in the map above, this is in great contrast to the low number of clinical studies that are occurring in Mexico. According to available data, while activity appears to have increased since 2004, there were still only approximately 140 studies tracked by the NIH in Mexico in fall of 2005. This is despite the proximity of both California and Texas, two states with large concentrations of innovative medical institutions and clinical trials. Most studies under way in Mexico are sponsored by major pharmaceutical firms and address a variety of conditions (several of which are listed below). The vast majority, however, are conducted in the Mexico City metropolitan region, as well as Guadalajara and Monterrey. Only eight studies were found with activity in Baja California — contrasting dramatically with the large number of studies active in San Diego and California.

Pharmaceuticals & Clinical Research

San Diego's expertise in managing clinical trials and research capability with thousands of San Diego County citizens could represent a resource to Baja California in developing a clinical trials capability. The development of a new and dynamic economic sector for the border region in the area of clinical research has the potential to benefit both Baja California and San Diego in various ways:

Population Distribution Comparison
Baja CA (2005est.) & San Diego County (2004est.)



Source: Crossborder Business Associates

- Baja California has already identified the "health services cluster" as an area of economic growth in the future. The expertise that San Diego has in managing hundreds of clinical studies involving thousands of County residents in an ethical and professional manner could represent a resource to Baja California in developing a clinical trials capability. Baja California has implemented a few studies and could very easily increase this activity with San Diego's help as long as federal and state laws and research protocols are respected.

- An increased number of clinical studies in the region could result in greater investment in R&D in the binational region, which in turn would generate greater funding for institutions and professionals involved with managing and/or performing these studies. Particularly important to Baja California could be the increased investment in health care facilities and equipment needed to accommodate such studies;

- Benefits to companies are also considerable: As seen at right, the population base of Baja California is significantly younger than that of San Diego. Companies interested in the U.S. Latino market or in Latin America would have an opportunity to study a population with similar age and cultural characteristics and to focus on certain infirmities, such as respiratory and diarrheal disease, that are less common in the United States than in Mexico;

- The savings in time and money could also be very important: According to industry and governmental sources, the average protocol authorization for clinical studies in Mexico from the Secretaría de Salud can be as short at 4 months. In addition the cost of implementing a study could be reduced by 30 percent to 40 percent compared to similar U.S. and European studies. Finally, such studies would be within driving distance for employees of many San Diego and California pharmaceutical firms; and

- In the case of major public health threats such as HIV/AIDS, clinical research conducted on both sides of the border can be a tool to address real and current health threats to the regional community. For instance, San Diego has the fifth-highest number of AIDS cases among 37 California counties, while Baja California ranks

second among all Mexican states. In this case, fostering new treatment options in the region could turn a shared problem into a shared solution.

Many pharmaceutical firms and contract research organizations (CROs) have begun to see the potential synergy with Mexico, but not yet in Baja California. While most studies are generally conducted directly by major pharmaceutical firms — often in collaboration with a university partner — there are also several CROs in Mexico: Kendle International, Quintiles Mexico; MMATISS; and IMIC (Mexican Institute of Clinical Research). At least two of these — Kendle and Quintiles — have offices in San Diego, presenting a possible option for catalyzing such activities locally.

While a crossborder pharmaceutical cluster may take decades to form, the prospect of crossborder clinical trials holds great promise in the near term. As clinical research protocols typically fall under federal jurisdiction, efforts to explore this opportunity will require close coordination amongst state and federal officials, as well as input from the community on both sides of the border.

Care must be taken to conduct all research in an ethical manner, focusing on parallel studies in both U.S. and Mexican sites thus addressing important local concerns and sensitivities. Societal benefits could be significant, including health care workforce development, improving health care infrastructure, increasing access to potential therapies to a broader community and supporting the growth of regional bio-pharmaceutical companies. Clinical trials may also be a first step towards a much larger goal: the research capabilities resulting from conducting studies at world-class standards can develop the skills and experience essential to growing a life sciences industry cluster in Baja California.

EXAMPLES OF CLINICAL TRIALS IN MEXICO

Sponsor	Phase	Condition	Mexico Locations
Bristol-Myers Squibb	Phase II	Metastatic Breast Cancer	Chihuahua, Mexico City
Eli Lilly and Company	Phase III	Non Small Cell Lung Cancer	Mexico City, Chihuahua, Guadalajara, Leon, Mexicali
GlaxoSmithKline	Phase II & III	Immune Thrombocytopenic Purpura	Mexico City, Puebla
Hoffmann-La Roche	Phase III	Severe Active Rheumatoid Arthritis	Mexico City, Leon, Tijuana
Instituto Nacional de Ciencias Medicas y Nutricion, National Council of Science and Technology, IMSS	Phase IV	Acquired Immunodeficiency Syndrome	Mexico City, Guanajuato
Johnson & Johnson	Phase III	Schizophrenia	Puebla, Monterrey, Tampico
Merck	Phase II & III	Acute Asthma	Mexico City
Merck	Phase II & III	Type 2 Diabetes Mellitus	Mexico City
Wyeth	Phase II	Ventricular Arrhythmias	Mexico City, Guadalajara, Monterrey, Veracruz

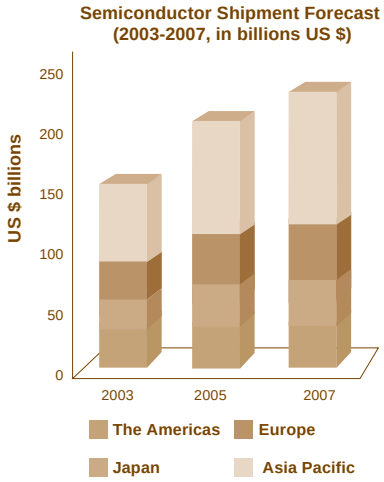
Source: ClinicalTrials.gov

Other Prospective Transborder Clusters in the Californias

While an exhaustive analysis of each potential crossborder cluster is beyond the scope of this study, the region has other potential clusters of opportunity — some of which are quite promising. A few of these are briefly presented below.

Semiconductors

If you build it, will they come? The developers of a 10,000-acre technology park project called Silicon Border outside of Mexicali certainly hope so. Their proposal: to catalyze the development of a global semiconductor manufacturing center in this region through a combination of state and federal tax incentives, priority energy and water infrastructure, industry-oriented workforce-training programs and proximity to North American and Latin American markets.



