

**Managing U.C. Berkeley in the 21st Century:<sup>1</sup>**  
**Campus Research, (Social) Innovation, and Entrepreneurship**

Discussion Paper

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**Table of Contents**

- I. Introduction ..... 3**
- II. The imperative for better strategic management ..... 5**
- III. UC Berkeley’s historical aspirations and achievements .....10**
- IV. Barriers to campus entrepreneurship.....14**
- V. The case for strengthening support for entrepreneurial activities .....17**
- VI. Social Entrepreneurship: What is it? .....20**
- VII. The importance of the broader innovation ecosystem .....23**
- VIII. Importance of strategic leadership .....25**
- IX. Toward a new vision and a new campus culture .....28**
- Endnotes .....32**

## I. Introduction

Great research universities are characterized above all by a commitment to the independent truth-seeking inquiry of their faculty, who seek to push the frontiers of understanding of all phenomena and pass on discoveries and findings and methods of inquiry to future generations. As creators, connectors, and places for understanding, imagination, reflection, and tolerance, research universities make discoveries and help shape the framework and educate the talent required for a prosperous and peaceful civil society at home and abroad.

The University of California, Berkeley (UCB) faces many challenges as it strives to maintain its performance in the very top tier of global universities, where competition for the best faculty and students is particularly fierce. UC Berkeley's success or failure in meeting these challenges will impact the local, state, and national economy as well as the lives of students, faculty, and staff for decades to come. UCB needs to be managed adroitly to meet and exceed stakeholder expectations while ensuring its own survival prospects. It must stay strong if it is to continue to help augment the world's stock of knowledge and educate the next generation. UCB must also seek to find new ways to contribute and new ways to generate resources. Of particular focus here is how universities spawn new businesses and assist with economic and social development through science, creativity, innovation and problem solving.

Sadly, the allocation of **state** funding for Berkeley has been greatly reduced. Over the past 50 years, the share of UCB's budget that comes from state funding has fallen from about 90 percent to little more than 10 percent. The foundation of the historical compact between the state and the university has been shattered. Cuts in state support are only one reason why

universities have come under increasing pressure to go beyond their traditional roles in basic research and embrace applied research and alliances with industry. This goal-directed work, with benefits for students and society, must be done in addition to, rather than instead of, the university's continuing mission of creation and transmission of knowledge across a broad range of disciplines. Not only is the era of resource munificence and limited accountability for results over in many parts of the higher education sector, there is increased competition from online and offshore educational entities and declining support from governments. The "Baumol paradox" in higher education (i.e., low productivity improvement and tuition escalation) must be addressed in a way that doesn't undermine the university's mission.<sup>2</sup> Better management and better strategy are essential if leading public universities are to maintain and enhance their historical record of academic excellence and social contributions. There are also opportunities to team up with new actors. The significant changes that have occurred require research universities to be managed more strategically and purposefully, using modern concepts, frameworks, and understandings. The management task is complicated because universities pursue multiple goals, playing a central role not just in teaching and research but also, increasingly, in knowledge transfer<sup>3</sup>. When research universities are public, they face additional mandates and constraints and requirements that limits their degrees of freedom and strains their financial resources still further.

Management not for the moment but for the future requires a strategy. In a dynamic and competitive environment, strategy must be constantly honed to the exigencies and opportunities that arise. A basic goal of university management must be to ensure the adequacy of resources to meet its current commitments to a range of stakeholders. But a

strategy must also encompass a vision for the future that brings continued benefits to those who follow. As Oxford University Vice Chancellor Sir John Hood noted, “Reputations built on the memorable success of the past do not of themselves provide a stable foundation for the future.”<sup>4</sup> More is needed.

## II. The imperative for better strategic management

When resources are scarce, it is particularly important to prioritize and understand the costs of various functions (e.g., research, teaching, and programmatic activity). There is often benefit to be gained from bringing in best practices from the public and private sectors. However, operational efficiency is often the only focus of many campuses’ “strategic” (five-year) plans; but an operational plan is not a strategic plan. A strategic plan involves specifying goals and a credible differentiated way of achieving them.

Today’s global education market involves active competition for top faculty, top students, and for resources. The strength and global nature of this competition has changed the game. Competition in the higher education industry more generally is increasing with the emergence of non-traditional providers and traditional providers branching into online learning. The very scale and importance of UCB requires modern, forward-looking management, and a well-developed, differentiated, and well-articulated strategy. Strategic management goes beyond devising good financial and operating plans. The university must set priorities and commit resources consistent with challenges and supportive of opportunities, while balancing the interests of stakeholders. Good strategic management requires careful diagnosis of emerging problems. It also requires working with all key stakeholders to forge and

to implement a widely supported coherent plan of action.<sup>5</sup> Campus leaders need to develop and articulate and implement a vision for the future and build sufficient consensus.

Strategy also needs to be joined with dynamic capabilities.<sup>6</sup> Dynamic capabilities require integrating, building and reconfiguring internal and external resources to address and shape rapidly changing business and institutional environments. They can be weak or strong, and they reside in both the management team and the institution as a whole. The three main categories of these capabilities are sensing, seizing, and transforming . New campus business models or new revenue streams “need to become a core component of universities’ activities rather than merely being “bolted on” to the traditional streams of research and teaching.”<sup>7</sup> Avoiding institutional bloat and sclerosis requires that leaders reallocate resources away from mature and declining activities toward emerging scientific areas and growth opportunities.

