

# CHAPTER

## Transforming the Walls of Academia into Bridges: Connecting Research Universities and Industry in San Diego, California

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### INTRODUCTION

**W**hen they respond to internal and external stimuli, universities are challenged to broaden and deepen the ways in which they carry out their trilateral mission to educate, encourage the pursuit of unfettered research, and serve as relevant public citizens. In order to attract and retain the best and brightest scientists, support increasingly costly, often interdisciplinary research, train growing numbers of students,

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and take on a greater role with respect to public service, university leaders are questioning how the multifaceted relationships among research institutions, government and industry will evolve.

Alliances between universities and industries support the research, teaching and public service elements of the university's mission. While bolstering research excellence and benefiting students, these collaborations also provide opportunities for the university to play a vital role in an increasingly globalized economy. As generators of new knowledge, research universities—the fundamental building block of economic prosperity in the information age—will play an increasingly important role not only in the generation of new industries but in supplying the educated, entrepreneurial talent required to launch and sustain successful commercial ventures (Porter & van Opstal, 2001; Regents of the University of California, 1997).

In an effort to understand the forces that are re-shaping university-industry relationships and the power these alliances can have economically (Hirsch, this volume) and environmentally (National Research Council, 2001), we begin with a brief discussion of the motivation for building industry-university partnerships. Recognizing that such partnerships carry risks as well as potential rewards, we summarize potential drawbacks to these alliances, and try to put into perspective controversial aspects of university-industry collaboration.

By way of example, we turn to the experiences of the University of California, San Diego (UCSD) in spawning, nurturing and now working to sustain a somewhat unlikely high-technology economic cluster in the lower left corner of the United States (Cohen, 2001; Wilson, 2001). How has UCSD come to play a major role in regional economic development? How can the university sustain the highest levels of innovation, respond to the changing needs of the maturing business community, and rise to the challenge of maintaining the outstanding quality of life that has attracted so many brilliant scientists and entrepreneurs to San Diego?

## **POTENTIAL BENEFITS AND HAZARDS OF UNIVERSITY-INDUSTRY PARTNERSHIPS**

University-industry interactions take a variety of forms that contribute to economic prosperity locally and globally, facilitate more rapid commercialization of the results of university research, enhance the training of future scientists, provide intellectual stimulation to academic researchers, help finance university research and allow the university to be an involved, trusted member of the local community. Corporate partners may provide funding for research, endowment of chairs, student support and technical assistance to individual scientists and departments in exchange for privileges

that include attending seminars, interacting with faculty and students, and opportunities to recruit promising graduate students. Industries look to the university for their most important resource: talented, skilled, creative individuals (Regents of the University of California, 1995). In addition to people, the university offers industry a window on the latest research, infusion of new ideas, and access to long-term, basic research that cannot easily be sustained by many private companies.

Not all benefits that result from university-industry partnerships are immediate or even readily quantifiable. Powerfully positive outcomes can be unanticipated, far-reaching and long-term. University leaders at UCSD have observed that commitments from businesses tend to expand the longer these relationships thrive. Businesses with which the university has enjoyed long-term interaction are better positioned to respond positively to unforeseen opportunities, for instance when matching funds are required or capital must be raised for new buildings. Clearly, it is in the university's best interests to cultivate valuable relationships with businesses with the same level of care accorded to nurturing the institution's private donors.

Development of successful relationships between university and industry partners requires that those involved understand and respect cultural differences that are likely to color their interactions (National Academy of Sciences, 1999). One fundamental difference between the business community and the university has to do with time horizons. Business partners are sometimes frustrated by the pace of institutional review and decision-making within the university, particularly when expediency is necessary to ensure competitiveness. The incongruity may be rooted in managerial and philosophical divergence that, if unrecognized or under-appreciated, can thwart progress when businesses and universities try to work together. In the private sector, governance tends to be strongly hierarchical; in academia decisions are more commonly reached by building consensus (Dynes *et al.*, 2001). The corporate world is generally more comfortable taking on risk, whereas the academic culture, when dealing with issues that affect the institution as a whole, tends to be more risk averse.

