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Four: University High-Tech Alliances in California: Gain and Losses

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# UNIVERSITY HIGH-TECH ALLIANCES IN CALIFORNIA: GAINS AND LOSSES

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## I. Introduction

Nathan Myhrvold, until recently chief technology officer and member of the Executive Committee at Microsoft Corporation, wrote in *Science* – “After World War II the United States poured money into basic research, creating a strong and vibrant scientific community. It is no accident that Silicon Valley and other high-tech enclaves in computing and biotechnology are largely U.S. phenomena. Technology businesses grew up in the shadow of great universities and research institutes, and the apple did not fall far from the tree.”<sup>1</sup> That high-tech industries are growing up in the shadow of great universities is the result of many interactions, synergies and knowledge spillovers, which are lowering the barriers between town and gown. This provides great opportunities, but also dangers.

The breathtaking pace of information-communication advances has shrunk the importance of time and place. One result has been the emergence of open, highly competitive systems and environments, including those of research and education. Under these circumstances, alliances between domains have been formed previously considered autonomous.

Planned interactions between universities and high-tech industry are today at an all time high. Annual corporate university research support reached \$1 billion in 1989 and has continued to grow year by year, amounting to more than \$1.7 billion in 1997.<sup>2</sup> But relatively little of this financial support has been for basic research.

This paper takes cognizance of the fact that institutions of higher learning, particularly those with large research components, are no longer mere learning cloisters, but are evolving into much more permeable universities.<sup>3</sup> They have become open systems, often with close ties to high-tech industries. The focus will be strategic alliances between research universities and high-tech firms, especially those in California.<sup>4</sup>

There is no discussion of either Science and Technology Centers or Engineering Research Centers which the Federal Government has launched on many university campuses. Such centers are provided federal grants only when universities cooperate with industry, government or non-profit organizations.

## II. California's High -Tech Alliances

California is the home of many of the most pre-eminent high-tech industries. Its technology industry in 1998 employed nearly 420,000 workers, or 20 percent of the nation's high-tech work force, shipping \$125 billion in goods worldwide.<sup>5</sup> California's research universities have played a major role in this development. Faculty and students have founded many successful high-tech firms. For example, the original impetus that led to the emergence of the Silicon Valley can be traced to 1938 when William Hewlett and David Packard, two students of Stanford University Engineering Professor Frederick Terman, developed the audio oscillator in a garage at 767 Addison Street in Palo Alto. University of California alumni founded Intel Corporation, Apple Computer, Inc., and Sun Microsystems, Inc. with annual sales of \$11.5, \$9.1 and \$4.6 billion respectively by the mid-1990s.<sup>6</sup>

In addition to contributing to the information-communication industry, faculty and alumni of California's universities also have played a major role in founding its biotech industry. Examples are Genentech Inc., which was co-founded by Herbert Boyer of UC San Francisco and Stanley Cohen of Stanford University, and Tyron Corporation and Amgen, Inc., which were founded by UC scientists.<sup>7</sup> These three companies by the mid-1990s accounted for nearly half of the U.S. biotech industry's annual sales. They had more than 12,000 employees, including 7,000 in California.

In recognition of the role a research university can play, the California Institute of Technology in 1998 was given an \$18 million dollar private gift for the purpose of developing a 100 acre "corridor" of biotechnology firms in Pasadena.<sup>8</sup> The University of Southern California was given a \$100 million grant to establish a biomedical research campus.<sup>9</sup>

California's research universities are not only preeminent in the excellence of their faculty, but also distinguish themselves by large research budgets. Thus, while the 130 U.S. universities with the largest research budgets spent \$21,304 million on research in FY 1997, the twelve in California spent \$2,861 million or 13.4 per cent.<sup>10</sup> These twelve California universities received \$152.9 million in corporate research grants, of the \$1.4 billion awarded by industry to these 130 universities.

By 1998 UC's corporate research had increased to \$174 million of which \$134 million went to the biological sciences and medicine and \$29 million to the physical and computer sciences and engineering.<sup>11</sup> These grants as well as those to California's private universities are concentrated in three regions -- UC San Francisco and UC Berkeley accounting for \$52 and \$14 million, respectively; UCLA and UC Irvine for \$24 million and \$18 million, respectively; and UC San Diego for \$37 million. Also the largest biotech research contracts in the last five years went to these three regions -- to UC Berkeley from Novartis for \$25 million in 1998, to UC San Francisco from Daichi for \$20 million in 1994 and to UC Irvine from Hoffmann-LaRoche for \$8 million in 1997. With Stanford University in the Bay Area and California Institute of Technology, UC Los Angeles, and the University of Southern California in Los Angeles, it is little wonder that in these three regions California's premiere research centers are located.