Understanding how universities become more successful requires an examination of how campus leaders make the right decisions and put the right processes in place to undergird the organizational and institutional capabilities that sustain competitiveness. This involves orchestrating tangible and intangible assets both on and off campus, cutting (within limits), building, and integrating as necessary, all consistent with a clearly articulated strategy.

Good leadership requires an understanding of the foundations of an institution’s competitive advantage—and an awareness of its vulnerabilities. Good leaders must reduce existing over dependencies and identify new research opportunities, new educational markets, and new funding sources, all while monitoring and sometimes mimicking successful competitors, albeit with a distinctive flare based on heritage, insight, and a differentiated

strategy. Dilatory decision making and capitulation to whichever constituents have the loudest voices will undermine capabilities—and educational success.

Strategy implementation invariably involves change. The ability of a management/leadership team to bring about change is shaped in part by structural factors, including governance. The mechanisms of state governance/control and the manner of state funding are, in the main, beyond the control of campus leadership. Academic governance and the deference given to faculty often limits a university's agility and flexibility, creating sluggishness and fostering a tendency toward the status quo. Good faculty governance and engagement can also help defend academic values and prevent and/or correct leadership blunders. However, it must also be recognized that naked and single minded pressures for "reliability" and "accountability" delivered clumsily can also reduce the likelihood of change and renewal.

One example where UCB has a chance to get ahead of the curve is in the use of technology in education. New technology allows and requires different ways of educating. This could mean reducing costs for introductory classes, adding a new tier of students, and still more. Meeting the challenge will require and allow the development of new revenue models because a great research university should be insulated from the vagaries of political whim and public funding availability. Institutional independence and academic freedom require the will and energy to build levels of endowments where the collective aspirations of the campus community can no longer be compromised. The university's leadership team must formulate and implement strategic initiatives that augment the endowment and efficiently deploy campus resources, while tapping into new resource pools that are congruent with strategic goals.

This is not to say that UCB should favor commercial and entrepreneurial values over research, instruction, and professional activity. The two are complements, not substitutes. The evidence suggests, for example, that faculty who are excellent in outreach and external (entrepreneurial) engagement are also likely to be better researchers.<sup>8</sup> Faculty entrepreneurs are among the most productive and best cited in their respective fields, even after they form startup companies. In fact, a recent study [see Table one] showed that, in general, campus entrepreneurs are more productive than peers in terms of annual research papers. This was found to be true for biology, mechanical engineering, materials, ECE, medicine, but not chemistry.<sup>9</sup> An additional finding of great interest is that faculty entrepreneurs experience an increase in annual publications before and after starting a firm. This is particularly pronounced for engineering faculty<sup>10</sup> and holds not just in absolute terms, but also relative to co-authors and peers. The table below makes a compelling case for the complementarity of entrepreneurship and research output across multiple scientific fields.



**Table One**

Entrepreneurs' average annual publications: 5 years before and after founded a firm

	Obs	(a) Before		(c) After		(d) - (a) Difference	Significant Ha: mean (diff) > 0
		Mean	Std Dev	Mean	Std Dev		
ECE	46	2.56	3.86	3.66	6.44	1.1	**
Mechanical Eng	11	0.53	0.61	0.89	0.78	0.36	
Materials & Physics	20	6	6.42	7.94	11.33	1.94	
Chemistry	13	5.22	4.72	6.46	6.38	1.24	*
Medicine	40	5.66	4.9	6.02	4.79	0.36	
Biology	20	3.81	3.09	4.06	3.89	0.25	
Full sample	150	4.09	4.62	4.95	6.61	0.86	***
Engineering	77	3.16	4.75	4.38	7.88	1.22	**
Biomedical	60	5.04	4.44	5.37	4.57	0.33	
Chemistry	13	5.22	4.72	6.46	6.38	1.24	*

\*\*\* Significant at 1%; \*\* significant at 5%; \* significant at 10%

R. Lowe & C. Gonzalez-Brambila, "Faculty Entrepreneurs and Research Productivity", *Journal of Technology Transfer*, (February 2007).

In this paper, we start by briefly describing how UCB has, in the past, and in part, distanced itself from entrepreneurial faculty, students, and alumni. We then lay out the case for raising the level of entrepreneurial activity that links UCB research with the outside world. We discuss this in the context of the broader ecosystem and how it requires a refresh of the university's strategic vision. We advocate for a new, more entrepreneurial vision to be coupled with a high-profile augmented research initiative to address fundamental real-world problems and have great impact.

### III. U.C. Berkeley's historical aspirations and achievements

Berkeley's leaders have succeeded for many years in their core educational and research missions, but some may have been too complacent with respect to the long-run sustainability and survival of the campus. Their thinking in the 1960s was dominated by large sociopolitical aspirations, including universal access and progress through science.<sup>11</sup> While laudable, these goals, which set the tone for much of what was to follow, fell short of ensuring the longer-term fiscal health and independence of the university. Moreover, despite their knowledge of the evolution of the state budget, Berkeley leaders failed to foresee and address future vulnerabilities.