Source: World Semiconductor Trade Statistics

At a joint meeting of the boards of the San Diego/Tijuana Chambers of Commerce, Baja California Governor Eugenio Elorduy announced an exciting initiative in Mexicali, funded by the Mexican federal government through ProSoft. This initiative has secured its first $100 million in investment with the goal of creating a semiconductor park employing thousands and a comprehensive educational complex led by CETYS over the next decade.

As the proportion of semiconductor manufacturing in the Americas continues its decline — it's currently projected to fall to less than 17 percent of all semiconductor shipments by 2007 — Silicon Border aims to offer the industry a "second-source" alternative. This represents a potentially attractive option for companies that already have major supply chains in the region, such as displays/monitors, telecommunications, automotive and defense. With worldwide sales of semiconductors expected to increase from $166.4 billion in 2003 to more than $247.3 billion by 2007, it may be irrelevant whether Baja California becomes a second or primary source for the semiconductor industry; demand for semiconductors in North America is expected to continue to grow, especially in light of the broadening uses for semiconductor products.

Other Prospective Transborder Clusters

Semiconductor & Related Device Manufacturing Employment
(NAICS 334413 – 2002)

Should Baja California be successful in attracting semiconductor-related manufacturing operations to Mexicali (noted by star), such facilities would be relatively close to U.S. firms with nearly 70,000 semiconductor-related employees in just the four states of California, Arizona, Oregon and Washington.

As with other sectors already outlined, the synergistic potential of Silicon Border, if successful, could be impressive, given the relative strength San Diego already has in semiconductor suppliers and wireless chip design, as well as the existing strength that Tijuana and much of Baja California have with integrated circuit assembly. The regional potential of this development is especially exciting given that California, the West Coast and the Southwest are already home to much of the semiconductor industry employment in the United States.

This synergy would not just benefit San Diego and Baja California. Attracting semiconductor fabrication facilities to the region would also help California to retain its leadership in semiconductor manufacturing and research and development. As noted by the U.S. Semiconductor Industry Association (SIA): *"…[It] has become increasingly important for companies to co-locate silicon process research and advanced manufacturing operations. … If leading edge manufacturing moves offshore because foreign governments have created more attractive investment environments, over time R&D facilities for manufacturing processes are likely to follow."*[27]

Creating a broader effort among Baja California universities and associations, San Diego universities and private companies could play a valuable role in helping the Silicon Border vision become a reality. The region already has a strong academic research base to draw upon, such as ongoing research at the Centro de Ciencias de la Materia Condensada at UNAM's campus in Ensenada, UCSD's materials science and engineering program, and electrical engineering programs at SDSU and UCSD. In addition, the strong presence of wireless, telecom, biotech and emerging nanotechnology companies in San Diego County may also present a strategic opportunity for semiconductor firms and encourage them to take root in the region.

Other Prospective Transborder Clusters

Selected Regional Companies in the Semiconductor Cluster

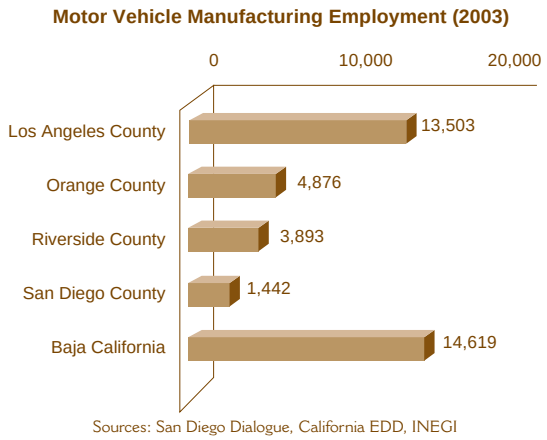
- Applied Micro Circuits Corporation (AMCC)
- CERCOM
- Cymer
- Delta Design
- DS Fibertech
- Entropic Communications
- Kyocera
- Memec
- Peregrine Semiconductor
- Qualcomm
- Schumacher
- Skyworks
- Staccato Communications

Representatives from the semiconductor industry and federal, state, and local governments attended the groundbreaking of the Silicon Border industrial park on June 22, 2005. Time will tell if this vision will attract the investment and semiconductor fabrication plants that the developers hope.

Automotive

According to 2003[28] data, there were approximately 40,000 employees working in the automotive manufacturing industry in Southern California and Baja California.[29] As seen in the chart below, however, San Diego sits between the two major poles of this sector's employment: L.A./Orange Counties and Baja California.

In fact, between 2002 and 2004, Baja California captured nearly $140 million in foreign investment in the automotive industry — the seventh-highest ranking among Mexican states during this time period. A 2004 survey by Baja California's ProduCen identified a total of 55 companies involved in the state's automotive industry, 22 of which have 250 or more employees.[30] Two of the best-known examples of Baja California's growing automotive cluster are Toyota, which produces full Tacoma trucks and truck beds in Tijuana; and Kenworth, which manufactures about 40 tractor trailers per day in Mexicali. Many of the companies in this cluster are global corporations that either supply original equipment manufacturers (OEMs) or are OEMs, including: Autoliv Safety, Honeywell, Delphi, and Parker Hannifin, to name a few. Supplier companies manufacture diverse components such as safety glass, turbochargers, wiring harnesses and electronic assemblies.



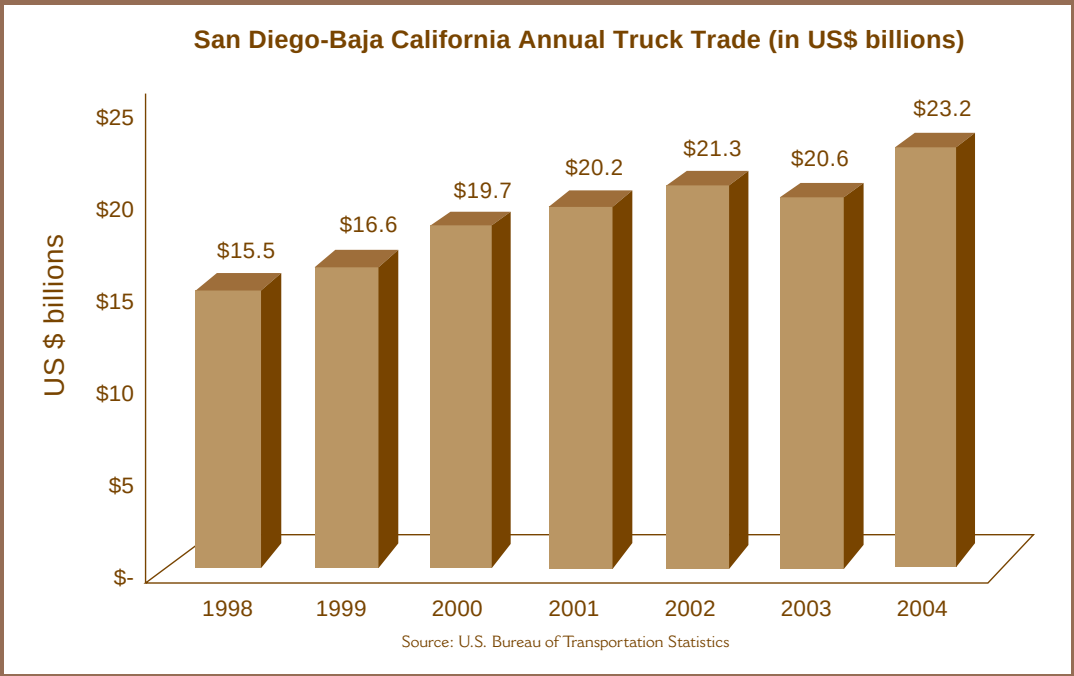
Sources: San Diego Dialogue, California EDD, INEGI