A situation in which university partners typically move more rapidly than their business associates is in the dissemination of research results. Prompt publication of research findings is essential to academic career success, but it may hinder patent protection of intellectual property. Academic researchers wince at requests to delay publication for weeks or months while companies evaluate the market potential of discoveries, knowing that once in the public domain, if unprotected by patents, they may be no longer attractive to venture capitalists able to support lengthy laboratory and clinical trials.

Much has been written about risks to academic research posed by commercial sponsorship (Press & Washburn, 2000; Atkinson, 2000; Hirsch, this vol-

ume). Aware of concerns that certain types of association with industry can, in the absence of appropriate safeguards, represent a threat to academic freedom, the majority of UCSD leaders we interviewed believe that the technical and legal aspects of working with the business community can be handled so as not to compromise academic integrity or adversely affect students. With suitable checks and balances regarding issues of non-exploitation of students, healthy, mutually beneficial relationships can prosper. A 1999 report<sup>2</sup> issued by a UCSD committee composed of faculty and administrators described the many benefits of university interactions with industry and made recommendations about topics ranging from conflicts of interest, to involvement of students and postdoctoral scholars in industry activities, appropriate use of university facilities for industry-related purposes, and an organizational structure for overseeing and managing UCSD interactions with industry.

Another aspect of university-industry collaboration that has garnered considerable criticism involves technology transfer, or more broadly, intellectual property management. In the United States, formal technology transfer policies became necessary to manage intellectual property created by the Bayh-Dole Act. This 1982 legislation gave universities the incentive to move ideas into the marketplace, because it granted to universities, rather than to the government, intellectual property rights for discoveries made in the course of federally funded research. Technology transfer officials work diligently to protect the rights of universities and assist in the application and commercialization of discoveries made within academic institutions. However, legal and institutional constraints on the flow of knowledge and capital sometimes lead to technology transfer programs being viewed – perhaps unfairly – as obstructions rather than facilitators of economic development. Despite well-documented success in maximizing the benefits of innovative research, even the best university technology transfer programs in the United States are targets of internal and external criticism.

While acknowledging the necessity of skillful intellectual property management on behalf of the university, we will not deal further with the complex issues surrounding university technology transfer policies in this paper for two reasons. First, the existence of technology transfer programs is predicated on relationships between higher education and the private sector, and our primary concern here is the initiation, growth and sustenance of these relationships, not their regulation. Our focus is on building an environment in which shared intellectual interests are identified, trust established, and the foundation laid upon which to build strong, long-term, mutually beneficial alliances. Second, graduate students, not technology transfer, are the primary instruments by which the university contributes to economic development.

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2 <http://www-ogsr.ucsd.edu/research/industryreport.htm>

At UCSD and elsewhere students are highly effective networking agents, working in the private sector to initiate and sustain fruitful associations with industry, and in some cases, launch new businesses. Hence, in training students, the university supports economic well-being by generating the knowledge to help existing industries grow and providing educated entrepreneurs to launch new commercial endeavors.

## **EVOLUTION OF THE UNIVERSITY-INDUSTRY RELATIONSHIP IN SAN DIEGO**

Robert Conn, Dean of the Jacobs School of Engineering at UCSD (1999), asserts that the mission of the research university “now includes the responsibility to proactively ensure that research discoveries are translated rapidly and effectively for the benefit of society and people.” Conn argues that given major shifts in the relationships between the federal government and universities and the federal government and industry over the past three decades, the relationship between universities and industry is at a defining moment and that, at this critical juncture, universities need to maintain flexibility and openness. To prompt a discussion of how universities can develop fruitful interactions with industry, we now describe the development of alliances between UCSD and the surrounding high-tech business community.

In a region previously anchored economically by the presence of the military’s naval bases, UCSD, from its establishment in 1960, has played an important role in the area’s economic development. In the late 1980s and early 1990s, when national defense budgets were cut and the Navy drastically reduced its presence in San Diego, UCSD provided fertile ground for attracting, promoting and nurturing new, small, high-technology firms that grew out of defense industries, then rapidly adapted to meet the demands of the commercial market.