In the words of Berkeley's former executive vice chancellor Earl Cheit, any strategy for UCB must include maintaining the school's public character for the indefinite future, which adds complexity to its drive for excellence:

"We want to be open and at the same time, as good as the places that have much more money ... Stanford has half our students and twice our budget ... So how does a land grant institution compete with people with that kind of money? It must compete in a very tough labor market for faculty and the best graduate students. That's the challenge that our leadership has."<sup>12</sup>

Cheit remarked in a 2002 interview that:

"new regulations on universities—regulations about affirmative action, regulations about equity, and all sorts of regulations... make universities more accountable and bureaucratic. But... Berkeley is much more bureaucratic than other campuses in the system."<sup>13</sup>

Berkeley's administrators are not well attuned to the immediacy that a supportive culture for innovation and entrepreneurship relies upon. Moreover, parts of the campus have

been lukewarm (some might say even hostile) to the commercialization of faculty research. There is a need both at the societal level and within universities to become less bureaucratic and more decisive and to adapt their promotion and remuneration systems to incent new arrangements and new partnerships to deliver better education more cheaply, as well as to assist in technology commercialization activities that benefit the campus.<sup>14</sup> The quality of faculty and staff must be continuously upgraded.

Despite heavy regulation, Berkeley delivers more for less, but having better cost-of-service/enrollment metrics does not guarantee survival as a world-class institution. UCB's financial foundations are precarious, with much less of its revenue provided by endowment income than universities with which it must compete. Delivering high quality education to students at a (diminishing) discount price is not a business model with long-term viability. More is needed, and is occasionally supplied.

UC Berkeley was established as a land grant university with a mandate to assist in economic development. There have always been technology development and transfer activities in areas ranging from agriculture to civil construction. However, until recently, assisting startups (or established enterprise partners) wasn't common. Despite encouragement at the Office of the President and at the chancellor level, the historical record indicates that UCB faculty (with the important exceptions of electrical engineering, computer sciences, and recently biological sciences) have been only somewhat entrepreneurial.<sup>15</sup> Except in isolated pockets, the campus culture remains ambivalent.

UCB actually has a long, albeit inconsistent, connection with start-up activity. An under-recognized but significant technology development initiative that engaged faculty from the

Berkeley campus during the 70s and 80s was Teknekron Corporation, which was one of the world's first and finest technology-focused business incubators. A group of UCB engineering professors and industry professionals founded Teknekron in 1968. Teknekron helped commercialize new technologies, many of which were developed by UCB engineering faculty. Corporate offices located in the city of Berkeley served as a catalyst for engaging faculty, former students, and other scientists and engineers into new enterprise development.

Teknekron specialized in linking high-technology firms with university researchers, a model that has since been much copied. According to David Culler, chair of the Electrical Engineering and Computer Sciences Department at UCB, "Many of the things we see today were ideas that George [Turin, a College of Engineering, UCB professor and Teknekron vice president] was advocating in the late '80s, early '90s, trying to bring academia, industry and innovation closer together."<sup>16</sup> The Teknekron model calibrated the psychological profile of faculty and then guided suitable candidates onward to be young entrepreneurs. Teknekron then connected the chosen (often faculty) entrepreneurs to sources and users of innovation, taught them business methods, and guided them psychologically during the early stages of their projects. At a given maturity level, the projects become employee-owned "affiliated companies," with the entrepreneurs as company presidents. The viable companies were eventually sold, yielding solid profits to Teknekron and providing financial independence to the entrepreneurs.<sup>17</sup> By 1994, Teknekron had claimed a compounded average return on investment of more than 50 percent per year, building new businesses worth over \$750 million.

UC Berkeley never embraced Teknekron. The company's near-stealth presence perhaps reflected an ambivalent culture on campus toward entrepreneurship and reduced the opportunities for the campus to benefit from Teknekron efforts. Its significant contributions are almost unknown to the faculty and to the administration. They should have been trumpeted.

The problem is a more general one that transcended particular experiences. In the words of Ed Penhoet, who co-founded Chiron Corp in 1981 when he was a professor of Biochemistry:

Certainly there always was a negative view about commercial activities on the Berkeley campus, maybe more pronounced than in most places. But there were some people on our campus who had consulted for commercial organizations for quite a long time ... There is a long tradition of people in chemistry consulting. There is a long tradition of people in engineering consulting. But I think in the biological sciences it just wasn't done very much. The sixties and seventies were periods where there was a big chasm between business and academia. It developed over the politics of the sixties. There was deep mistrust on both sides of that chasm. Berkeley was always identified as being one of the most leftist places in the country. Whether it truly was or not is another matter.<sup>18</sup>

College of Engineering Faculty member Kurt Kueter offered an updated view in 2014:

"Our culture is changing slowly but faculty are still shy to talk about their startups even though almost every faculty member (in the college of engineering) is involved in quite a number".<sup>19</sup>

Biotechnology is an example of how UC Berkeley has contributed mightily to technology development in the United States and worldwide. Much of the industry's early work was done by a handful of scientists at UC Berkeley, Stanford University, and UC San Francisco. Cetus Corp, a biological engineering company often considered the first "true" biotech company, was

founded in Berkeley in 1971. Cetus was led by two Nobel Laureates, Donald Glaser and Ronald Cape, who invented the polymerase chain reaction (PCR), a major biotechnology tool. Cetus commercialized machines originally developed by Glaser, professor of physics and molecular biology at Berkeley, which could rapidly screen and isolate mutants that were more efficient in producing complex compounds such as antibiotics and vitamins.<sup>20</sup> The technology at Chiron, mentioned above, built on the work of Cetus.