Despite the relatively low overall employment in this sector, San Diego County is home to two of the 14 major automotive design centers in Southern California: the DaimlerChrysler Pacifica Design Center in Carlsbad and Nissan Design International in La Jolla. San Diego is also home to numerous companies that provide "cross-cutting" technologies, such as software and wireless telecommunications, that have applications in the automotive sector. For example, Reaction Design recently announced a partnership with several major automotive manufacturers and petroleum companies to use its chemical-process simulation software to develop

cleaner burning, more efficient engines.[31] Additionally, San Diego's strength in telecommunications could potentially support the growing demand for telematics — technologies related to embedded and wirelessly connected devices that are increasingly used in motor vehicles for communications, navigation, diagnostics and monitoring, and entertainment.[32] The California Institute for Telecommunications and Information Technology (Calit2), based at UCSD, has a dedicated research program focused on intelligent transportation and telematics technologies.[33] Building on these companies and expertise, the capability exists for San Diego to grow this sector and become a link between Southern California and Baja California, as well as to attract new players interested in both regions. Additional San Diego-based automotive-related strengths — such as the Laboratory for Intelligent and Safe Automobiles at Calit2, companies such as Maxwell Technologies, which develops ultracapacitors for hybrid and electric vehicles, and the growing prominence of the San Diego International Auto Show — all suggest the potential for growth of this sector in the region.

Several companies already have a crossborder relationship in the automotive sector. Hyundai Translead has corporate offices in San Diego that oversee more than 2 million square feet of manufacturing, assembly and design operations in Tijuana, and San Diego is host to the logistical operations of Bose and Pioneer, which supply automakers with speakers and sound equipment manufactured in Baja California.

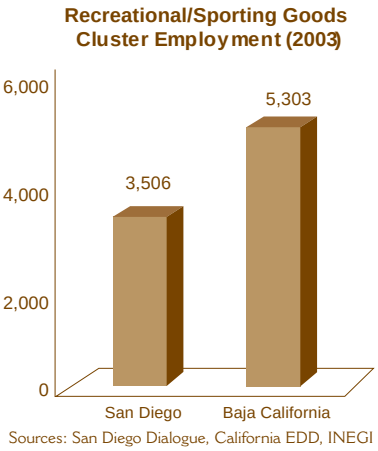
IN 2004, MORE THAN $23 BILLION IN GOODS WERE TRUCKED ACROSS THE SAN DIEGO-TIJUANA COMMERCIAL BORDER CROSSING OF OTAY MESA. MORE THAN $100 BILLION OF GOODS HAVE BEEN SHIPPED THROUGH THIS POINT BETWEEN 2000 AND 2004.



Other Prospective Transborder Clusters

Recreation and Sporting Goods

The binational region is a hotbed of recreational sporting goods manufacturing. While this industry may fly under the radar when compared with biotechnology or wireless telecommunications, it plays a significant role in the economies on both sides of the border. This cluster includes companies involved in surfing, scuba diving, sport fishing, golf equipment manufacturing, snow and water skiing, and equipment for traditional sports, such as basketball and football.



Sources: San Diego Dialogue, California EDD, INEGI

Located primarily in central and northern San Diego County are well known companies such as K2, Callaway Golf, TaylorMade Golf, Aqua Lung, and Suunto. In Baja California, companies such as O'Neill, Easton, Eagle Creek, and Wham-O are concentrated in Tijuana and Ensenada. Ensenada is home to a group of companies that make ocean-related products, such as sport fishing and neoprene wet suits. In the region as a whole, there are at least 120 companies making items that range from wetsuits to carbon fiber golf club shafts. As shown by the graph at left, the San Diego-Baja California region employs 8,800 people in this cluster, with 60 percent in Baja California.[34] The San Diego metropolitan area is ranked as the largest employer in this cluster in the United States.[35] San Diego also is home to more than two dozen companies that produce bicycle frames and components — a subsector that is not included in the formal definition of the recreational products cluster. Several of San Diego's bicycle companies — including Speedplay, Reynolds Composites, Ellsworth, NiteRider — are recognized as national and global leaders in the industry.[36]

The general perception of the sporting goods industry may be that is relatively "low-tech." However, over the last decade, many companies — often working with local research universities such as UCSD — have invested in improving their product lines with advanced materials. Many of these are derived from the aerospace industry, including exotic aluminum alloys, titanium, scandium alloy (used for the skin of sub-launched ballistic missiles), and composite blends of carbon fiber. The research, engineering and manufacturing done on both sides of the border in the continuing quest to make the equipment lighter, stronger and better-performing is anything but low-tech. Given the presence of many aerospace companies, as well as research universities with strong programs in materials science, the potential may exist for spillover from the crossborder university-industry partnerships in aerospace.

Other Prospective Transborder Clusters

Energy & Environmental Technology

Several converging factors could make the San Diego-Baja California a hub for energy and environmental technologies. In addition to the major investments that are occurring in more traditional energy infrastructure — including new power production facilities in San Diego and Mexicali and a new liquid natural gas terminal in Baja California — the region already has a degree of expertise in power-production technologies with companies such as Solar Turbines, a global leader in the production of mid-range industrial combustion turbines that has operations in both San Diego and Tijuana.