UCSD, together with The Salk Institute and The Scripps Research Institute, fertilized the blossoming of high-technology industry in San Diego (Ferguson, 1999). Under the leadership of visionary individuals who were not only committed to making UCSD a center of research excellence but also worked diligently to make the university supportive of entrepreneurial endeavors, UCSD became a highly effective agent of regional economic development. Plentiful Southern Californian sunshine, the availability of affordable commercial land close to the research institutions, the region’s military legacy, and the timing of advances in the computer industry all played roles in attracting high-technology business to San Diego and transforming the region into a recognized economic cluster in which high-caliber, small companies thrive.

UCSD continues to incubate industries dependent on scientific discovery. Not only does the University train many of the engineers and scientists who later take positions with the region's high-technology firms, it also provides a valuable science and technology base for these businesses.

Over the last decade, small technology firms have led the way in setting new directions for San Diego's economic future. Initially, the growth of these high-technology businesses was practically unlimited by external forces. Connections between industrial entrepreneurs and the University were simple, intimate, direct and based on scientific progress. While young businesses grew into San Diego's empty spaces, today, industrial development no longer fills a vacuum.

San Diegans have begun to experience undesirable side effects of rapid industrial growth: decline in the availability of land, worries about affordable water and power supplies, daunting increases in housing costs, traffic congestion, and concerns that the region's public schools are not preparing children adequately to compete for high-paying jobs (Kupper, 2001). While UCSD remains an intellectual leader in the community, relationships among the University, high-technology businesses and government have become more complicated. Increasingly, the community will look to the University to help identify and ameliorate a wide variety of growing pains that have accompanied regional economic development. The challenge to UCSD, and all modern research universities, will be to fulfill a vital civic and intellectual role in regional development, while continuing to build a global knowledge base across disciplines.

## **BUILDING BRIDGES BETWEEN UCSD AND INDUSTRY**

UCSD Chancellor Robert Dynes characterizes UCSD as a start-up university, in part because the institution has played such an important role in spawning and assisting many high-technology entrepreneurial ventures. UCSD shares certain characteristics with start-up, private-sector businesses. A relatively youthful university, UCSD, has as its fundamental strength talented, motivated people whose ideas and commitment to excellence are the seed corn for innovation, economic success, and potential leadership regionally and globally. As for a young business, opportunities for the university to create, refine and disseminate groundbreaking discoveries are plentiful. UCSD must continue to attract expertise and capital while cultivating the vision and flexibility needed to achieve its goals. The entrepreneurial spirit that thrives at UCSD and in the local business community may be a key ingredient in the success of alliances forged between the university and industry.

Interactions between UCSD and the business community take many forms. Some were initiated by the university in response to internal stimuli or external opportunity. Others enjoy affiliation with the university but are independent of UCSD economically and politically. Below we highlight several programs and organizations that build and reinforce powerful, resilient bridges between academic and business partners.

## UCSD CONNECT

Created as an interactive, community-based organization in 1986, CONNECT<sup>3</sup> is an excellent example of a university program that promotes economic development by sponsoring ongoing informal and educational activities supportive of the commercialization of research findings, formation of new enterprises, and growth of small companies. Through its educational and networking programs, it leverages the multiple advantages of the San Diego region—world-class research institutions, an urban business-industrial context, available land, and hospitable geography—to support local high-tech enterprises that stimulate and maintain the long-term prosperity of the region.

Entirely self-supporting, CONNECT receives no funding from the University or the State of California. It is supported by membership dues, course fees, grants, and corporate underwriting for specific programs. This autonomy positions CONNECT to serve as an honest broker of information and ideas. CONNECT is not a technology licensing office, nor is it a formal incubator; rather, it is a deliberately developed network of professional competencies focused on building shared knowledge and robust entrepreneurial teams that can build and sustain technology based companies. With its combination of hands-on mentoring and support for entrepreneurs to create business opportunities built around world class scientific discovery from UCSD, CONNECT has succeeded by bringing together people, technology, ideas and capital. Currently under the direction of an accomplished former software entrepreneur, CONNECT has served as a model for analogous organizations at other US and European universities.