### III. Alliances' Raison d'être

Universities and high-tech industry have entered into research alliances, which are driven by powerful forces -- many positive, though with possibly also undesirable by-products. This paper approaches these alliances from the perspective of the university<sup>12</sup>, for whom positive driving forces include the quest for new revenue sources and intellectual gains from collaborating in research with scientists in industry used to work on real world problems, and with particular experience and cultural thinking. Moreover, industry (and government laboratories) bring to the table expensive world class equipment, instrumentation and financial resources. Alliances also facilitate the placing of graduates.

Industry benefits since universities bring to the table world class scientists and a well-educated staff, as well as patents and an environment that stimulates inquiry and creativity. (For example, the top 173 universities' 1996 royalty and license fee earnings were \$592 million).<sup>13</sup> Moreover, industry benefits since outsourcing of research enables it to engage the very best scientists who often are unwilling to work in industry and to gain greater flexibility in manning their research efforts.

Collaboration can clearly benefit both parties. As a consequence, alliances have grown steadily, with industry contributions to research in 1997 amounting to more than \$1.7 billion, about equal to the contributions made by state and local governments combined.<sup>14</sup>

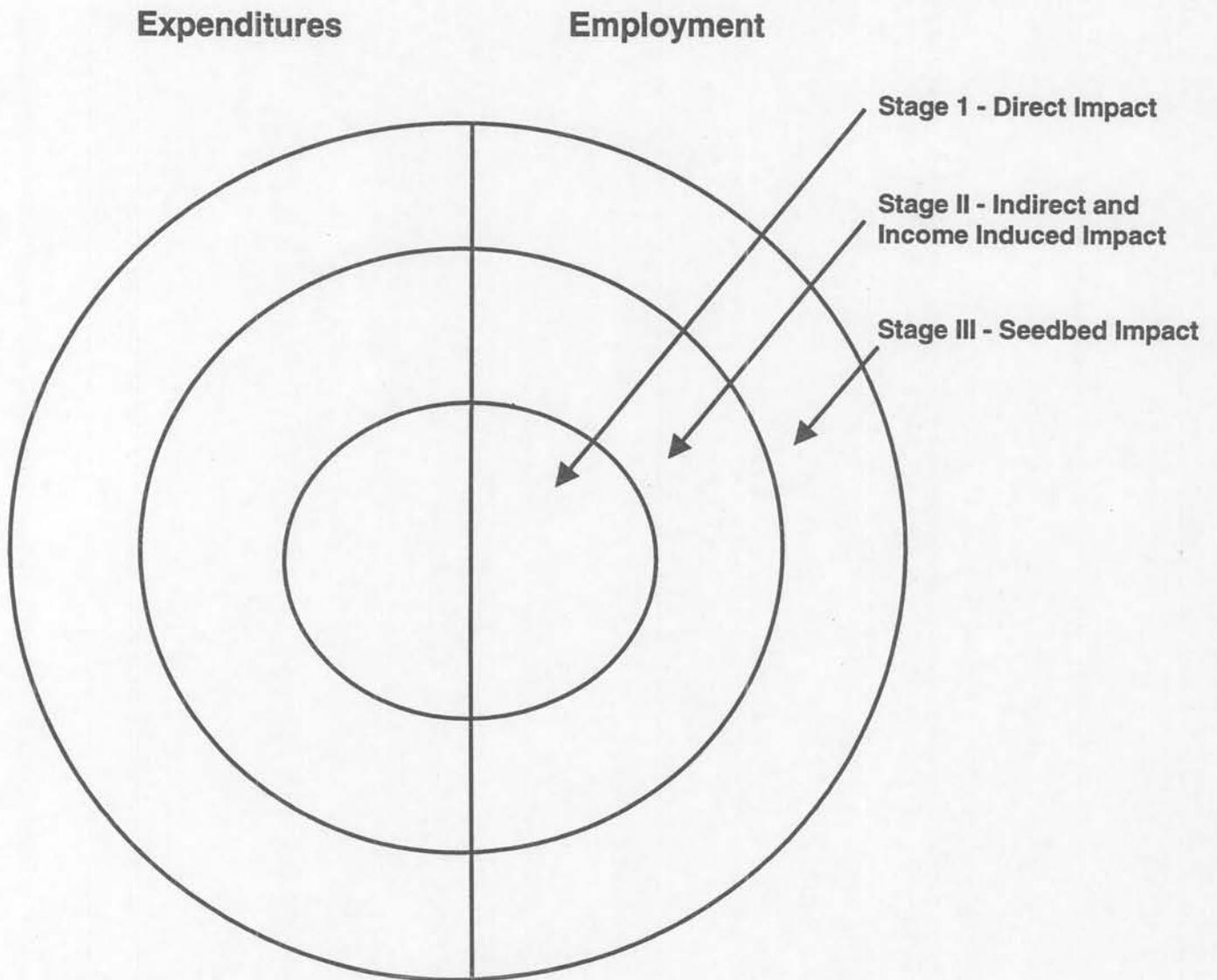
Society at large can benefit. Synergies from complementary integration are common, and so are productivity gains from vertical disintegration through outsourcing, and scale economies from horizontal integration. Consequently, strategic research alliances can raise productivity, though often major hurdles must be overcome, as research universities and high-tech firms complement one another.