Beyond the traditional energy industries and companies, there may be an opportunity to grow a renewable energy cluster in the region. Baja California is already home to one of the largest geothermal production plants in the world, and demand is growing for wind and solar energy products — energized in part by California's mandate for utility companies to increase their use of renewable energy to 20 percent of their energy mix by 2017. Already, several manufacturers in the local crossborder region, including Kyocera and United Solar Ovonic, specialize in solar energy products, making Tijuana a major producer of solar panel modules.

In addition, new local investments are using fuel cell technologies and wind energy, adding to the region's prominence in environmental technology fields. The Sheraton San Diego Hotel & Marina plans to use four 250-kilowatt fuel cell power plants to convert natural gas into electricity, and a 50-megawatt wind farm is currently under development at the Campo Indian Reservation. Given the depth and breadth of expertise in composite materials and electronics represented by the region's aerospace, semiconductor and sporting goods industries, potential exists to attract existing companies to this field.

Massive 20-story wind turbines dwarf nearby structures along the Tecate Divide in East San Diego County.

Specific Crossborder High Value-Added Targets of Opportunity

The last 25 years have yielded more globally competitive industries and high-value-added jobs in both Baja California and San Diego than most people recognize. This report provides data on what has been happening in a variety of high-value-added sectors of economic activity on both sides of the San Diego-Baja California border during this period. Simply adding up the employment numbers from the sectors reported in this preliminary study paints a picture that is potentially very attractive to R&D companies interested in proximity to reliable high-quality manufacturing and supplier networks, as well as to Latin American and global companies interested in manufacturing in a region where education and R&D resources are widely available.

In broad terms, the increasing number of companies and employees working in these various clusters on both sides of the border suggest a trend that is very promising. There are obviously strong complementarities between the R&D, supplier and manufacturing capabilities that exist on both sides of the San Diego-Baja California border. These complementarities represent significant potential for economic growth and prosperity in both Southern California and Baja California. Properly leveraged, this potential can help anchor good companies in need of manufacturing partners in Southern California and benefit growth among Baja California's existing manufacturers and suppliers by exploiting the synergies of the research and development clusters in Southern California and the growing research and development capacity in Baja California. In sum, these preliminary data suggest three "big ideas" that merit wide public discussion and significant attention by politicians and economic development professionals on both sides of the border.

I. **There is a need for aggressive and collaborative marketing efforts showcasing the high-value-added crossborder clusters in the region.**

Specific Crossborder Targets of Opportunity Summarized: Employment Data 2003

	San Diego Clusters	Baja California Clusters	Total Crossborder Clusters
Biomedical Devices	6,799	23,702	30,501
Aerospace & Defense	18,338	4,756	23,094
Software	14,546	738	15,284
Biotech/Pharmaceutical	20,353	379	20,732
Motor Vehicle Manufacturing	1,442	14,619	16,061
Recreation & Sporting Goods	3,506	5,303	8,809
Total High Value-Added Clusters	64,984	49,497	114,481

Sources: San Diego Dialogue, California EDD, INEGI

The extraordinary achievements of both Baja California and San Diego over the last 25 years need to be better understood on both sides of the border. Their complementarities need to be leveraged strategically and comprehensively in a manner that more effectively showcases the uniqueness of the entire crossborder region for high tech. There is a very powerful story that could be embedded in a campaign to promote a concept such as The Innovation Corridor of the Californias, which has great potential because of the following drivers of global competitiveness:

- Increasingly, large and small technology-based companies are interested in locales that provide proximity to basic and developmental research; clinical trials (in the case of pharmaceuticals and biomedical devices); high quality manufacturing; and global distribution.
- Efficiency and reliability are as important in manufacturing decisions in the high-tech sector as is the cost of labor. Time is money. The proximity of Baja California's increasingly competitive manufacturing clusters, the foundation of trust and respect that has already developed in some key sectors and the more competitive pricing of land and labor are important assets.
- For the incubating R&D clusters in Baja California, as well as the growing manufacturing sector, the ability to market alliances with R&D institutions on the U.S. side of the border would greatly enhance attractiveness for foreign investment and expansion in Mexico.
- The superb educational institutions in fields relevant to high-value-added industries and professions on both sides of the border supports co-marketing campaigns that promote the region's superior education and training resources so essential to adaptable manufacturing processes and workforce flexibility.

II. Leadership in the crossborder innovation clusters needs to deepen its commitment to expanded technical assistance and professional and workforce education programs in order to assure sustainable growth and competitiveness on both sides of the border.

The data presented in this report make a strong case for the growth in both quality and diversity of the economic base on both sides of the San Diego/Tijuana border over the last 25 years. What is particularly dramatic is the diversity of colleges and universities that are graduating young people in fields such as computer science, engineering, medicine and the life sciences. This is changing the face of the professional workforce on both sides of the border. In addition, there has been substantial growth in workforce skills within the manufacturing and supplier networks characterizing both sides of the border. These dual developments suggest that the crossborder region can call upon an increasingly competent talent pool and workforce so essential to high-value-added, globally relevant clusters. In order to enhance this capability, it is important that consulting, educational and business development organizations in the crossborder region more actively collaborate through such things as:

- Jointly planned educational programs in the engineering and technical fields.
- Jointly planned education and development programs in management and entrepreneurship.
- Development of workforce competencies capable of leveraging the synergies in the crossborder

region, such as research in the life sciences and clinical trials management in Baja California.

III. **There is a need for new social and institutional mechanisms that can move the crossborder region beyond symbolism into action — action that involves shared governance, co-planning, co-investment and well orchestrated implementation of programs.**

It is clear from the various focus groups, roundtables and interviews conducted during this research study that more interaction among both institutions that are currently involved with the crossborder region, as well as non-crossborder oriented institutions, must occur. Institutions and groups involved in economic development; chambers of commerce; workforce development; enterprise financing; hospitals and health care organizations; need frequent and regular interaction among crossborder peers. Genuine collaboration between similarly focused institutions does not occur to the degree needed to enhance the existing and potential crossborder linkages that exist.

For any sort of crossborder innovation strategy to be effective, the region will need to significantly increase interactions among leadership in key institutions, enhance collegiality and build collaborative initiatives. At a minimum, such collaborative initiatives should occur among the following kinds of institutions on both sides of the border:

- Colleges, universities and workforce education programs.
- Hospitals and health care providers.
- Centers of economic analysis and policy studies.
- Economic development agencies and business-promotion organizations.