Through its programs, events, and forums, CONNECT provides numerous networking opportunities for both local entrepreneurs and entrepreneurial campus researchers with venture capitalists and seasoned business advisors. The product of these interactions frequently result in the formation of new companies based on scientific discoveries born in UCSD's research labs. CONNECT's designation as an "incubator without walls" attests to its success in catalyzing the formation of various high tech industry clusters in the

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3 <http://www.connect.org/>

San Diego region. Strengthening regional clusters of innovation can have global impact, as Porter and Van Opstal (2001) observe: “Although national boundaries matter less in some respects in a global economy, the clusters of firms and industries concentrated at the regional level matter more.”

In its early days, CONNECT focused its resources on helping new high-tech companies launch themselves on a good trajectory and attract the venture capital required to exploit and bring to market intellectual property. While it continues to serve in this capacity, in support of the economic stability mature companies give the region, CONNECT’s role has expanded to assist the growing “adolescent” firms that look to the university for human capital and continuing education and training for employees. The organization has also taken on a greater role in evaluating, facilitating and defending local policy and infrastructure developments relevant to the maintenance and establishment of new businesses.

In expressing optimism about the direction UCSD is going in developing industry partnerships, university and community leaders we spoke with emphasized the importance of ongoing, informal dialogue between academic researchers and representatives from the private sector who have the resources to assist in the commercialization of the products of research. Repeatedly, CONNECT was praised for its success in initiating links between UCSD and industry, while providing a mechanism to help the university stay abreast of private sector developments that may have intellectual, educational, and social implications for academia, the region, the nation, and the world. CONNECT has also furthered UCSD’s involvement in local public policy, an arena a world-renowned research institution may not have chosen to participate in so earnestly had it not been for this organization.

Despite consensus regarding the value and promise of CONNECT, we noted a modicum of disagreement about how CONNECT and the UCSD Technology Transfer and Intellectual Property Services (TTIPS) should interact. Currently the two operate independently, with the former not representing UCSD’s interests as does TTIPS. This is seen as a strength by those who cite the separation as a factor in CONNECT’s dialogue-enabling success. CONNECT’s credibility with the business community might be compromised if it were perceived as another agent of the university. Others, critical of technology transfer efforts, believe it could simplify industry-university interactions if UCSD’s networking organization and the group that oversees intellectual property issues joined forces. Given the related but distinctly separate functions of TTIPS and CONNECT, merging the two would be ill-advised. In the interest of heightened internal awareness of the diversity and depth of industry partnerships, exchange of information between CON-



NECT and TTIPS is highly desirable and actively encouraged by the university administration as well as the directors of both organizations <sup>4</sup>.

### **UCSD Extension**

UCSD Extension <sup>5</sup>, like CONNECT is part of UCSD's Division of Extended Studies and Public Programs. Serving the lifelong learning needs of nearly 40,000 adult students annually, Extension's departments develop and conduct over 2000 courses and 100 certificate programs each year for working professionals, thereby serving the skill development needs of individuals, organizations, and the community. Extension's effectiveness, based on a blend of instruction by both faculty members and practitioners, contrasts with the more structured, degree-oriented, faculty-taught courses offered by UCSD's traditional academic departments. In responding to the changing needs of the business community, Extension provides multiple pathways by which UCSD can help sustain the regional economic prosperity it has been so instrumental in creating. Will society's rapidly growing need for lifelong learning spur universities to incorporate continuing education into their core missions?