The university continues to generate biotechnology entrepreneurs from the ranks of faculty. Corey Goodman founded Exelixis in 1994 and Renovis in 2001. Both licensed IP rights from his work (and that of Tito Serafini) as a faculty member at Berkeley. Later, Goodman worked with Pfizer, founded venture capital firm venBio, and became CEO of one of venBio's portfolio companies. His experience, like that of Ed Penhoet, exemplifies how university-based talent can circulate between academia, industry, and investment capital to support research, company formation, commercial product development, and global health.

#### **IV. Barriers to Campus Entrepreneurship**

Universities engage in technology transfer through a variety of channels. These include licensing, faculty consulting, and recruitment of students by industry, and publications. Of these, licensing is almost certainly not the most important for society,<sup>21</sup> but it one with some untapped benefit for the university itself. However, its successful execution requires a very proficient licensing and market research capability which is hard to develop inside a public or a not for profit entity.

As a consequence, some research universities have already shifted their focus from patenting and licensing to a broader emphasis on “academic entrepreneurship.”<sup>22</sup> This new emphasis has led to greater university involvement with technology transfer institutions, such as incubators/accelerators and science/technology parks, which are often located in or near urban areas. It opens the possibility of substantial wealth creation for various stakeholders through new enterprise development and the sharing of that wealth with the campus. The new focus is thus on research, invention, innovation, and entrepreneurship.

Universities in the U.S., including UCB, have now begun to look beyond licensing and faculty consulting to new-enterprise development initiatives. As noted, universities have begun investing resources in incubators and accelerators as a new way to assist technology transfer. This may also involve developing land adjacent to campus for high tech business use.<sup>23</sup> These initiatives, which may have licensing as one element, offer a more promising approach (over simple patent or copyright licensing) as a way for the university to benefit from the research it conducts. Faculty, staff, and administrators that help make this happen should be recognized for their contributions. This recognition need not be pecuniary; symbolic rewards and proactive campus facilitation may well suffice.

Many constituencies on and off campus have recognized the value of encouraging students, faculty, and alumni to launch new ventures in the urban areas surrounding campus. When activity is local, universities can provide resources such as highly skilled faculty, assistance from staff, and the energy and creativity of students to help solve particular problems.

The commercialization of university inventions through startups and partnerships in no way undermine the social benefits of other forms of technology transfer. Studies of technology commercialization strategies indicate that a licensor (in this case, the university) is likely to capture only a small percentage of the profits from innovation, unless the invention enjoys especially strong intellectual property protection.<sup>24</sup> Put differently, when the university benefits from licensing and commercialization, society is likely to benefit even more because the spillovers are large.<sup>25</sup> Moreover, a well-run licensing program encourages the university to find the licensees most likely to put the new technologies to productive use.

Faculty engagement with technology transfer and related consulting and entrepreneurial activities can also strengthen ties with industry, such as joint research and contract research. These links can help shape priorities on campus. Notwithstanding, these benefits, the cultural support for entrepreneurship on campus is not as widespread as one might think. Most engineering, chemistry, biology, and business faculty embrace entrepreneurship with few hesitations. Some don't. Elsewhere on campus it can be problematic.

University policies and reward structures influence the decision of professors to engage in entrepreneurial activity. At present, structures around consulting and conflicts of commitment are not balanced by affirmative requirements for external engagement with technology transfer and new enterprise formation. Professional activities are rewarded but entrepreneurial efforts to advance technologies towards practical application and market acceptance are treated, at best, with indifference. In some cases, particularly when there is the



perception or actuality of enrichment, entrepreneurial efforts and activities are treated with disdain, no matter the societal benefit.

In short, engagement with new enterprise development does not fit as comfortably as it might with the traditional faculty performance pillars of research, teaching, and professional engagement, and university service. Launching companies is a much more time-intensive and complex activity than technology licensing, even if entrepreneurs are brought in from outside. Faculty promotion and reward criteria are not sufficiently friendly with respect to engagement with partners and with new enterprise development.

**V. The case for strengthening support for entrepreneurial activities**

Online technology can help with teaching and outreach. Research, on the other hand, can be enhanced in our view by campus efforts to encourage and ensure greater impact. As noted this often requires greater attention to technology transfer, partnerships with business, and engagement in new enterprise development.

Deeper engagement with established enterprises and their industrial research activities, as well as with startups, is needed. Besides the university's own requirement to enhance impact, there are broader societal reasons for universities to prioritize research, innovation, and entrepreneurship:

1. The decline of basic research in the corporate sector has made research universities relatively more important in renewing the US science base.<sup>26</sup>
2. UC Berkeley has the breadth to integrate knowledge across disciplines, which is how contemporary breakthroughs in new hybrid fields such as bioengineering are made.

3. The regional abundance of venture capital and the entrepreneurial energy of students have created the opportunity for a startup culture on campus to help bring the fruits of research more quickly to applications and to the marketplace, where they can help satisfy society's unmet needs.