### IV. Economic Framework for Regional Impact Analysis

Research alliances can not only benefit their partners, but they can also affect the economic health of the region in which they are located, with spillovers to the rest of the state and nation. For an analysis of the effects on economic activity -- expenditure and employment -- we can call on regional impact analysis and extend it to three stages as presented in Figure 1.<sup>15</sup> The funds provided to the university by the firm under their research contract generate a number of economic consequences, most with significant geographical dimensions. The alliance's total impact on local and regional economies is significantly greater than the sum of direct expenditures made by it. Monies spent indirectly impact demand, income, and employment throughout the area. Each dollar expended may cycle through the economy several times, generating additional income and jobs before being fully withdrawn from the economic system through savings, taxes or expenditures made outside the area.

Economists refer to the recycling of monies in an economy as the "multiplier effect." The impact of each dollar spent is "multiplied" as it is spent again in an economy. For example, the salary paid by the university to a faculty member is spent by him to buy food, transportation, clothing, schooling, etc. To produce these and other items, the grocery store, gasoline station,

**Figure 1.**  
**Three Impact Stages of University High-Tech Industry**  
**Research Alliances**



clothing store and school buy a host of inputs, including labor. The extent of the effect can be estimated by using economic multipliers, which have been calculated by modeling regional economies and by making econometric estimates of their magnitude.<sup>16</sup> Economic multipliers, developed for a particular region, vary according to several factors, including definition of the sector, geographic scope, and the specific economic data and econometric model used in the calculation. An expenditure multiplier of 2.0 indicates that the combined direct, indirect and income induced effect is twice as large as the initial expenditure.

But the economic impact does not stop here. The alliance's activities, especially those in the high-tech arena, often spawn new economic activities that benefit from proximity to the university. We will refer to this as the seedbed effect. The resulting agglomeration of commercial activity has further indirect and income-induced effects.

Thus, the economic impact of alliances can be modeled as involving three sequential stages. In stage I, the alliance augments the university's research budget, so that the agreed upon research agenda can be pursued. Toward this end, commonly additional staff is hired and a variety of goods and services are purchased. Even some construction activities can occur, requiring further manpower as well as goods and services. As a consequence, moneys will flow to households (to compensate for their labor) and suppliers of goods and services. Most of these payments go to households and firms in the area surrounding the university (e.g., county), though some will leak outside it.

In stage II, indirect and income induced effects occur. The first result from suppliers of goods and services paying both their suppliers and employees, i.e., households.

In the stage III, economic impact relates to the fact that research universities, and with them alliances, create an environment which is the seedbed of new economic activities in their vicinity. Most are carried out by commercial enterprises. Clustering of firms is in response to the fact that research activities require as inputs goods and services, unusually highly sophisticated ones, while other firms are attracted by positive externalities generated by the university's research and teaching activities. Not only are universities the seat of culture, knowledge, scientific discovery and innovation, but they also are the source and the home of educated and well-trained residents, as well as faculty and staff. These characteristics, even in the cyberspace age, benefit commercial enterprises and induce them to locate near a research university. According to The Economist:

"Even in these days of instantaneous communication, there is no substitute for researchers pressing flesh ... and the ability to sit in the bar and chew the fat with colleagues and rivals..."<sup>17</sup>

An example is the experience of Lucent Technologies, a premier high-tech company. In its efforts to develop Bandwidth Manager, which was crucial in creating a new fiber-optic phone switch, the team leader found that "Lucent is rediscovering the importance of face-to-face interaction... You can never discount how many issues get solved going to lunch (and at) the water cooler."<sup>18</sup>

Agglomerations occur because firms locate in proximity to the university in the hope of benefiting from synergies and positive externalities. The agglomeration economies tend to be self-re-enforcing and can explain the emergence of the Silicon Valley as the center of the information-communication industry and of La Jolla and Irvine as biotechnology enclaves.<sup>19</sup> Modeling stage III requires an agglomeration model in conjunction with the application of output and possibly other regional multipliers, using stage II output and employment estimates as points of departure. Caution must be exercised to avoid double counting.