### **California Institute for Telecommunications and Information Technology [Cal-(IT)<sup>2</sup>]**

In late 2000, an unprecedented three-way partnership linking state government, industry and the University of California was launched. The Governor of California, convinced of the economic value of long-term research and high-level graduate education, announced his support of four California Institutes for Science and Innovation <sup>6</sup> (Dynes, 2001). The intention of this effort, which originated with business and academic leaders, is to foster an environment that increases opportunities for cooperation between industry and the University to speed delivery of public benefits from research and education. One of these institutes – the California Institute for Telecommunications and Information Technology <sup>7</sup> [Cal-(IT)<sup>2</sup>] – will team more than 220 UCSD and the University of California, Irvine (UCI) faculty with professional researchers from 43 leading Californian companies to expand the reach and capacity of the global wireless Internet. It will use the new telecommunications infrastructure to advance applications important to California's economy, including education, environmental monitoring, health care

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4 For a detailed examination of CONNECT's approach to facilitating economic development in San Diego see: Walshok (1995, pp. 175-191) and Preuss (1999, pp. 93-98).

5 <http://extension.ucsd.edu/>

6 <http://uc-industry.berkeley.edu>

7 [www.calit2.net](http://www.calit2.net).

delivery and transportation (Markoff, 2000). With \$100 million in state funds and \$200 million in matching funds from industry and private sources Cal-(IT)<sup>2</sup> will support investigations of a scope and scale that could not be undertaken by a single investigator nor supported by the resources of an individual company.

### **Industry-University Cooperative Research Program**

Pre-dating the California Institutes for Science and Innovation, the Industry-University Cooperative Research Program<sup>8</sup> (IUCRP) begun in 1996 is additional evidence of California's ongoing support of university-industry collaboration (Penhoet and Atkinson, 1996). The IUCRP serves the nine-campus University of California (UC) system by providing incentives for California businesses to develop research partnerships with UC scientists and engineers, enabling them to engage in fundamental research that could not be accomplished with the limited resources of entrepreneurial R&D firms. The program now invests \$60 million a year (\$21.6 million from the State, 3 million from UC, and \$35.4 million from industry) to create new knowledge and make California businesses more competitive.

### **Industrial Affiliates Programs**

Programs to foster continuing dialogue between corporate executives and academics thrive at UCSD. Industrial affiliates programs provide an effective vehicle for fostering intellectual exchange among university researchers, students, and industry. In UCSD's Jacobs School of Engineering<sup>9</sup>, through the highly successful Corporate Affiliates Program, ideas are exchanged, curricula updated, student internship and professional recruitment opportunities are created, and long-term relationships between the university and private companies are cultivated. By encouraging both formal and informal interaction, the Corporate Affiliates Program provides opportunities for collaboration that lead to enhanced economic prosperity in the private sector, while ensuring the fiscal and intellectual support of the university's research and educational missions.

### **San Diego Regional Economic Development Corporation**

University and business leaders we talked with unanimously asserted that UCSD has a civic responsibility to participate in urban planning and in addressing the social and economic problems that have accompanied the rapid growth of high-tech business in San Diego. As a council member of the

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8 <http://uc-industry.berkeley.edu/>

9 [www.soc.ucsd.edu](http://www.soc.ucsd.edu)

San Diego Regional Economic Development Corporation<sup>10</sup>, UCSD Chancellor Robert Dynes meets with leaders of local businesses to discuss concerns about the consequences of regional development (e.g., diminishing land availability, worries about the adequacy of existing water and energy resources, traffic congestion) and debate the merit of potential solutions. Dynes' participation in the council's activities helps to keep him informed about issues affecting the current and future prosperity of the region. Organizations like the Economic Development Corporation, and the San Diego Dialogue, described below, help close the gap between academic and civic knowledge.

### **San Diego Dialogue**

The San Diego Dialogue<sup>11</sup> is a self-funded organization based at UCSD. Its invited membership consists of some 150 civic and community leaders from San Diego and northern Baja California who work to identify and address cross-border and quality-of-life issues, such as transportation, affordable housing, pre-college education, and environmental preservation. The emphasis on cross-border issues stems from the recognition that San Diego is unique among large industrial regions in that there are 2-3 million people on either side of the US-Mexican border, and cultural, linguistic, and economic differences, as well as issues of nationalism, must be confronted in regional planning. Many private companies that have R&D operations in San Diego have manufacturing facilities in Tijuana. San Diego Dialogue's research and public education activities are funded by a combination of foundation and corporate grants, as well as revenues generated from public events and corporate and individual affiliate programs. Though independent of UCSD, its university association provides another effective mechanism for civic exchange.

