



Entrepreneurs, Startups, and Innovation at the University of California

August 2016

Acknowledgments

The Economic Institute is deeply grateful to the many individuals who generously gave time to discuss their programs, their campuses, their ideas, and the future of entrepreneurship programs at the University of California. We are particularly indebted to Dr. Martin Kenney and Dr. Donald Patton of UC Davis, who together with their team provided valuable data on startups generated by the UC system, and to Dotti Miller in the University of California Office of the President, whose team supported the development of the data.

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About the Institute

Since 1990, the Bay Area Council Economic Institute has been the leading think tank focused on the economic and policy issues facing the San Francisco/Silicon Valley Bay Area, one of the most dynamic regions in the United States and the world's leading center for technology and innovation. A valued forum for stakeholder engagement and a respected source of information and fact-based analysis, the Institute is a trusted partner and adviser to both business leaders and government officials. Through its economic and policy research and its many partnerships, the Institute addresses major factors impacting the competitiveness, economic development and quality of life of the region and the state, including infrastructure, globalization, science and technology, and health policy. It is guided by a Board of Trustees drawn from influential leaders in the corporate, academic, non-profit, and government sectors. The Institute is housed at and supported by the Bay Area Council, a public policy organization that includes hundreds of the region's largest employers and is committed to keeping the Bay Area the world's most competitive economy and best place to live. The Institute also supports and manages the Bay Area Science and Innovation Consortium (BASIC), a partnership of Northern California's leading scientific research laboratories and thinkers.

Methodology

The Bay Area Council Economic Institute used three separate sources to compile data on startup formation and related employment, revenue, venture capital, and federal awards.

First, the Office of Research and Graduate Studies division of the University of California Office of the President (UCOP) provided the dataset used in its annual Technology Commercialization Report. This data dates from 1981 through June 2015 and includes all startups in STEM-related fields (science, technology, engineering, and mathematics) that were formed using UC-licensed technology. Campuses report these companies to UCOP as part of their fiscal-year-end reporting.

The second dataset was a university-wide spinoff firm database compiled under the leadership of Dr. Martin Kenney at UC Davis. To be included in the database, a firm had to fulfill four criteria. The firm had to be founded by UC faculty, staff or postdocs, or by students within one year of graduation; it had to be de novo; it had to be technology-based; and it should have grown to more than a few employees. Finally, affirmative evidence was needed that the firm had a founder who was affiliated with the University of California.

The Economic Institute also used a third UCOP-compiled dataset on startups at UC incubators.

There were many occurrences of companies appearing in more than one of the three datasets. To avoid double counting, only one record for each company was kept in the final compiled database analyzed by the Economic Institute.

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Executive Summary

The University of California system plays an important and growing role in California's economy, by producing cutting edge technology and know-how through its research programs, but also by enabling and supporting the formation of new companies by faculty and students.

Startups are important because in the vast majority of cases they locate in California, usually close to the founding faculty member's campus or to the campus from which the founding entrepreneur/CEO graduated. They also tend to grow in the communities where they are founded, magnifying the importance of UC's campuses to long-term job and business growth in the regions where they are located. Because of this, each campus plays an important catalytic role in local economic development. This role varies with the age and size of each campus, and whether or not it is located in a major urban center. Each campus, however, is playing a distinct and growing role in moving technology from the laboratory to the market and in engaging the entrepreneurial energy of its faculty and students to accelerate the process.

Part One: Measuring Impacts

The Bay Area Council Economic Institute used three separate sources to compile data on startup formation and related employment, revenue, venture capital, and federal awards. First, the Office of Research and Graduate Studies division of the University of California Office of the President (UCOP) provided the dataset used in its annual Technology Commercialization Report. The second dataset was a university-wide spinoff firm database compiled under the leadership of Dr. Martin Kenney at UC Davis. The Economic Institute also used a third UCOP-compiled dataset on startups at UC incubators. There were many occurrences of companies appearing in more than one of the three datasets. To avoid double counting, only one record for each company was kept in the final compiled database analyzed by the Economic Institute.