## V. Estimating Alliances' Regional Economic Impact

Using the analytic framework developed in the preceding section, economic activity in terms of alliances' expenditures and employment effects will be estimated for UC San Diego, the University of California as a whole, and all California research universities.

In estimating the regional impact of corporate research contracts with universities we will assume that there is slack in both the university and the local economy. Thus, both can readily meet the demand for personnel and goods and services needed under the contract. We recognize that not all inputs come from the region in which the alliance is located and therefore some expenditures leak outside it. According to UC Irvine and UCLA studies, both these institutions spent about 80 percent of their operating budgets in their respective surrounding counties and 95 percent within California.<sup>20</sup> The annual alliance-related expenditures are assumed to be the sum of the contract funding plus one half of royalties and license fees.

Finally the seedbed effect of a research university and its alliances must be estimated. No disaggregated data are available. However, a UC San Diego study concludes that the university's presence stimulated the creation in San Diego County of spin-off firms -- mainly in the biotech field -- with an annual revenue of about \$2.0 billion.<sup>21</sup> With UC San Diego's 1997 operating budget of \$1.1 billion, the expenditure seedbed factor is about 1.8.

In making economic impact estimates as stated earlier, alliance-related annual expenditures are assumed to be the sum of corporate research grants and half the royalties and fees earned in a given year. On the basis of a review of empirical expenditure multiplier studies of universities, we used a range with a low of 1.6 and a high of 3.0 for stage II. Moreover, for UC San Diego we found that it has 17,750 jobs/\$1.1 billion or 16 jobs for \$1 million expenditures. This figure was 99,629/9.04 \$billion or 11 for the entire University of California, and we assumed it to be 13 for all California research universities. These figures were used to translate stage II and III expenditures into employment impacts.

Finally, in the absence of better basic data, we used the above mentioned UC San Diego study to provide an estimate of the stage III seedbed factor based on the relation between high-tech industry's annual expenditures and those of the university, i.e., \$2.0 billion/\$1.1 billion or 1.8.

As can be seen in Table 1, UC San Diego's 1998 corporate grants and half of its royalties and license fees of \$40.4 million were found to have had a total stage II impact on the economy

**Table 1: Economic Impact of UC San Diego's Corporate Research Support (and Royalties plus Fees) in 1998**

	Expenditures (in \$ million)			Employment **			
	Total	County	State	Total	County	State	
<b>Grants</b>	37.4						Stage I
<b>Royalties and Fees*</b>	3.0						
<b>Total</b>	40.4	32.3	38.4	646.4	517.1	614.1	
<b>1.6 multiplier</b>	64.6	51.7	61.4	1,033.6	826.9	981.9	Stage II
<b>3.0 multiplier</b>	121.2	97.0	115.1	1,939.2	1,551.4	1,842.2	
<b>1.8 seedbed factor</b>		93.1			1,489.6		Stage III
		174.6			2,793.6		

\* Half of the year's royalties and license fees

\*\* Sixteen jobs per \$1 million expenditures

ranging from a minimum of \$64.6 million to a maximum of \$121.2 million.<sup>22</sup> Eighty percent, or somewhere between \$51.7 million to \$97.0 million were spent in San Diego county, while the comparable figures for California were \$61.4 million to \$115.1 million. Adding the stage III impact, overall expenditures in San Diego county resulting from its alliances amounted to between \$93.1 and \$174.6 million.

Turning to the employment impact of UC San Diego's alliances, we find in Table 1 that their corporate contracts plus half their royalties and license fees required in stage I a total of 646.4 employees, of which 517.1 and 614.1 lived in the county and state respectively, while the rest lived outside it. In stage II, total employment increased to between 1,033.6 and 1,939.2, with 80 percent living in San Diego County and 95 percent in California. Under the above assumptions, by including a seedbed factor, the county's employment in stage III increased to between 1,489.6 and 2,793.6.