Arizona State University President Michael Crow argues the case for a more entrepreneurial model for the research university is itself an “academic enterprise.” His goals for such an organization include academic excellence focused on maximizing social impact, agility, adaptability, responsiveness to changing needs, and quick decision making. This is consistent with what the funding environment now requires in many jurisdictions around the world. In many fields, greater impact requires the campus to expand and to leverage research for the betterment of humanity. In democratic countries, universities must accept this mantle. Greater responsiveness by campus can assist with securing increased public funding or at least public “soft” support, more freedom to operate, and increased private support too. Endowment gifts from alumni and those who have benefited from (or seen others benefits from) the catalytic role of the campus is also a likely consequence. These gifts along with corporate partnerships are promising avenues to ensure that the campus has access to the resources it needs. UCB to date has had few corporate alliances, and entrepreneurial activity while very considerable, could be expanded.

Increased external and corporate engagement—for grants licensing, alliances, and more—requires that campus leaders develop closer relationships with new and established foundations and business enterprises. It is no longer enough for the university president/chancellor to be adept at negotiations with traditional funding sources (public

entities, the state, established private foundations, alumni). The creation and management of new external relations, including with fledgling and emergent startups, and new family wealth offices must be high on the agenda of campus leadership.

The job description for campus leaders must accordingly emphasize new skillsets. In addition to casting a wider net externally, leadership entails uniting the campus around new opportunities, mandates and exigencies. There is an endemic failure of many universities to recognize opportunities and threats in an era of global competition in higher education and to communicate them effectively campus-wide. This requires redress at Berkeley and elsewhere.

The conception of academic and university entrepreneurship advanced here need not subtract from the long established tradition of excellence in research and teaching. Nor is there a suggestion that all faculty and administrators adopt the mantle of entrepreneurs and innovators as well as being great scientists, artists and teachers. Rather, the thesis here is that the ideas, intellectual framework, scientific principles and research findings that anchor campus knowledge assets should be understood, taught, and converted into action. Knowledge sitting on the shelf for too long may lose value. The university has an obligation to drive impact, either on a standalone basis or cooperatively with other institutions and organizations better able to do so.

By way of summary, campus ambitions and requirements today must extend beyond scientific publications, as important and critical as they are. A new strategy must promote the transfer and application of research findings for the use of society while capturing for the

campus through engagement, partnerships, grants, and gifts. Some portion of the wealth thereby generated ought to flow back to the campus.

Thomas Edison once put it,

*"I always invented to obtain money to go on inventing"*<sup>27</sup>

What goes for the individual inventor also goes for research based academic activity.

## **VI. Social Innovation and Social Entrepreneurship: What is it?**

If innovation and entrepreneurship is valuable, is social innovation and social entrepreneurship even more so? Social innovation/entrepreneurship is a new term but not a new idea. It is not, although it could be, depending on circumstance, synonymous with for profit innovation and entrepreneurship. For all social entrepreneurs, social mission is explicit. Wealth creation may occur but it is ancillary. The goal is to do well by society. That may require building a company in order to commercialize new technology and have impact with new concepts and ideas. It requires audacious goals.

That said, standard invention and entrepreneurship is not just about the money either. It's about people and communities helping everyone live better and helping the nation stay strong and vital. It's also about the next big thing and helping solve the knottiest economic, social and political problems. As Apple's founder, Steve Jobs likewise noted that commercializing technology and building companies is animated by a broader set of goals:

*"The company is one of the most amazing inventions of humans, this abstract construct that's incredibly powerful. Even so, for me, it's about the products. It's about working together with really fun, smart, creative people and*

*making wonderful things. It's not about the money. What a company is, then, is a group of people who can make more than just the next big thing. It's a talent, it's a capability, it's a culture, it's a point of view, and it's a way of working together to make the next thing, and the next one, and the next one.*<sup>28</sup>

Just as UC Berkeley has audience goals, so do many new enterprises. “Silicon Valley” companies and in large measure born, and remain attached, to big hairy audacious goals. Companies in the broader SF Bay Area ecosystem increasingly are quite explicit about doing something monumental... making as Steve Jobs put it, a small dent in the universe. For instance, Google’s mission is to “organize the world’s information and make it universally accessible and useful”. LinkedIn CEO Jeff Weiner asks his people to “think 20x”. Lesser known entities like the Berkeley Research Group aspire to “fundamentally change the way professional services are organized in the modern world”.

Absent building a company to bring technology to the public, there are fewer ways to garner the resources to improve and scale the technology and business models, thereby achieving the desired level of social and economic impact from campus invention. Moreover, entrepreneurship will as likely lead to innovation that will find application in government as in the private sector.

It should not be assumed that if an innovation happens to yield great commercial value, then it will somehow not have social value or solve important social needs. Indeed, studies show that the social returns from technological innovation (measured by real resource savings) are almost always orders of magnitude greater than any private returns that may result. If one samples on successes, like Zvi Griliches<sup>29</sup> did in his study on hybrid corn, the return on investment for society (due to spillovers) may well be over 1000%. Even taking failures into

account, Mansfield formed a lower bound of 58% on the social rate of return for a sample of modest innovations<sup>30</sup>. Other studies often show astonishing social returns due to spillovers or what economists call “positive externalities”. The invention and deployment worldwide of containerization, a modest technical breakthrough which became a global standard, was greater than 1000% too. General purpose technologies (like printing, the steam engine, electricity) and enabling technologies (like the laser) generate sufficient benefit that they may even lift the prosperity of entire sectors and entire regions and communities<sup>31</sup>. A bioengineering breakthrough or even a single new pharmaceutical can likewise stop the suffering of millions of people and solve human health problems. Antibiotics is a case in point. Other drugs, like statins can extend the healthy lives of millions of people in measurable ways. The CAT-scanner invented by Sir Godfrey Hounsfield was the greatest breakthrough in radiology since x-rays and has been a tremendous distinguishing device as well as a tool for research and surgery and for research too.