Counting only startups in STEM-related fields (science, technology, engineering and mathematics) that were formed using UC-generated intellectual property or were founded by faculty, staff, or postdoctoral, graduate, or undergraduate students within one year of completing their UC affiliation, 1,267 companies were generated by the University of California between 1968 and June 2015, the time period covered by the data used in this report. Of these companies, 622 were still in business—referred to in this report as “active”—in June 2015, and 603 of those still active companies were headquartered in California.

The aggregate revenue reported for the 440 active companies for which information was available in each company's most recent fiscal year was \$16,170,859,930. Among the active companies 189 received Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants totaling \$326,139,269. These federal grant programs enable domestic small businesses to research new technologies and advance their commercialization.

Venture capital investment totaling \$9,812,978,018 was attracted by 268 active companies. All types of venture investment in all companies related to the University of California system—including those that are no longer operating—totaled \$16,352,978,679 since 1968.

The focus of these UC affiliated companies spanned a range of 12 industry sectors defined by the university's offices of technology transfer, with the medical therapeutics sector showing the highest concentration, followed by software and services, research tools, electronic systems and components, medical diagnostics, and medical devices. These leading categories of activity reflect the university's strong life sciences and medical programs, as well as the strength of its engineering, computer science, and chemistry departments. Other significant concentrations of activity were in communications, information technology and data processing; advanced materials; energy; agriculture; environmental services; and transportation.

Of the counted 1,267 companies affiliated with UC, 1,240—or 97.8%—were formed after 1980. Startup activity has been particularly strong in recent years, with 956—or 75.4%—of these UC-affiliated companies having been formed between 2000 and 2015. These companies contribute to California’s economy through the revenues they generate, the jobs they directly create, and the indirect and induced effects of their spending and their employees’ spending in other sectors of the economy.

To assess the impact of UC-related entrepreneurial activity on the California economy, data for 603 active UC-affiliated companies headquartered in California was analyzed using IMPLAN, an input-output system that models the effects of changes in economic activities, in order to predict the impacts on specific state, regional, or local economies. Of the 603 active companies, 447 have reported employment of 38,056. Through direct, indirect, and induced effects that result from their activity in the state, these companies support a total of 146,516 jobs and \$20.1 billion in economic value added to the California economy. An additional \$503.8 million in corporate taxes is paid to the federal government, and an additional \$88.1 million is paid to state and local governments in California. These figures are conservative, as data on employment and revenue is not publicly available for all of the companies.

Part Two: Catalyzing Innovation

Campus Initiatives

While there are many variants, UC initiatives to support entrepreneur-led startups largely fall into four categories: business plan competitions, entrepreneurial education and support, incubators and accelerators (which provide cost-effective lab or office space), and funding. These blocks of activity are not mutually exclusive and frequently overlap. For example, programs with large entrepreneurial education components can also sponsor business plan competitions or host accelerators. Some campuses also help to accelerate research at highly affordable rates by offering access to sophisticated research facilities and equipment (“user facilities”) that would be too expensive for startups to own independently.

UC’s campuses also connect to what can be termed “associated programs and facilities.” These incubators, accelerators or other programs are located off-campus and are not directly administered by UC but are symbiotically linked and exist in large part to leverage their proximity to a UC campus. This is one important way that the campuses serve as focal points of local and regional innovation ecosystems.

Every UC campus has programs or initiatives in one or all of the four major categories, as well as associated programs in the vicinity. Not surprisingly, the largest programs tend to be on campuses in major urban centers, where they benefit in some degree from their proximity to large business communities that serve as sources of mentors, investors, and customers. Campuses that are smaller, younger and not in major urban centers in most cases have less developed programs. However, some campuses such as Davis and Irvine that are not in large urban centers have successfully leveraged their resources and partnerships in the community to create dynamic and sophisticated programs.

Not all UC-associated startups have participated in formal support programs. While a few entrepreneurial initiatives date back to the 1980s, most—even on the large campuses—are more recent, having been launched within the last four years. For this reason, more time will be required to evaluate their success. All campuses, however, are increasing their focus on entrepreneurial support and are increasing their ties to surrounding communities through collaborative initiatives to enable locally-based startups.