The expenditure and employment impacts of UC's, and all California's research universities' alliances can be found in Table 2. UC's corporate contracts plus half its royalties and license fees amounted in 1998 to \$213.6 million. Adding their stage II and III effects results in estimates of between \$584.5 and \$1,095.8 million. The corresponding employment impact is

**Table 2: Economic Impact of the University of California's Corporate Research Support (and Royalties plus License Fees) in 1998**

	Expenditures (in \$ millions)		Employment **		
	Total	State	Total	State	
<b>Grants</b>	173.7				Stage I
<b>Royalties and Fees*</b>	39.9				
<b>Total</b>	213.6	202.9	2,349.6	2,232.1	
<b>1.6 multiplier</b>	341.8	324.7	3,759.8	3,571.5	Stage II
<b>3.0 multiplier</b>	640.8	608.8	7,048.8	6,696.4	
<b>1.8 seedbed factor</b>		584.5 1,095.8		6,429.5 12,053.8	Stage III

\* Half of the year's royalties and license fees

\*\* Eleven jobs per \$1 million expenditures

**Table 3: Economic Impact of California's Research Universities' Corporate Research Support (and Royalties plus License Fees) in 1998**

	Expenditures (in \$ millions)		Employment **		
	Total	State	Total	State	
<b>Grants</b>	223.0				Stage I
<b>Royalties and Fees*</b>	51.3				
<b>Total</b>	274.3	260.1	3,565.9	3,387.6	
<b>1.6 multiplier</b>	438.9	417.0	5,705.7	5,420.4	Stage II
<b>3.0 multiplier</b>	822.9	781.8	10,697.7	10,162.8	
<b>1.8 seedbed factor</b>		750.6 1,407.2		9,757.8 18,294.1	Stage III

\* Half of the year's royalties and license fees

\*\* Thirteen jobs per \$1 million expenditures

between 6,429.5 and 12,053.8 jobs. Many of these people are well educated, highly skilled, and paid relatively high salaries.

In Table 3 and Figure 2 the impact of all of California's research universities (including the three private ones, with corporate contracts and half their royalties and license fees of \$274.3 million) is given. The overall expenditure impact is estimated to fall between \$750.6 and \$1,407.2 million and the employment impact between 9,757.8 and 18,294.1 jobs. The significance of the economic impact of California's research alliances on its economic health can be appreciated by realizing that UC San Diego's annual expenditures and employment falls within the range of the above estimates. In short, the economic impact of California's research alliances is about equal to the budget and employment of UC San Diego, one of California's major research universities. All this, however, does not mean that, except for the alliances, no other economic activities would have taken place. One can only speculate about their nature and scale. Most likely they would have been less at the cutting edge of knowledge, financially rewarding, and environmentally friendly.