Even though the economic evidence and initial crossborder data present a strong argument for focusing regional attention in San Diego and Baja California on a dedicated effort to foster a more dynamic and competitive Innovation Corridor of the Californias, such an effort requires addressing a number of major challenges — the most significant of which is the challenge of security at the border. Unless these challenges are confronted, the promising opportunities just identified are unlikely to develop.

Confronting Challenges, Finding Opportunities

There are a variety of challenges that need to be addressed, simultaneous with increasing the opportunities for collaborative development.

The Challenge of Security

Crossborder business and government leaders must address the need to make border crossings as efficient and as secure as possible for individuals and commercial traffic. Given the ever-changing political and social issues shaping the view of the border, this task requires constant vigilance and serious thinking on the part of local, state, and federal entities, as well as local policymakers and business advocates. In recent months, a number of studies have argued for the extraordinary promise of the bi-national San Diego/Tijuana economy. A recent study by SANDAG points out the economic impact of revenues, wages and jobs tied to San Diego's crossborder location.[37]

- 60 million crossborder trips annually.
- Up to 70,000 cross daily from Tijuana to San Diego for work or business.
- Up to 10,000 cross daily from San Diego to Tijuana for work or business.
- 90 percent of all crossborder trips are local (mostly the same people).
- 87 percent of those who cross from San Diego are bound for Tijuana.
- 94 percent of those who cross from Tijuana to San Diego are bound for San Diego County.

These existing relationships, as well as the potential opportunities identified in this study, are seriously jeopardized by the extension of the wait time at the border as a result of security issues and inadequate border crossing infrastructure. What is needed is a more efficient and modern border infrastructure to serve the needs of the region.

SANDAG's research also has looked into the implications of changing wait times at the border. Their data is sobering. For example:

1. **Economic impact for San Diego at today's average wait time of 45 minutes:**

- More than 8 million trips are lost.
- $1.28 billion potential revenues are lost.
- 3 million potential working hours and $42 million in wages are lost.
- Between 28,000 and 35,000 jobs are lost.
- Between $2 billion and $2.5 billion lost is the total economic impact for San Diego.

2. **Economic impact for Tijuana at today's average wait time of 45 minutes:**

- More than 2 million trips are lost.
- $120 million potential revenues are lost.
- More than 500,000 potential working hours and $10 million in wages are lost.
- Between 800 and 1,900 jobs are lost.
- Between $100 million and $230 million lost is the total economic impact for Tijuana.

3. Should the wait time increase by an additional 15 minutes:

- $1 billion lost in output, for a cumulative loss of $3.4 billion.
- 13,400 jobs lost, for a cumulative loss of 46,200 jobs.

There is an immediate need for a deeper analysis of the specific industries that are active in the crossborder region and are potentially affected by changes in wait times. This requires more than just a general economic overview such as that provided in this study; it calls for a very specific process for gathering information from individual CEOs and principals in the wide array of industries involved in crossborder activities. In addition, what is needed is more detailed analysis, broken down by industry sector, of the crossborder relationships that could be beneficial to the economies on both sides of the border. The combination of more detailed data and a larger and more diverse pool of informed advocates could go a long way toward the development of a comprehensive proposal for more effective border crossing infrastructure. Finally, what is desperately needed is a thorough analysis of the sorts of technologies that could enable more efficient and secure border crossings. With the help of universities such as UCSD, SDSU and high-tech firms such as SAIC and Cubic, who are already working on technologies relevant to this problem, some exciting regional solutions could emerge.

The Challenge of Globalized Innovation

It is not only the offshoring of technology products or services that poses a competitive threat to San Diego and Baja California. Rather, the global challenge we face is the large number of existing world-class research and technology regions. In addition, there is a growing number of specialized (yet increasingly qualified) emerging technology centers throughout the world that represent future sources of competition to the crossborder region. As these other regions begin to demonstrate their capabilities they have the potential, in a very short time frame (5 to 10 years) to be not just fierce competitors but to surpass both San Diego and Baja California.

The Challenge of Infrastructure

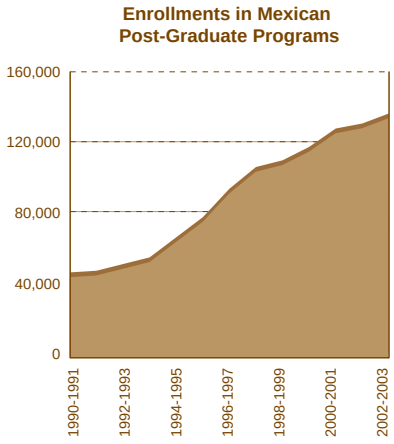
The passage of the Proposition A transportation-funding measure in San Diego is one of the region's success stories, with the effect of generating $14 billion dollars for San Diego's transportation infrastructure to keep commerce and the quality of life on the right path. Other successes have included more than $100 million in funding from the North American Development Bank for projects within Baja California — each of which has leveraged many multiples in federal and state funding for wastewater and air pollution projects.

Containers being unloaded at Port of Ensenada. Source: www.bajaimagemakers.com.

San Diego County and Baja California are already connected to each other through a broad network of critical infrastructure, including water, energy, transportation and telecommunications. The Colorado River is the primary water source for residents and businesses in Tijuana and Poway. Natural gas and electrical infrastructure crosses the border and provides energy to homes in Mexicali and Chula Vista. Telecommunication backbones (including the high-speed Internet 2 connection) span the border, linking computers at universities in Ensenada and San Diego. Cargo that was once driven from the Port of Long Beach is now arriving directly at the Port of Ensenada, being turned into new products in Tecate, and being shipped across the Otay Mesa Port of Entry.

Progress on important projects such as these has required taking advantage of shared needs for public infrastructure by creating new mechanisms to collaborate in planning, financing and managing that infrastructure for a more competitive, secure region with a better quality of life for its citizens. SANDAG has been the region's leader in this, but much more work remains.