Findings and Recommendations

While a university's primary purpose is not to create companies—that role rests with its graduates—UC's status as a research university and its public service role for the state point to a growing opportunity to leverage the research and academic resources of the university to support entrepreneurs and the companies they found.

To this end, community engagement must be a key part of a 21st century research university's DNA and deeply woven into its mission. There is a growing interest in starting new companies—from faculty and particularly from students. This cultural shift represents an opportunity for the state. Viewed from this perspective, the university's support for entrepreneurs and startups should be seen not as a shift away from traditional academics, but as an important way to amplify their impact.

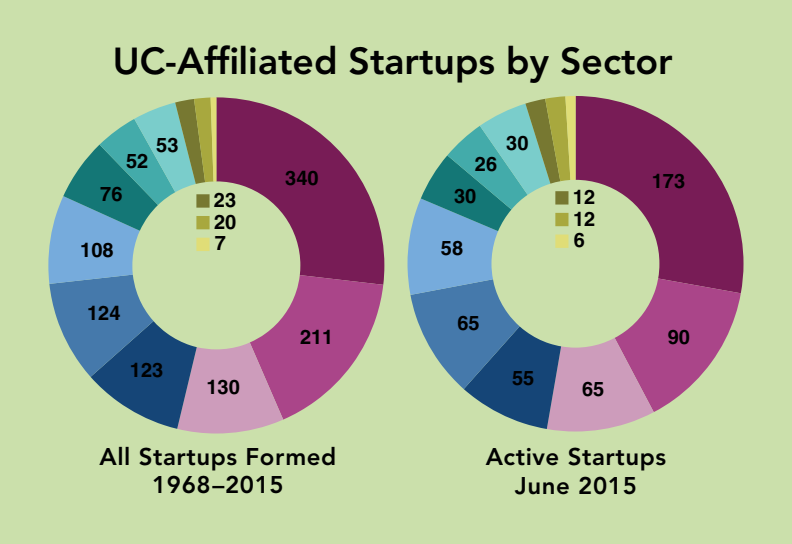
In Chapter 4, this report makes a number of recommendations for how the University's fast-developing initiatives to support technology commercialization and new company formation can be strengthened.

PART
One

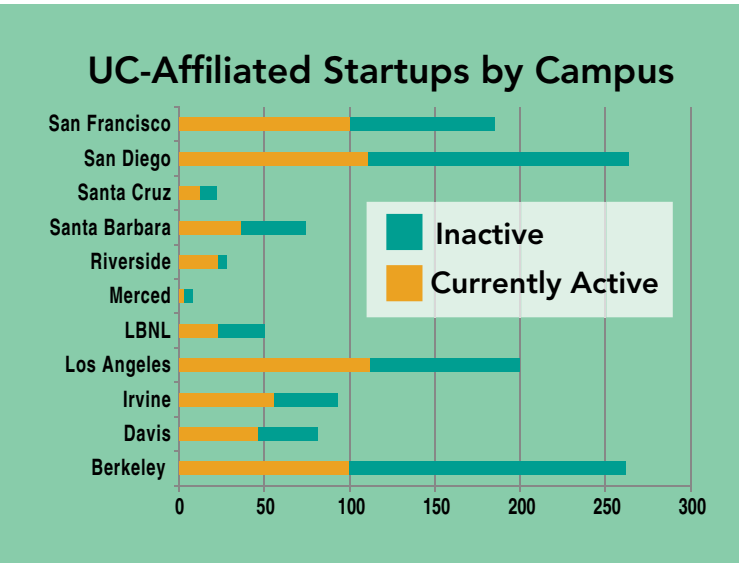


Locations of the Ten UC Campuses

Startup Activity and Its Impacts at a Glance

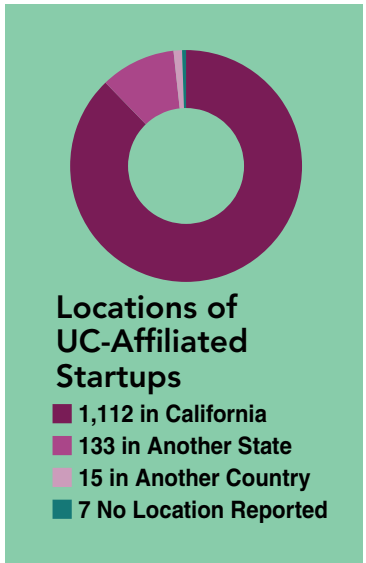


- Medical Therapeutics
- Software and Services
- Research Tools
- Electronic Systems and Components
- Medical Diagnostics
- Medical Devices
- Communication, Information, Data
- Advanced Materials
- Energy
- Agriculture
- Environmental Services
- Transportation