### **UCSD's new professional schools**

Rapid expansion in San Diego's high-technology business community made it clear to industry leaders that a technology management-oriented MBA program would benefit the local industrial infrastructure. Generously supported and aggressively promoted by industry, UCSD's new School of Management is now in the development stages. A parallel development took the form of a call by local biotechnology industries to establish a School of Pharmaceutical Sciences at UCSD. These developments illustrate UCSD's responsiveness not only to the needs of the business community, but also to opportunities created by the strong life sciences research community at

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<sup>10</sup> [www.sandiegobusiness.org](http://www.sandiegobusiness.org)

<sup>11</sup> <http://www.sddialogue.org/>

UCSD. Balancing the long-term interests of the university and the needs of the maturing business community will be an ongoing challenge to university leaders.

## CHALLENGES FACING UCSD

What will be UCSD's contribution in the next chapter of industrial development in San Diego? Will the increasing globalization of the economy force UCSD to adopt a more global approach to university-industry relations? The university will continue to be an intellectual wellspring, but it has the potential to do so much more in working with the business community to achieve economic prosperity and sustain the high quality of life that has attracted brilliant scientists and entrepreneurs. The heightened interest of large corporations from outside the region in the work of UCSD scientists and in the entrepreneurial activities of local start-up companies will afford new opportunities for university researchers to have global impact.

UCSD's Mary Walshok in a discussion of knowledge linkages needed for new forms of economic development asserts that research universities need more "responsive institutional mechanisms and resources committed to the dissemination and application of knowledge useful to economic development as well as continued support for basic research." She observes: "Economic development in knowledge-driven economies arises out of a confluence of technological, sociological, economic, and political forces." How can UCSD maximize the value of its partnerships with industry, which are focused on addressing technical and engineering issues? Walshok asserts that the university must build a "reinforcing set of knowledge linkages, which assure a policy environment supportive of economic growth, a regional infrastructure ready to support new and renewing industries, and an appropriately competent, informed technical labor force." (Walshok, 1995).

How can UCSD lead or participate in building and maintaining a network of social and infrastructure supports? It must recognize that adaptability and flexibility in the face of uncertainty are essential. Readiness rather than planning is the key to high-tech economic development, because it is difficult to predict which research programs will yield results or implications that can be adapted for useful, profitable individual, social or industrial purposes.

Projections of growth in the regional population and anticipated increases in the number of undergraduate students at UCSD (a staggering 60,000 in the next 10 years) will require the University to participate in urban planning and resource management. Known for excellence in scientific and technological research, UCSD is not commensurately recognized for its expertise in fields that bear upon current regional economic and social issues. Rather than attempting to serve as an authoritative voice in solving urban problems,

UCSD can strive to be an impartial but caring convenor of experts and stakeholders for the purpose of addressing quality-of-life issues. The University can do what it is good at: accessing, sorting, interpreting, validating and packaging knowledge. If UCSD desires to take on the role of leader rather than integrator, it will need to build expertise in fields for which the campus is not now known to excel on a national level. Should the university aspire to make more of its departments world-class? Should UCSD aspire to preeminence in all fields, or is it more sensible to choose to shine in some areas while contributing in others?

At the heart of many decisions UCSD will make is the question: To what extent should direction be influenced by internal and external stimuli? Pressures to form, define, promote, limit interactions with private enterprise stem from internal motivation—for example, the ongoing quest to support the highest caliber research—as well as external forces—for example, the call to provide lifelong learning opportunities and respond to environmental and social problems that have accompanied regional economic growth. Distinction between internal and external incentives reflects the university's dual intellectual and civic mandates. It also highlights the institution's role in both the global and regional economy. What approach should the university take in balancing its multiple commitments?