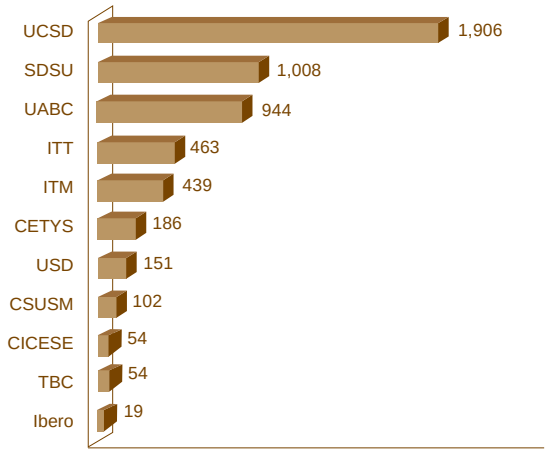
The Challenge of Education



Source: Mexico's Secretaría de Educación

The number of science and engineering (S&E) doctorates awarded by universities in the United States continues to decline. Between 1995 and 2003, the number of U.S. citizens or permanent residents awarded S&E doctorates in the United States declined by 17.5 percent.[38] It is noteworthy that the number of Mexican citizens awarded S&E doctorates by U.S. universities increased during this time period by more than 68 percent, from 130 to 219. Additionally, the number of Mexican students enrolled in post-graduate programs in Mexico has exploded since the early 1990s (see graph). Nonetheless, the fact remains that both countries have serious problems in providing the skilled workers needed by high-technology industries. This

Tech-Related Degrees Conferred (2003-2004 Academic Year)



Sources: Departmental statistics from each school

applies to the San Diego-Baja California region as well, where the San Diego metropolitan area ranks only 13th and Baja California ranks 6th (for Mexican States) in the percentage of population with a bachelor's degree or above (32 percent of the population for San Diego, 13 percent for Baja California).

Still, there is positive news regarding technology education in the crossborder region. According to a survey conducted for this study, more than 5,300 technology-related degrees were awarded in 2003-2004 by the major institutions in San Diego and Baja California. These major institutions include: UCSD, San Diego State University, CSU San Marcos, University of San Diego, the Universidad Autonoma de Baja California (UABC), Instituto Tecnologico de Tijuana (ITT), Instituto Tecnologico de Mexicali (ITM), CETYS Universidad, CICESE, Universidad Iberoamericana (Ibero) and the Tecnologico de Baja California (TBC). Degrees were awarded in engineering, software and life sciences programs at a variety of levels.

While technical capacity does not necessarily translate into operational skills, these preliminary data suggest that universities on both sides of the border are well positioned to provide significant advanced education in scientific and technical fields relevant to the high-value-added clusters developing in the crossborder region.

Technology Degrees Awarded by Discipline & Type (2003-2004 Academic Year, Selected Universities)

	SD Undergrad	BC Undergrad	SD Masters	BC Masters	SD Doctorates	BC Doctorates	Total
Life Sciences	1,001	243	126	13	84	44	1,511
Engineering	833	1,078	290	71	63	12	2,347
Marine Sciences	11	0	13	34	13	2	73
Math & Physics	188	14	58	4	22	7	293
Software	545	625	112	22	14	0	1,318

Sources: Departmental statistics from each school

The Challenge of Trust

Were the region to develop a strategy to support an Innovation Corridor of the Californias, it would require a significant amount of collegiality and trust among civic leaders, policy makers, educational institutions and the private sector. This means sharing timely and relevant information, frequent interactions and a commitment to one anothers' future and quality of life — in essence, acknowledging that history, geography and existing social ties have inextricably linked our communities and our economies on both sides of the border. Only with this level of trust can the region achieve its deepest integration and most promising competitive opportunities.

A wide variety of organizations, institutions and individuals within the San Diego-Baja California region have been working over many years to achieve such interactions and trusting relationships. Building on this strong foundation, civic leaders could bring together a core group of stakeholders and political leadership from which a more integrated strategy could emerge.

ØRESUND: A MODEL OF BORDERLESS INNOVATION

Seeking closer crossborder collaboration and integration to foster innovation may appear to be a daunting task. Yet it is already being done in other parts of the world as regions strive to enhance their economic competitiveness and quality of life. One of the best examples of this is the Øresund region that spans an area from Copenhagen, Denmark, to Malmö and Lund, Sweden. Its strong life science and information technology sectors are internationally known because of the critical mass of research and medical institutions this border region has networked. Its life sciences cluster, called the "Medicon Valley," has more than 30,000 individuals working in biotech, medical device and pharmaceutical companies, such as Pfizer, Pharmacia & Upjohn, Astra Draco, Novo Nordisk, and Lundbeck.

Northern Denmark and Southern Sweden's high-technology companies, government officials and universities engage in joint marketing efforts, collaborative business ventures and shared workforce education and training programs. However, it was not always this way. Differences in language and culture had long created tensions for those on either side of the Øresund strait. During the mid-20th century, efforts to catalyze a major infrastructure project — a bridge spanning the strait — were becoming a reality, prompting the region to envision a new identity, and to find ways that Swedes and Danes could work toward a shared future.

This transformation in how the region perceived itself led to other breakthroughs. In the 1990s, community leaders and universities within the region noticed that these two technologically sophisticated nations were doing more collaborative work with other countries than with each other. With increasing pressure caused by global competition, concrete steps were taken to better link the two sides. New crossborder trade associations, such as the Medicon Valley group, were formed, and the "triple helix" of those within the private sector, government and the region's 14 universities joined together to form the Øresund Science Region (OSR) initiative. This initiative helps coordinate and facilitate programs to supply the human capital necessary to sustain and grow local high-technology industries while also serving as a catalytic agent to foster a more competitive knowledge-based economy. Since its establishment, OSR now coordinates six technology-focused programs in biotech/medical, IT, food sciences, environmental science, logistics, and design, as well as three specific projects in nanotechnology, digital media and recreational sports.

Competing as the Innovation Corridor of the Californias

"To be sure, increasing computational power and connectivity offer enormous potential to convey knowledge, transact commerce, and raise productivity. And biotechnology is full of incredible promise that is only now starting to be realized. But technology spans a much larger spectrum.... It encompasses materials and machine tools, energy systems and systems engineering, aerospace and atomic clocks, automobiles and autonomous combat vehicles, food processing and chemical processes, and on and on. The point is simply this: Advances in science and technology present us with an incredibly rich— and evergrowing — array of manufacturing opportunities. From somewhere within this wealth of possibilities will come the next technology revolution...Our competitors are not standing idly by. From Europe to China, our companies are facing fierce and fast-paced competition. As U.S. industry races toward the 'next big thing,' we need a strong manufacturing sector."

Samuel W. Bodman, Deputy Secretary, US Department of Commerce
New Directions in Manufacturing Workshop (2004)
National Academy of Sciences

Redefining the crossborder region as one with the potential for borderless innovation and opportunities adds a new dimension to regional economic and workforce development activities, and can become the means whereby we rethink who we are, what strengths each side of the border has to offer, and where the transnational region will fit and compete in the global community in the next decade. This region is unlike any other in the United States or Mexico. It is a truly binational community different from nearly every other in world. This uniqueness provides the region with the opportunity to leverage an incredibly diverse set of multicultural and multilingual individuals, as well as the natural and institutional resources the region possesses.