1,267
UC-Affiliated Startups Generated Between 1968 and June 2015

622
UC-Affiliated Startups Still Active in June 2015



<p>\$16.2 BILLION Recent Aggregate Revenue Reported for 440 Active UC-Affiliated Companies</p>	<p>38,832 Jobs in Active UC-Affiliated Companies</p>	<p>\$16.4 BILLION Venture Capital Investment Acquired by UC-Affiliated Companies Since 1968</p>	<p>\$20.1 BILLION Value Added to the State Economy by UC-Affiliated Startups Headquartered in California</p>
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Education, Innovation and the Economy

The University of California (UC) is widely regarded as the leading public university in the world, with 21,200 faculty and 251,700 students (52,600 graduate and 198,866 undergraduate) distributed across ten campuses. Since its founding in 1868, the university has served as a primary engine for the state's economy. In that time, it has generated a high proportion of California's business, community and scientific leaders, including 61 Nobel Prize winners. Their contributions advance technological development and the economy through inventions and scientific breakthroughs in fields ranging from biochemistry and genetics to game theory and the economics of information to particle physics.

The primary role of a university is the creation and transmission of knowledge to society. This takes place first and most importantly through students. In addition to producing graduates with bachelor's and master's degrees, the University of California is designated in the California Master Plan for Higher Education (1960) as the public institution in the state responsible for the granting of PhDs. The combination of a research mandate with graduate and undergraduate education has made the University of California a potent generator not only of fundamental scientific research, but also of technology with commercial applications and of business leaders who found companies, particularly in science, technology, engineering, and mathematics (STEM) fields.

With the growth of California's innovation economy and of technology-based industries as its leading edge, the measure of the university's contribution to society has expanded to include not just research and educated graduates but also new metrics such as business and job creation. While its essential role in producing educated citizens and leaders has not changed, expectations have grown that the university will engage its surrounding communities and measurably support the economy. While a university's primary purpose is not to create companies—that role rests with its graduates—UC's status as a research university and its public service role for the state point to a growing opportunity to leverage the research and academic resources of the university to support entrepreneurs and the companies they found.

"While the average worker may never be employed by Google or a high-tech startup, our jobs are increasingly supported by the wealth created by innovators."

—Enrico Moretti, Professor of Economics, UC Berkeley, and author of *The New Geography of Jobs*.

In a national and world economy where competitiveness is increasingly associated with the capacity to innovate, and where new companies can rapidly overtake sector leaders or create entirely new industries, supporting entrepreneurship matters. From an employment perspective, the benefits of entrepreneurial growth extend far beyond the companies themselves. For example, a study by the Bay Area Council Economic Institute found that high-tech companies (defined as companies employing a high proportion of workers in STEM-related fields) support high wages and are also an important source of secondary employment: each tech worker indirectly supports 4.3 non-tech jobs—far more, for example, than manufacturing’s already-high ratio of 1:4.

Reflecting this, the University of California, like many other public and private universities in the United States, has created an array of programs and facilities designed to nurture and support entrepreneurship among both students and faculty, with the goal of stimulating new off-campus jobs and businesses. While some of these activities began in the 1980s—when the passage of the Bayh-Dole Act allowed universities to retain title to innovations developed with federally funded research and encouraged them to pursue technology transfer—their number and diversity has grown dramatically in recent years. This reflects the growing focus on entrepreneurial activity in California and across the country, as companies that not long ago were startups have grown into giants like Facebook and Google, and as innovation has become a mandate for companies both large and small.