John Hennessey, President of Stanford, made it clear that it was important for the university to focus on achieving “big” discoveries. When discussing students<sup>32</sup> he noted:

“I think we still want people who are going to go out and change the world. Google is a company that's changed the world. It hasn't just invented technology, it's changed the world. So big changes like that. I think that's the role of the university. It's really those big gaps of discovering things new and creating the opportunity to do them that we want to encourage. “

And likewise for faculty:

“Faculty can do whatever they want with their time, whether it's Stanford or Berkeley or anywhere else. As long as they stay focused on doing things that are big, that's great. Everyone benefits.”

We note earlier that social entrepreneurship is not in the first instance about the pursuit of profit. Focusing on impact does, however, raise the issue of the circumstances in which the pursuit of profits might be socially harmful. Prof William Baumol addressed this conundrum long ago. His answer, is that if national laws/rules are set up poorly, the pursuit of profit can undermine rather than enhance social value. He pointed out that a private enterprise economy has a bias first to profit, not to innovation. Entrepreneurship has a positive value to society when it is focused on innovation. However, entrepreneurship has a negative (parasitic) value to society when it is focused on organized crime or mere “rent seeking” flowing from exploiting regulation or access to government. The job of government is to set the rules so that payoffs from good entrepreneurship are positive and the payoffs from socially wasteful entrepreneurship are negative (Baumol, 1990<sup>33</sup>). The essence of Baumol’s position is as follows:

*“It is the set of rules, and not the supply of entrepreneurs, or the nature of their objectives...that helps to dictate the ultimate effect.”*

The implications for public policy are unambiguous, and the remedies limited. Put simply, it is important for society to have good laws. Since this is not always the case, the moral compass of the university must come into play when issues arise with respect to whether and how to embrace entrepreneurship. If society’s values and the rules are wrong and the campus

encourages regulatory arbitrage or the exploitation of inadvertent legal loopholes, social value can be negative. Hence, the campus must discriminate with respect to what it supports, particularly in circumstances where the law is deficient. This is because the university's role must always be to improve the lot of society. Campus involvement with new enterprise development must be in lock step with the goals of society, varied as they may be. At the same time, the campus must not be afraid to see value created and value captured.

While innovation that benefits society will always be cherished, there needs to be some bounds and a clear understanding of where the limits lie (in terms of what is supported) for a resource constrained research university. The reason is that the university has no distinctive advantage in many categories of positive social innovation and there are other organizations and institutions that are better able and better equipped to do so. There are thousands of not-for-profit as well as major foundations that engage in and/or financially support social innovation in local communities at home and abroad. Accordingly, the university must position itself where it can expect to succeed and where it can help sustain itself rather than undermine itself by eroding its core strength and distinctive role in the innovation ecosystem. Embracing entrepreneurship is a big step; going too far from the core competence of the campus is risky and could undermine the excellence of major research universities. Competing for endowment and partnership funding for its core mission could be inadvertently undermined if the campus strays too far from where it has competitive advantage.

In short, social entrepreneurship does not require that the university adopt a narrow view of society and confine itself to the immediate environment of campus. Indeed, to do so



would make it less likely that the distinct competence/capabilities of the campus would be properly leveraged. Other institutions such as the United Way and the Red Cross can do this. That's not to say that research based approaches to "social" innovation that have impact shouldn't be pursued and at least experimented with locally.

What then is the campus mandate for non-STEM activities? The answer is that it is considerable; but it need not come from the core academic heartland. Society is better off if the core academic heartland where there is global strength focuses on big issues that will benefit many communities and constituencies, locally, regionally, nationally, and globally. Other campus units (e.g. Cal Performances) can support the development of skills, attitudes, and entrepreneurial values on campus and in local communities. So can athletics and medical/optical where there are academic medical units.

## **VII. The Importance of the broader innovation Ecosystem**

The university exists as part of a broad ecosystem that starts in its immediate environs and extends to the regional, national, and global economic levels. The ecosystem provides the conduits through which research results and other knowledge are diffused, and it also shapes and constrains UCB's ability to leverage its capabilities to improve its financial position.

At the local level, the city of Berkeley and nearby towns are potential landing places for campus-spawned start-ups. Businesses thrive in environments where they can draw on the

culture and diversity of the campus and the human diversity and economic resources of a city.<sup>2</sup> A good innovation ecosystem will combine a strong university with an attractive close knit living environment, a local entrepreneurial milieu, and easy property development approvals for structures suitable for new ventures and the industries and services that support them, and easy access to major airports and other transportation arteries.<sup>34</sup> Quality housing and other amenities for top talent are also a high priority.

Successful universities also shape the cities that surround them. Universities can stimulate the creative powers, aesthetic desires, and human passion of talented individuals in and around universities.<sup>35</sup> Further, a rich cultural landscape and good urban infrastructure contribute to attracting top talent by helping create an inventive ethos.