For businesses and universities alike, having a vision of organizational goals can serve as a good foundation for decision-making. Difficulty in predicting technological developments that will revolutionize the way we think, live, and work suggests that readiness rather than planning may be the best strategy any organization can take. How can research institutions ensure the level of adaptability and flexibility that are essential in the face of uncertainty? Gordon Moore, co-founder of Intel, put it simply: "First, surround yourself with the best people you can possibly find." (*Technology Review*, 2001). Acknowledged intellectual leadership positions the university to achieve political leadership.

### **CONCLUSIONS: WHAT CAN BE LEARNED FROM UCSD'S EXPERIENCE?**

From the university's perspective, forging and nurturing relationships with industry can enhance academic research, add value to the educational experience of students, create diverse opportunities for the institution to participate in civic affairs, and support regional economic development. Formulating policy to guide university-industry interaction is a multi-dimensional task intended to safeguard academic freedom, ensure that university resources are not misused, and, more generally, maximize the benefits of corporate-academic alliances. Building on common interests and goals while acknowl-

edging cultural differences, academic institutions and private sector partners can rise to the challenge of framing highly successful collaborations. By continuing to provide opportunities for open dialogue with the business community, supporting research excellence, and embracing an attitude conducive to collaboration (i.e., serving as a hub of knowledge rather than the master architect; striving for flexibility and adaptability), the university can pave the way for the development of synergistic links with the private sector.

The types of relationships that are desirable are likely to differ among industries and academic disciplines. There have been and are likely to be more mis-steps taken as universities and businesses try to get it right, but the potential rewards are great enough that universities and the private enterprise should not let these fumbles dissuade them from cooperation. Instead, these growing pains should be viewed as opportunities to be more careful, creative and visionary in conceiving and implementing future interactions.

UCSD has done very well in initiating and sustaining healthy relationships with the surrounding high tech business community. In that so many entrepreneurial ventures in San Diego have roots in the university, UCSD's relationship with these young businesses has been somewhat parental. Now that many of these companies have matured into "adolescence" and have more complex needs, their relationships with the university are changing. They turn less to the university for help in finding venture capital, but seek more in terms of human capital. Much like teenagers who, despite increasing independence, benefit from parental ties, maturing businesses look to the university for enhanced collegial relationships. How can UCSD amplify its permeability, expand its engagement in the service of its "offspring", and prepare to spawn new "fry"?

Drawing on our own observations and those of others, we have discussed a number of ways the university, by way of interaction with industry, can add value to the regional economy. The university has much to contribute by:

- generating new knowledge through research,
- building an educated workforce through teaching and graduate education,
- serving as an honest broker, integrator, convenor and dialogue enabler,
- expanding institutional engagement and permeability of the university,
- responding to community needs and participating in urban planning,
- working with industry to overcome obstacles to collaboration,
- bringing to bear global expertise on the local agenda.

In the interest of summarizing the most vital themes of our discussion and providing a starting point for discourse, we suggest that in building resilient,

fruitful liaisons with industry, universities would do well to consider the following strategies:

- 1) Recruit and hold on to the very brightest people.
- 2) Emphasize readiness rather than planning.
- 3) Deliberate on the balance to be struck between:
  - a. local and global aspirations.
  - b. quantity and quality (e.g., number of students versus quality of education).
  - c. requirements to respond and lead, sustain and innovate.
  - d. seeking benefits and tolerating or avoiding risks.
  - e. long-term benefits and short-term gains.
- 4) Support programs like CONNECT and corporate affiliates programs that increase the permeability of the institution, track and nurture university-industry interactions, and provide a forum for dialogue with industry leaders to better understand the interests, culture, current and future needs of the ambient economic cluster.
- 5) Support the highest-quality graduate education to equip students preparing to enter the workforce with the broadest knowledge base and skills to join existing businesses or start new companies.
- 6) Embrace the role of honest broker in gathering, synthesizing and disseminating knowledge.
- 7) Maintain awareness of local economic, political and environmental issues and work with the community to solve problems.
- 8) Craft sensible, flexible guidelines for university-industry interaction, but evaluate the justification, merits and potential risks of collaborations on a case-by-case basis.

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