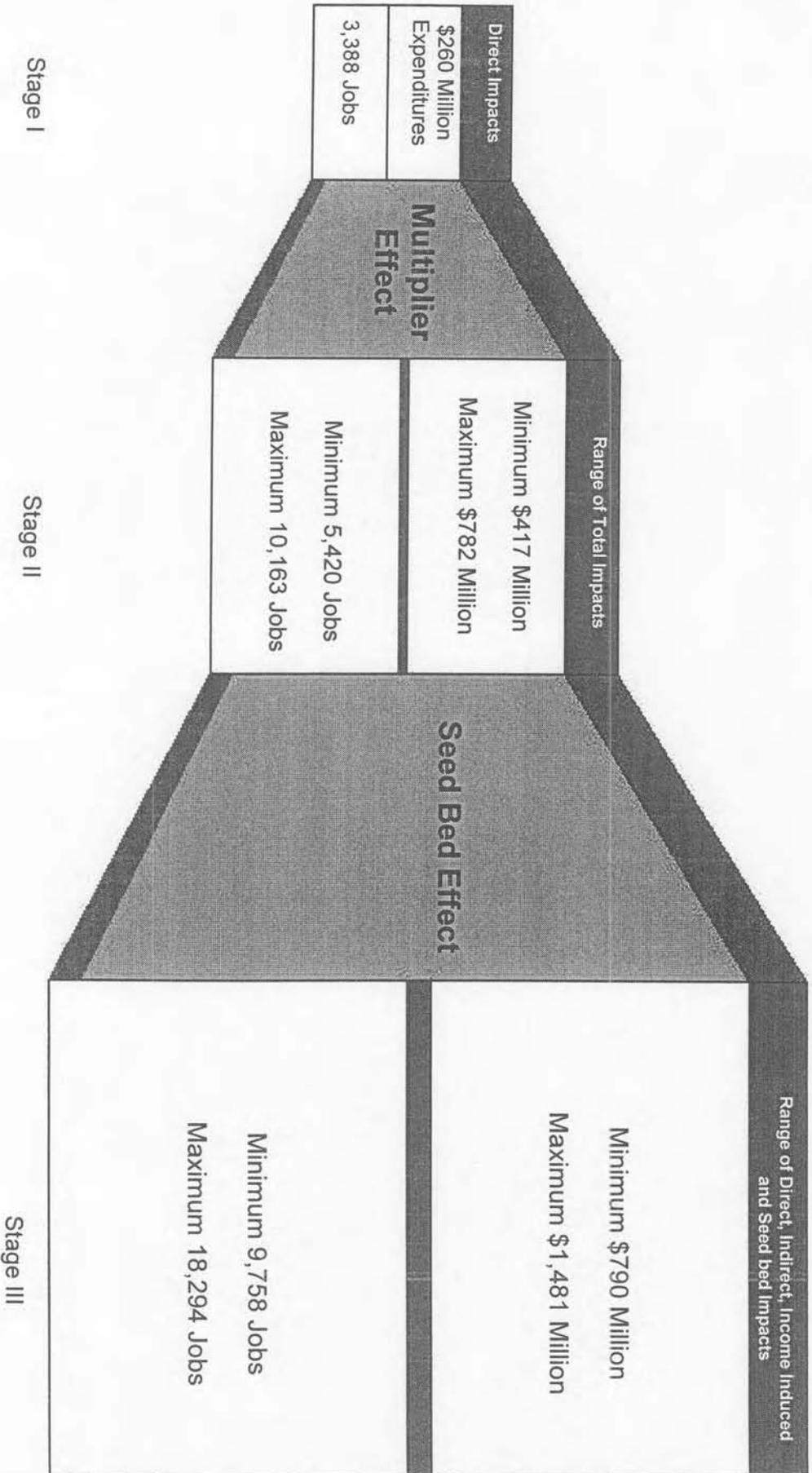
## VI. Cost of Alliances to Universities

While alliances tend to financially benefit the university and also positively impact the regional economy, there are potential costs to the academic institution. The major cost is in the threat to its integrity and its ability to effectively fulfill its major missions of teaching and research.<sup>23</sup>

Why do alliances pose serious challenges and dangers to the academic integrity and health of universities? Historically, faculty have engaged in researching subjects of intellectual interest to them in the belief that thereby they will add to our fund of knowledge. Corporate research funding has a tendency to compromise creation of new knowledge, for example, by having universities induce or even pressure faculty to focus on areas likely to be fundable. If so, will the visual representation of a corporation's and faculty's interest, now approximated by circles that overlap in places, be replaced by one of a linear relationship? In extreme cases the corporation will tell university faculty what specific research must be selected to be funded. If so, can close ties between the university and the corporate world transform universities into private sector laboratories, heavily focused on the potentially most profitable research? Already there are a few ominous signs of universities agreeing to contracts including pre-invention license agreements, publication delays, pre-publication access to research results and possible censorship.

Depending on the contractual agreement, the university may become a party to the commercialization of research results. Once the results are patented a decision to license or found a jointly owned (and possibly jointly operated) start-up company must be made. As a consequence, the university is forced into an unaccustomed commercial world which poses difficult cultural and value questions. Patents and licensing can cause many frictions within the university, some relating to patent assignment and others to licensing fee distribution. A dissatisfied inventor can leave the university, taking with him the best students, and set up his own corporation, or he can consult for corporations while giving less time to the university, resulting in a change in faculty's conduct, commitment, role and time budget. Also, university

**Figure 2**  
**Three Stages of California's Research Alliances' Economic Impact on California**



administrators can be at risk.<sup>24</sup> In short, as Daniel J. Kevles has suggested... "Universities today are not only knowledge centers but also financial conglomerates, with all the incentives to corner-cutting behavior that mark such enterprises."<sup>25</sup>

In today's university, the cloister-ivory tower of the past, which was dedicated to the unencumbered pursuit of creating, disseminating, and storing knowledge, is replaced by new, often badly skewed, priorities. Friction results between disciplines, departments, and schools when alliances unbalance the university's academic program. Corporate research funding is much easier for the biological, physical, computer and information sciences as well as medicine and engineering than for the humanities and the arts.