These developments also parallel a sharp decline in public funding for the University of California and growing pressure on the university to demonstrate its value to taxpayers and policymakers, not only in the long term as has happened in the past, but in the near term as well. UC’s expanding array of commercially-oriented programs and initiatives should therefore be viewed not in isolation, but as part of a diversified portfolio of research and educational programs that together help to support a competitive economy in California and its communities.

The growing focus on entrepreneurship within the UC system raises a number of questions that this report addresses, if not fully answers.

What should the role of the university be in supporting entrepreneurial activity, and how should that relate to its core educational mission?

What different models and programs are being used by UC and its partners to support entrepreneurs and new company formation?

What is the trajectory of this activity within the UC system?

What metrics are available to measure the effectiveness of startup and entrepreneurial support programs?

What role does UC play in local economic development through the stimulation of off-campus environments that are conducive to innovation?

Given that most of these programs and initiatives are comparatively new, in what ways should they grow in the future?

“As innovation and entrepreneurship becomes an even greater force in economic growth, U.S. universities and colleges will be the vanguard in discovering that innovation and in nurturing the entrepreneurs that can create products, services, economic value, and high-quality jobs.”

—US Department of Commerce, *The Innovative and Entrepreneurial University: Higher Education, Innovation & Entrepreneurship in Focus*, 2013.

Measuring Startup Generation and Its Impacts

Three metrics for measuring UC's actual or potential impact on the economy represent a value pipeline: inventions (which may or may not lead to licensed technologies), licenses (transactional impacts that potentially lead to commercial outcomes outside the system), and the formation of startups.

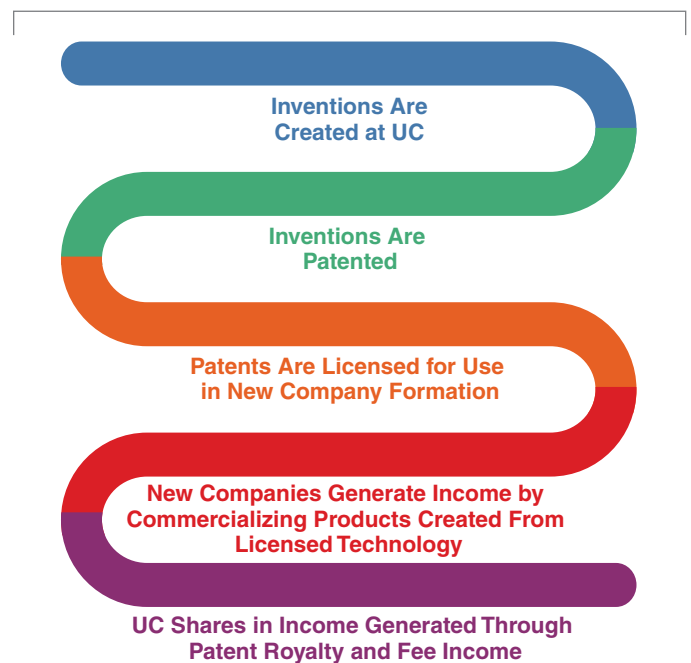
Though not the only measure, value is created for the university when licenses generate royalties, which result from the licensed technology producing income. Often, this means the license has been used in a commercialized product sold by a company. New company formation is also a critical measure of UC's economic impact and how the talent and technology developed on UC campuses flows into and supports the wider economy.

Inventions and Licenses

The University of California Office of the President reports that in its 2015 fiscal year (July 1–June 30) UC research was employed in the disclosure of 1,745 new inventions (bringing the total number of active inventions in the university's portfolio to 12,203); the filing of 1,756 US patent applications, and in 520 issued patents (for a total of 4,621 active US patents covering UC inventions); the issuing of 186 new licenses for utility inventions and 53 new licenses for food plant cultivars; the starting of 85 new companies that used UC inventions and licenses as a key aspect of their creation; and the generation of \$177 million in patent royalty and fee income for UC.

The intellectual property embedded in these inventions, patents and licenses is critical to the technology commercialization process through which research conducted on a campus flows into the hands of companies that can convert its underlying value into products for the commercial marketplace. These companies can be large or they can be startups—often led by UC-associated entrepreneurs who have been instrumental in creating the underlying technology.