"Integration with Mexico will require cross-border collaborative institutions."

Michael Porter
and the Council on
Competitiveness Clusters
of Innovation Initiative:
San Diego (2001)

But how can the region get there? What is needed to catalyze a new vision focused on transforming clusters of opportunity into clusters of prosperity, which improves the quality of life for all? Through the course of this Initiative, several barriers to creating a more globally competitive binational region were identified. The barriers include the fragmented nature of efforts to promote and develop the capabilities of the region; increasing demands for workforce education and training in a binational context; a lack of professional networking across the border; uncertainty regarding legal and regulatory issues; compatibility of data; and

difficulty determining how best to maximize our current competitive advantages. The following recommendations suggest some ways the region might begin to move along a path toward resolving these challenges, and toward a robust and globally competitive Innovation Corridor of the Californias.

WHAT CAN BE DONE TO CREATE THE INNOVATION CORRIDOR OF THE CALIFORNIAS

Recommendation #1: Creation of a Crossborder Innovation & Competitiveness Center

A new way of fostering collaboration among key actors in the crossborder community must be created to spur the interaction and integration required to achieve mutual economic and social benefits. Based on the data presented in this report and the feedback from meetings and roundtable discussions held in 2004 and 2005, San Diego Dialogue and its partners intend to establish just such a collaborative institution. As conceived, the Crossborder Innovation & Competitiveness Center, would serve as a catalytic agent for an integrative economic growth strategy in the binational region of the Californias, operating a core set of research, education and networking programs; and providing funding through regranting to organizations focused on crossborder issues. The center, envisioned as a fully binational, nonprofit entity, would specifically support regional groups in capacity-building efforts focused on four key areas:

- Research of regional significance (such as binational economic indicators, crossborder cluster analyses and tracking developments in science and technology that affect the region's future);

Dozens of organizations, trade groups, institutions and governmental agencies have worked over the years on a broad range of border-related technology, economic development, philanthropic and workforce issues. These groups, and many others too numerous to mention, could play a valuable role in fostering a successful Innovation Corridor of the Californias:

Biotechnology Council of Ensenada • BorderTech • Calit2 • CANIETI • CDEM • CDT • CENTRIS • CETYS • CICESE • COBBH • COLEF • CONACYT • CONNECT • DEITAC • East County EDC • Institute of the Americas • International Community Foundation • Jacobs School of Engineering at UCSD • Mexico Business Center • ProduCen • SANDAG • San Diego Dialogue • San Diego Regional Chamber of Commerce • San Diego Regional Economic Development Corp. • San Diego Workforce Partnership • Scripps Institution of Oceanography • SDSU • SEDECO • South County EDC • Southwestern College • TI@Baja • UABC • UCSD's Center for US-Mexican Studies • USD's Transborder Institute

CICESE's campus in Ensenada. Source: www.bajaimagemakers.com.

- Technical assistance to enhance the capacity of firms on both sides of the border to build world-class capabilities and the tools and strategies essential to successful crossborder partnerships;
- Development of binational workforce education and training programs that meet the needs of dynamic crossborder industries; and
- Promotion of community forums and civic initiatives related to maintaining and improving the binational region's quality of life in a more integrated economic context.

The Center would be governed by a binational board of directors, operate with a small staff and do so in a collaborative fashion, leveraging the knowledge and specialized capabilities of partner organizations from the community. It is envisioned that, from offices on both sides of the border, the Center would serve as the nexus of current and future crossborder activities, enabling the development of relationships and networks that are crucial to achieving the full potential of the Innovation Corridor of the Californias.

Recommendation #2: Launch a crossborder program to foster scientific & technology relationships, awareness of research and commercialization of discoveries

Building on the many successes of the UCSD-originated CONNECT program, the crossborder region needs to leverage the research relationships, investment know-how and entrepreneurial skills resident in San Diego's innovation clusters to help grow similar clusters in Baja. There needs to be an ongoing commitment to create a platform for high-technology professionals on both sides of the border to build new relationships; increase the awareness of ongoing research in academia and the private sector; and support the potential commercialization of new technologies that have been developed in the binational region. San Diego's high-technology industries have succeeded in part due to the strength of their networks among researchers and business executives. It is time to extend these networks into the broader binational region.

Recommendation #3: Provide ongoing research and analytical reports on crossborder clusters

This report has attempted to show economic data for various industrial sectors for San Diego and Baja California side by side — something rarely done. While based on the best information available, and while uncovering a variety of new insights on the regional economy, it is also incomplete. In some cases, definitions of economic activity may vary, and activities that may be integral to clusters may not be part of cluster definitions.

While it might be overly ambitious in the short-term to undertake the development of a set of comprehensive indicators and definitions that more accurately show the integration of the broader San Diego-Baja California economy, ultimately it is crucial to bring together governmental and economic entities from San Diego and Baja California responsible for tracking economic statistics in order to reliably describe crossborder clusters. Such data is essential to pursuing strategic investments in shared opportunities.

Recommendation #4: Work with Baja California to establish crossborder clinical trials research as a precursor to growing a transregional biopharmaceutical industry

The knowledge, experience and technical quality required to conduct world-class clinical research represent the foundation upon which a new crossborder cluster can be built. Benefits from pursuing this attainable opportunity are many: New drug therapies will be made available to help solve our shared public health challenges; the region's human capital will be enhanced; and the region will attract new outside investment. Tentative steps have already been taken toward exploring crossborder clinical trails efforts; however, many more steps will need to be taken, including creating new education and training programs to clarify trial protocols and other regulatory requirements of agencies such as the FDA and Mexico's Secretariat of Health. A committee of local, binational experts from government, academia UCSD Extension, and the biopharmaceutical industry should be formed to outline a phased approach for developing the necessary research capabilities, the infrastructure, and legitimate parallel studies (approved by both the FDA and Mexico) that will lead to the development of a larger crossborder biopharmaceutical industry.

Recommendation #5: Promote private investor networks in the Californias

Innovation does not happen without successful commercialization, and commercialization is dependent upon capital to develop ideas into

businesses that launch new products and processes into the marketplace. Investment by angel investors, venture capital fund managers and corporate interests plays a crucial role in the development of high-technology industries, helping entrepreneurs turn their ideas into businesses. Within San Diego, private investor networks such as the Tech Coast Angels are already well established. In Baja California, however, private capital has traditionally been focused on real estate and non-technology sectors.