In order to reduce the cost research alliances pose to universities, ways must be found to meet three major challenges –

- avoid arrangements that can compromise fulfillment of the university's mission and debase the academic enterprise;
- avoid conflicts of interest; and
- avoid the appearance of unfair advantages.<sup>26</sup>

In response, universities must institute safeguards by crafting policies and guidelines covering the formation, oversight and review of alliances and faculty outside activities.<sup>27</sup> They must articulate clearly the criteria that alliances must meet to pass muster as well as the rights and obligations of participating faculty and the university.<sup>28</sup>

Furthermore, university governing boards should create reliable buffer organizations with responsibility for the business aspects of the commercialization of university-owned intellectual property and for the investment of funds produced by these ventures. The first could be in the form of a separate full-service technology corporation, and the second of an investment company, possibly in cooperation with other research universities. Finally, research universities should collectively agree on guidelines, which carefully spell out limited disclosure restrictions in corporate research grants agreements.

## VII. Conclusion

To conclude, let me paraphrase Vannevar Bush, Presidential Science Advisor – The university should accept new responsibilities for promoting the flow of scientific knowledge and development of scientific talent in our youth. These responsibilities are a proper concern of the university, for they vitally affect our health, our jobs, and our national security. University high-tech alliances are clearly an appropriate response. In forming alliances, California's research universities act not only in their own interest, but also in that of their region, state, and society.

California is fortunate not only in having great research universities, but in that its civic, government, and business leaders have helped create an environment, and with it communities

surrounding universities, that is attractive to the knowledge industry. The existence of world-class universities is a necessary condition for this kind of regional economic development; but a progressive, highly cultured environment together with superior schools and amenities which can attract the sort of persons who can exploit the scientific advances that universities generate, is a sufficient condition.<sup>29</sup> Very few states meet both of these conditions and consequently their great universities often have contributed relatively little to the economic development of their region. California's leaders should realize that the present positive state of affairs must be carefully and continually nurtured, and they must act accordingly. Otherwise, the state will lose the advantage that comes from its alliances-generated demand for goods and labor being met internally (both stages II and III having relatively small leakage to the outside) and of benefiting from relatively large seedbed effects.

California's research universities, because of their excellence, are instrumental in attracting high-tech industries to their region and thereby creating high-income employment, prosperity and ultimately, an increased tax base. Alliances can strengthen these tendencies. Governments should often find it cost-effective to increase financial support to its research universities. At times, such additional funding will be exceeded by the growth in tax receipts.

Collaborative undertakings between California's universities and industry can have a salubrious economic effect. Universities, however, are well advised to be vigilant in balancing their gains and losses from alliances, while making sure that they have put in place policies to preserve their academic integrity. Thus, those at the helm of research universities must in each case solve what Richard Florida calls the "fundamental tension between the pursuit of eminence and the need for financial resources."<sup>30</sup>

## Endnotes

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<sup>1</sup> Nathan Myhrvold, "Essays on Science and Society: Supporting Science," Science, vol. 282 (October 23, 1998): 621-670.

<sup>2</sup> National Science Foundation/SRS, Survey of Research and Development Expenditures at Universities and Colleges, Fiscal Year 1997 (Washington, D.C.: 1998, Table B-35).

<sup>3</sup> Christophe Lecuyer, "Academic Science and Technology in the Service of Industry: MIT Creates a 'Permeable' Engineering School," American Economic Review, vol. 80, no. 2 (May 1998): 28-33.

<sup>4</sup> Universities' other alliances, for example, partnerships with multimedia companies in the production of digital courseware and with publishers of books and scholarly journals, will not be considered here.

<sup>5</sup> P.J. Huffstutter and Tini Tran, "U.S. Launches Initiative to Fight Software Piracy," Los Angeles Times (July 24, 1999): C8.

<sup>6</sup> University of California, UC Means Business: The Economic Impact of the University of California (Oakland, Ca., 1995): 6.

<sup>7</sup> Ibid:5

<sup>8</sup> "Clearing a Revolution's Path," Los Angeles Times (September 20, 1998): M4.

<sup>9</sup> Ibid: M4.

<sup>10</sup> National Science Foundation/SRS, op.cit.

<sup>11</sup> Communication from UC Research Administration and Technology Team, dated April 20, 1999.

<sup>12</sup> Lawrence J. White, University-Industry Research and Development Relationships: The University Perspective, (New York University Department of Economics Working Paper EC 92-12, July 1999).

<sup>13</sup> John Marcus, "Universities and Private Firms Cash in on Faculty Research," The Associated Press (February 18, 1998).