Technology Licensing Economic Impact Value Pipeline



Startups

Startups are important because in the vast majority of cases they locate in California, usually close to the founding faculty member's campus or to the campus from which the founding entrepreneur/CEO graduated. They also tend to grow in the communities where they are founded, magnifying the importance of UC's campuses to long-term job and business growth in the regions where they are located. Because of this, each campus plays an important catalytic role in local economic development.

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The focus of these UC affiliated companies spanned a range of 12 industry sectors defined by the university's offices of technology transfer, with the medical therapeutics sector showing the highest concentration, followed by software and services, research tools, electronic systems and components, medical diagnostics, and medical devices. These leading categories of activity reflect the university's strong life sciences and medical programs, as well as the strength of its engineering, computer science, and chemistry departments. Other significant concentrations of activity were in communications, information technology and data processing; advanced materials; energy; agriculture; environmental services; and transportation.

Of the counted 1,267 companies affiliated with UC, 1,240—or 97.8%—were formed after 1980. Startup activity has been particularly strong in recent years, with 956—or 75.4%—of these UC-affiliated companies having been formed between 2000 and 2015. Of the 1,267 UC-affiliated companies tracked in this report, 622 were still active in June 2015, and 603 of those still active companies were headquartered in California.

Startup incubators related to the University of California have housed or are currently housing an additional 196 companies. Of the 102 of these companies that

have graduated from an incubator program, 76 remain active. (Incubators have housed a total of 283 startups, although to avoid double counting, some have been excluded here.)

The aggregate revenue reported for the 440 active companies for which information was available in each company's most recent fiscal year was \$16,170,859,930. Among the active companies 189 received Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants totaling \$326,139,269. These federal grant programs enable domestic small businesses to research new technologies and advance their commercialization.

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Economic Impacts

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PART
Two



A broad range of initiatives at the University of California's ten campuses—plus UC Hastings Law School, Lawrence Berkeley National Laboratory and Lawrence Livermore National Laboratory—are designed to support entrepreneurial development and startup formation, and through them stimulate economic activity in surrounding regions and communities.

Campus Initiatives: Catalyzing Innovation Communities

While there are many variants, UC initiatives to support entrepreneur-led startups largely fall into four categories: business plan competitions, entrepreneurial education and support, incubators and accelerators (which provide cost-effective lab or office space), and funding. These blocks of activity are not mutually exclusive and frequently overlap. For example, programs with large entrepreneurial education components can also sponsor business plan competitions or host accelerators. Some campuses also help to accelerate research at highly affordable rates by offering access to sophisticated research facilities and equipment (“user facilities”) that would be too expensive for startups to own independently.

In addition, UC’s campuses connect to what can be termed “associated programs and facilities.” These incubators, accelerators or other programs are located off-campus and are not directly administered by UC but are symbiotically linked and exist in large part to leverage their proximity to a UC campus. This is one important way that the campuses serve as the focal points of local and regional innovation ecosystems.

Every UC campus has programs or initiatives in one or all of the four major categories, as well as associated programs in the vicinity. Not surprisingly, the largest programs tend to be on campuses in major urban centers, where they benefit in some degree from their

proximity to large business communities that serve as sources of mentors, investors and customers. Campuses that are smaller, younger and not in major urban areas in most cases have less developed programs. However, some campuses such as Davis and Irvine that are not in large urban centers have successfully leveraged their resources and partnerships in the community to create dynamic and sophisticated programs.

Not all UC-associated startups have participated in formal support programs. While a few entrepreneurial initiatives such as UCSD CONNECT date back to the 1980s, most—even on large campuses—are more recent, having been launched within the last four years. For this reason, more time will be required to assess their success. All campuses, however, are increasing their focus on entrepreneurial development and support and are increasing their ties to surrounding communities through collaborative initiatives to enable locally-based startups.

This report examines these efforts on individual UC campuses and identifies major programs that are designed primarily to support entrepreneurial development and startup growth. Because these programs are constantly evolving and new ones are being created, this review is not comprehensive. It is indicative, however, of the range of activity in this field within the UC system.