In order to foster a change in the outlook and culture of potential investors in the crossborder region of the Californias, an ongoing program for angel and innovation capital professionals needs to be created to promote the exchange of experience between investors in California and colleagues in Baja California and Mexico. The aim: to create new sources of capital for crossborder entrepreneurs in the Baja California and San Diego region.

Recommendation #6: Promote "smart border" technologies and infrastructure

More efficient border infrastructure facilitating secure but frequent border crossings remains one of the region's greatest challenges. But San Diego and Baja California are not alone; borders throughout the world are under increasing pressure to balance the need for legal and secure crossings by individuals and goods with the potential threats to health and national security.

The fact that approximately 17 percent of all US border crossings (Mexican and Canadian combined) occur in the San Diego-Baja California region represents an opportunity to create innovative ways to balance these border management imperatives, as well as a chance to foster innovative technologies and infrastructure solutions. The economic benefits from more secure and efficient border crossings argue strongly for efforts to incubate "smart border" innovations. Approached correctly, these efforts would have the dual effect of positively impacting the border community, while also developing technologies and knowledge that can be applied worldwide.

Recommendation #7: Expansion of existing and new crossborder education and research linkages

All of the industries mentioned in this report rely on a highly trained and knowledgeable workforce in order to compete successfully in the global economy. While the binational region's educational institutions have done a good job of structuring their curriculum to match the needs of local businesses, little has been done with a sensitivity to the crossborder opportunities, nor at the scale required. The innovative binational MEXUS dual-degree program (by SDSU, UABC, CETYS Universidad and Southwestern College), as well as the UC-Mexus grant program (which funds joint California-Mexico research projects) are notable exceptions; however, more joint programs at the university and high school levels for science and engineering will help meet the needs of crossborder companies in the life sciences, health care, aerospace and engineering.

Recommendation #8: Harmonization of economic, health and education data

In gathering data for this report, it quickly became clear that data spanning both sides of the border in a consistent, harmonized and readily available format are not available. For instance, while California tracks employment statistics on a monthly basis using 6-digit NAICS (North American Industry Classification System), Baja California data (provided by INEGI's periodic Economic Census) uses 5-digit NAICS — and no shared definitions exist for industry clusters. In the case of epidemiological data, each side of the border tracks infirmities in a different way. Acute and

chronic forms of hepatitis, for instance, are not always reported separately. Or, as in the cases of hypertension and diabetes, only estimates are made by California using survey data. Lastly, in the case of education data, each school mentioned in this report was contacted several times to collect specific information about science and technology degrees.

Efforts must be made to harmonize a consistent set of economic, health, research and education data in order to: (a) take advantage of the combined strengths of the regions; (b) more effectively track our progress as the Innovation Corridor of the Californias; and (c) better market our region for investors throughout the world. Such a "binational census" is essential to inform business and policy decisions.

Recommendation #9: Convene a high-level working group to assess the feasibility of a Californias model based on the successful INBio program

The San Diego-Baja California region is one of the world's richest in bio-diversity. It is also under threat from a rapidly expanding population. The environment is an asset to be explored and also protected, in order to ensure that economic development is achieved in a sustainable manner and natural resources are preserved for future generations. This approach can potentially be the foundation for an expanded effort by regional biotechnology companies to find new discoveries within the region's natural ecosystems while supporting the development of a life sciences industry in Baja California.

Costa Rica's INBio offers a model mechanism for finding a balance between conservation and development, providing private-sector companies with a greater amount of certainty while upholding the rights of local communities and channeling additional resources back into conservation. Next steps by appropriate research, governmental, business and community representatives are needed to examine whether the INBio model fits the binational region's unique needs, and how best such a mechanism could be implemented.

Recommendation #10: Exploration of broader, non-technological economic linkages

In the course of research for this project, it became clear that several non-technology sectors of opportunity also likely exist in such diverse areas as retirement housing, tourism, nursing, business services and environmental programs. While these fall out of the scope of this report, it is worthwhile to mention them, as well as to encourage business and community leadership within the San Diego-Baja California region to explore ways to both better define the crossborder opportunities and catalyze collaborations to understand how they can be leveraged for the mutual benefit of the citizens of the crossborder region.

Facing the Global Challenge

The acceleration of globalized business, manufacturing, and innovation is occurring at a pace with which neither San Diego nor Baja California has yet come to terms. While the competitive challenge that the San Diego-Baja California region faces is enormous, there also is great potential. The region is endowed with human, manufacturing, and innovative capacity that, if combined, promises a whole greater than the sum of its parts. Diversity of innovation and innovators, leveraging "global" competitive advantages in a local region, access to a broader range of markets and entrepreneurs, and the ability to better attract new foreign and innovation capital are the keys to prosperity on both sides of the border.

This synergy cannot flourish under the current weight of misconceptions, misunderstandings and social distance. The 21st Century offers a new chance for an already loosely connected and interdependent region to redefine itself, and to create new means for a better quality of life for all of the citizens on both sides of the border. The recommendations in this report offer ideas for action to policymakers, business and community leaders, and to citizens within what is poised to become the Innovation Corridor of the Californias.

> "The real battle, if battle there is, lies between regions, not countries... As the borderless and interlinked economy develops, regional- and city-level interests come more and more into play. In fact, informal pairings of cities... have taken on greater importance."
>
> Kenichi Ohmae
> The Borderless World

Additional Credits

Work for the Crossborder Innovation and Competitiveness Initiative has been overseen by Associate Vice Chancellor for Public Programs and Dean of UCSD Extension, Dr. Mary L. Walshok. Research and writing was managed by Kenn Morris, Director of the Initiative for San Diego Dialogue, with the strong support of Nathan Owens and Charles Pope.

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1 "Science and Technology: The Key to Creating Prosperity," SANDAG, April 2004 (p. 22).

2 All cluster data used in this report is generally derived from either the California Employment Development Department (for San Diego County data) or INEGI's Economic Census data (for Baja California) from 2003. When noted, some data is sourced from the San Diego Association of Governments or Baja California's Producen.

3 Based on recent interviews with representatives of Baja California's biomedical device industry, Baja California's employment in this sector was closer to 35,000 in the Fall of 2005, with six new companies opening facilities during this year alone.

4 San Diego Dialogue analysis of California EDD ES202 and INEGI Economic Census data.

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26 Data and map from ClinicalTrials.gov website (September 13, 2005 database search)

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