Over 50 years ago, UC Berkeley President Clark Kerr proclaimed that the university was the “prime instrument of national purpose,” an essential element for developing the “knowledge industry.”<sup>36</sup> There is greater recognition today than ever that universities can contribute significantly to economic development locally, nationally, and globally. The university can play a catalytic role through astute, strategically motivated orchestration of assets on and off campus. Successful orchestration often involves establishing fruitful connections among individuals and organizations; designing business models; and applying entrepreneurial skills. This can entail, for example, working with locally based startup firms,

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<sup>2</sup> In the case at Berkeley, our university at our local cities share a common set of values, a question everything ethos, and a commitment to challenge society to be better

whether or not they are licensees, encouraging the flow of ideas to and from campus. Another model is to collaborate with an independently owned incubator.

Whether the model is ownership or independence, the university must ensure the creation of suitable physical spaces on or near campus to allow the business/technology incubation process to begin. The 2012 creation of Skydeck, a joint venture amongst UC Berkeley the city of Berkeley and initially Lawrence Berkeley Lab, was a solid step in this direction. These physical spaces allow universities to host new enterprise forums, business plan competitions, hackathons, startup weekends, and mentoring. Incubators/accelerators and science/technology parks can provide platforms for idea labs and “angel” networks.

The shaping of an entrepreneurial “ecosystem” also requires the provision of a productive social context,<sup>37</sup> which UCB is well positioned to create. Commercially focused startup initiatives benefit from access to faculty, students, other entrepreneurs, public agencies, and investors.

Finally, for a university to contribute to the vitality of its ecosystem, it must itself be vital. That requires pioneering (or latching onto) new fields. To accomplish this, a university needs strong dynamic capabilities to be able to recognize and invest decisively in emerging new fields. These investments yield new knowledge, and the campus context makes it easier to integrate that knowledge with other disciplines. This knowledge then provides a foundation for entrepreneurial activity by faculty and/or external partners.

## VIII. Importance of strategic leadership

The creation of supportive environment and physical and social spaces for innovation and entrepreneurial activity must be guided by a strategic vision for mutually beneficial engagement on and off campus. The creation, articulation, and communication of this vision is the province of university presidents, chancellors, provosts, deans, and faculty. Campus leaders' perceived and actual strategic priorities are of great importance with respect to how a university uses its existing resources and capabilities—and which ones it will develop to address upcoming opportunities.

Asset orchestration often begins with an explicit commitment to the strategy. Consider the following description of the initial vision of the legendary Dean of Stanford's Engineering School (and, subsequently, Provost) Frederick Terman:

Terman argued that, "by determining the proper fields on which to concentrate, and then really laying it on those selected spots we can go places without needing large amounts of extra money. With 20 years, a suitable administrative basis, and reasonable backing from the President, it would be a pushover to do something really big." In his view, universities typically lacked the ability to plan: "their detailed administrative operations such as new appointments, allocation of funds for new equipment, etc. are decided largely on the basis of this year's and next year's needs." If Stanford could allocate resources strategically, as part of a long time program, it could move ahead of its competitors.<sup>38</sup>

Terman's "Steeple of Excellence" strategy quickly brought Stanford University into academic leadership positions. Within 25 years, Stanford was transformed from a regional university to a national player and subsequently a globally recognized research campus. However, different universities face different challenges.

Stanford President John Hennessy, provides another useful description of the strategic role of university leaders:

"I view the role of the President as scouting for opportunities, possibly by bringing a group of faculty together that kind of know each other, but need a little inspiration and maybe a little funding and a little incentive to come together and do something. I think that's especially important when we are doing something new. Faculty go their own way, they do their own thing. The challenge is to do something that creates a synergy among them and enables us to do something larger. It could be because it enables us to do research we couldn't do before. Sometimes it can attract philanthropy that couldn't be attracted with ten individual efforts. So I'm constantly looking at that, I think of myself as the scout trying to match the talents we have in the faculty. Sometimes you look at it and you say, "Okay, here's an area that's emerging. For example, neuroscience. The area's getting bigger, it's growing by leaps and bounds. It's a critical area. It's a big frontier in human medicine." You look and you say, "Can I get a group of faculty together between the medical school, engineering and biology. Are we missing people who do the following?" And then we'll look for ways in which we can help finance that or establish it."<sup>39</sup>

As this suggests, part of good leadership involves engaging faculty in carrying out the strategy. Faculty play a critical bridging role between the campus and the wider ecosystem, and strategy implementation will not be effective if faculty are pulling in too many different directions at once. The role played by "star" scientists in the formation of innovation ecosystems is particularly important. A study in the biotechnology sector found that the location and timing of new firm formation were related to where and when star scientists were publishing.<sup>40</sup>

Ideas for institutional renewal do not, by any means, need to come from the top, but campus leaders must be willing to back promising initiatives and dissuade the pursuit of foolish ones. Faculty-led initiatives led to the unification of fragmented research activities in molecular

biology and related fields. In 1980, Provost Roderick Park at UC Berkeley established the Chancellor's Advisory Committee on Biology (CACB), with scholar Dan Koshland as chair. The CACB pushed through a sweeping reorganization of biological sciences that included the winding up of ten biology departments and 150 faculty and their relocation into two new departments: integrative biology; and molecular and cell biology. These two clusters created a multidisciplinary community that allowed a focus on therapeutics. The initiative was strongly supported by the chancellor, in part because it looked like it would assist in external fundraising and attract state funding for capital expenditures. It did in fact attract state co-funding; that opportunity then triggered the first major fundraising campaign for the Berkeley campus, led by Chancellor Ira Heyman.<sup>41</sup>

Clearly, in the campus history, and in the history of other great institutions near and far, there are compelling clues with respect to the path ahead. What's needed now is the energy, the courage, and the leadership to take big steps and to do so now. There is much to be done on all fronts, including graduate and undergraduate research instruction. Strengthening the campus contribution to innovation and entrepreneurship is an important one that, done successfully, will help shape the resource base needed to support other campus activity.