<sup>14</sup> National Science Foundation/SRS, op.cit.

<sup>15</sup> John Caffrey and Herbert H. Isaacs, Estimating the Impact of a College or University on the Local Economy, Washington D.C. : American Council on Education, 1971).

<sup>16</sup> Adam B. Jaffe, "The Real Effect of Academic Research," American Economic Review, vol. 79; no. 5 December 1989): 957-970.

<sup>17</sup> The Economist, (July 3, 1999): 71.

<sup>18</sup> Thomas Fetzinger, Jr., "With the Stakes High, a Lucent Duo Conquers Distance and Culture," Wall Street Journal (April 23, 1999): 131.

<sup>19</sup> Using an index of technology concentration, the clustering of high-tech industries around great research universities stands out. For the San Jose metropolitan area, the index is 23.69, followed by Dallas with a 7.06, Los Angeles-Long Beach with a 6.91 and Boston with a 6.31. [Ross Devol, "Charticle," Milken Institute Review, vol. 1, no. 3 (Third Quarter 1999): 12-13].

<sup>20</sup> The Economic Impact of the University of California, Irvine on Orange County, 1982-1983 (Decision Support Systems : December 1983) : 11 and 74, and Peat Marwick, UCLA Economic Impact (Los Angeles; January 1990) : 46.

<sup>21</sup> Steven W. Relyea, A Report on the Ways UC San Diego Benefits the Local, State and National Economics (UC San Diego, 1997): 1 and 4.

<sup>22</sup> Half the royalties and license fees are estimated to be related directly and indirectly to corporate research funding in preceding years. While more than half of the University's research funding comes from sources other than corporations (and includes funds for the social sciences, humanities, and the arts), work supported by corporations is significantly patent-oriented.

<sup>23</sup> Alliances housed in universities impose a variety of costs on the community. For example, research universities are either tax exempt public or non-profit institutions, but they are provided local government services, e.g., fire and police protection. Moreover, because of their size, they can generate congestion and air pollution.

<sup>24</sup> For example, the president and several members of the board of trustees of Boston University have been investigated for conflict of interest involving the university's investments in start-up companies who develop intellectual property owned by Boston University. Michigan Technological University's Venture Group, Incorporated has faced charges of mismanagement and embezzlement by its officers. Action against the University of South Carolina's research and development foundation has led to the conviction of the university's former president. (Gary W. Watkin, "Technological Transfer and Public Policy: Lessons from a Case Study," Policy Studies Journal, 22/27 (1994): 372-73.

<sup>25</sup> Daniel J. Kelves, "Fraud and Science – Reflections on the Baltimore Case" Skeptic, vol. 7, no. 1 (1999): 23.

<sup>26</sup> The charge of unfairness is often leveled in connection with patents, license fees and other income earning arrangements gained from research by the faculty. Public research universities,

in the eyes of many citizens and legislators, are not entitled to gain income from knowledge produced by faculty whose salary is paid from taxes collected by government.

<sup>27</sup> Need for such a policy becomes clear when the following experience of John Stevens, assistant professor of Cardiac Surgery at Stanford University is considered. Stevens, together with another Stanford University trained surgeon, developed a procedure for keyhole heart surgery. They founded a start-up company, initially called Stanford Surgical Technology Inc., and “promoted it in a marketing blitz. Hundreds of surgeons, some impressed that prestigious Stanford was linked to the procedure, gave the method a whirl.” The company’s stock rose and went public in 1996. Members of Stanford’s heart-surgery department participated in medical conferences organized by Stevens and gave up-beat presentations, while some others published papers in medical journals and were given stock in the catheters producing company. Dr. Stevens, as co-founder, had 2.5 million shares, which after the 1996 public offering briefly became worth more than \$100 million. When mal-results in the form of aortic dissection occurred up to ten times as often as in open-chest heart surgery, many surgeons stopped using Steven’s procedure (Ralph T. King, Jr., “Keyhole Heart Surgery: The Doctor as stockholder,” Wallstreet Journal (May 5, 1999): A1 and A10.

<sup>28</sup> Items to be covered should include, among others, detailed information on oversight and review procedures, how and when faculty is to inform relevant administrators of their outside work, nature of type and scope of outside work, specifics of university’s patent and royalty policy, and involvement of graduate students.

<sup>29</sup> Richard Florida, “The Role of the University: Leveraging Talent, Not Technology,” Issues in Science and Technology, vol. 15, no. 4 (Summer 1999): 67-73.

<sup>30</sup> Ibid; 68.