#### **IX. Toward a new vision and a new campus culture**

So far I have focused on the need for Berkeley to provide better support for entrepreneurial and innovative activity. Here I will also add another branch to the proposed vision, that of developing widely applicable technologies that can potentially address major societal challenges.

By expanding support for research and for new enterprise formation and development, UCB can clearly enhance its contribution to society and sustain its viability. A deeper commitment to entrepreneurial activity will speed the application of the knowledge generated on campus while enhancing the university's resources for new knowledge generation.

Yet, despite its well-known disruptive culture, Berkeley has not been known for disruptive commercial impact, and its significant contributions to date have generally gone unheralded. Improved communication and outreach are required. In this regard, I propose:

- a. Continued and expanded support for academic research as it contributes significantly to industrial innovation
- b. Prioritization of research funding and effort to new emerging areas and to research that might generate "enabling" technologies
- c. Unambiguous endorsement of innovation and entrepreneurship is an integral and legitimate component of campus activity
- d. Increased financial & nonfinancial support (through partnerships and other mechanism) to technology transfer and new enterprise development activities.
- e. Eliminate financial support for "dead end" initiatives that were once promising.
- f. Amending faculty promotion and advancement criterion to give affirmative permission for faculty to engage in commercial and other activities which have impact, including new enterprise formation.
- g. Immediate launch of UC Berkeley Technology Magazine and website, which will comprehensively document discoveries and associated accomplishments

emerging opportunities of all Berkeley scientists, engineers, entrepreneurs, innovators, and creative talent.

- h. Development of an entrepreneur-focused public relations campaign to trumpet the availability of licensable technology, our successful engagements with industry, and related ongoing activities and startup activity.

I am not advocating, however, that UCB researchers narrow their focus to applied research of immediate interest to industry. While there is a place for this, the emphasis should be firmly on basic and applied research and on fundamental discoveries that might spawn “enabling” technologies. However, facilitating and enabling widespread use and impact must also be a goal.

UCB students, faculty and alumni are eager to bring solutions to the most pressing global, national, and local problems; but many feel the need for a strategy, for focus, and for permission, encouragement, and financial support. Addressing dreams requires additional resources; focusing our efforts strategically can help attract those resources.

To bring this about, it is necessary to have a high-level strategy to encourage the on-campus development of new knowledge (and augmentation of creative activity more generally) that addresses major problems and opens up new possibilities. The category of technology that can have such an impact is “enabling” technology. Enabling technologies, often require multidisciplinary collaboration for which UCB is well positioned. Enabling technology can be used to drive radical change across diverse fields. Past examples include the laser, recombinant DNA, and the microprocessor. Not only can the enabling technology itself improve over time,



but it opens up possibilities for new or improved complementary technologies. In short, enabling technologies have broad societal impacts over extended periods of time. Jennifer Doudra and colleagues breakthrough with gene editing is a case in point.

Of course, most inventions and discoveries will have a far narrower impact. And some enabling technologies may not be initially recognizable as such. The laser, for example, was a laboratory curiosity for years before it began to find widespread application.

Campus leadership should encourage its researchers to aim high (or, in the words of Steve Jobs, “make a little dent in the universe”<sup>42</sup>). We should encourage our students and faculty to stretch their imaginations and science based interdisciplinary capabilities to focus on big, real-world problems the solutions to which has social, economic, and political impact.. Among other implications, this will require expanding the psychological and physical space on campus for multidisciplinary activities, engaging not just engineering and the sciences but also the arts and literature.

UCB can capture the imagination of many important constituencies with a bold approach. Campus commitment to an exciting and authentically Berkeley vision will unlock financial and other resources in the entire university community, in government, in industry, in alumni, in not-for-profit foundations, and in friends.

To summarize, this paper advocates a two-prong strategy that encourages and supports (1) innovative and entrepreneurial activity and deeper engagement with outside organizations; and (2) a stronger commitment to fundamental and applied research on focused on generating enabling technologies that will help solve medium and longer term societal problems. Properly

executed, this strategy can help renew and enhance the Berkeley brand and expand the utility and impact of campus research. It can also help preserve campus independence and sustain its unfettered, truth seeking (and conventional wisdom shattering) academic environment.

## ENDNOTES

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<sup>1</sup> This paper borrows in part from the research and publications of S. Leih, D. Siegel, and D.J. Teece. In particular: *Leadership and asset orchestration by universities in innovation ecosystems: An application of the dynamic capabilities framework*, submitted to California Management Review; and *Campus leadership and the entrepreneurial university: A dynamic capabilities perspective*, Academy of Management Perspectives (2016).

<sup>2</sup> W.J. Baumol, "Macroeconomics of unbalanced growth: the anatomy of urban crisis." *American Economic Review* 57.3 (1967): 415-426.

<sup>3</sup> Chancellor Sam Hawgood of UCSF says that the modern university must become more porous, by which he seems to mean more directly engaged with society. This can happen on several levels, in several arenas, and entrepreneurship is one of these.

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