System-Wide Support

University of California Office of the President

The University of California Office of the President (UCOP) plays a cross-campus catalytic and supporting role for the system's entrepreneurially-oriented programs, which are in most cases rooted in local campus initiatives.

UCOP, which is responsible for the oversight of the state-wide UC system, sets the rules for and oversees the legal and policy review of technology transfer and patenting. In recent years, the focus of its economy-facing activities has been expanded through initiatives designed to more broadly support innovation and entrepreneurial activity through technology commercialization.

Technology Transfer, Investment and Policy Services

At the system-wide level, support for innovation, entrepreneurship, and technology commercialization is distributed across four organizational units: Innovation Alliances and Services (IAS), UC Investments (Office of the Chief Investment Officer of the Regents), Research Policy Analysis and Coordination (RPAC), and the Office of General Counsel (OCG).

Innovation Alliances and Services (IAS) was originally established in 1978 as the UC Office of Technology Transfer to oversee the licensing process for all UC campuses. In 1990, when UCLA and UCSD established their own technology transfer offices, the University of California began decentralizing technology transfer operations; each campus now manages its own licensing and technology transfer activity. With that change, IAS has evolved to a broader role, supporting campuses as they build partnerships and collaborations with local and regional communities and with national and international corporations. It provides accounting services (including payment of attorney fees and distribution of inventor shares from licensing revenue) for nine campuses, patent prosecution services (including patent filing, sponsor reporting, and coordination with both internal and external legal counsel) for five campuses, equity approvals and management (in coordination with UC Investments), and information technology systems that support the campuses in managing technology commercialization activities.

UC Investments manages equity accepted through campus licensing transactions and through the pilot incubator-equity program. In both cases, equity is held in the name of the Regents of the University of California and any proceeds are returned to the campus. UC Investments is currently leading the effort to create a fund to invest in innovation opportunities emerging from the University.

Research Policy Analysis and Coordination (RPAC) develops and implements policy regarding all funded research at UC, including policies impacting patents, equity, and industry-university relationships.

Legal oversight of technology commercialization activities rests with an intellectual property group within the **Office of General Counsel**.

President's Innovation and Entrepreneurship Initiative

Announced in November 2013 by UC President Janet Napolitano, the Innovation and Entrepreneurship Initiative aims to leverage the scale and diversity of the UC campuses and affiliated national laboratories to build an innovative entrepreneurial culture across the system. Its key focal points include developing a stronger environment to stimulate innovative and creative research and structuring the UC system to more aggressively support entrepreneurs and investment in entrepreneurs. Instrumental in its conception was the experience of the Gray Davis Institutes for Science and Innovation, launched in 2000, which demonstrated the potential of the university to contribute to the state's economy through a strengthened innovation and entrepreneurship focus.

To support this initiative, in 2014 Napolitano created the Innovation Council—composed of technology experts, business leaders and venture capitalists from outside the university—to advise UCOP on issues relating to innovation, entrepreneurship and technology commercialization.

Most recently, in early 2016, legislation (AB 2664) was introduced to support innovation and entrepreneurship on all ten campuses through investment in infrastructure to identify, generate, and support entrepreneurs who will found new companies. At the same time, the Office of the President has created a new internal position—the Senior Vice President for Research Innovation and

Entrepreneurship (reporting directly to the president)—to provide integrated management and leadership for the initiative.

Taken together, these measures reflect a heightened commitment by the University of California as a system to prioritize technology commercialization and entrepreneurial support. They also suggest a new emphasis on the university's economic contribution to the state, going beyond its traditional research and academic functions.

“In short, it’s time to start exploring innovative new approaches to unleash the full potential of UC’s research activities. We need to speed the translation of ideas and inventions that are developed by UC faculty, researchers, and students into products and services that can help benefit all of society... This means streamlining our existing processes. It means supporting our researchers with graduate students and world-class facilities. It means removing the barriers that can slow the pace of tech transfer. And it means thinking about how we can invest in all elements of technology commercialization: patents, proof-of-concept, and early-stage investment in UC startups—everything that can help move our research into the market and into the world.”

—UC President Janet Napolitano, *Remarks to the Board of Regents*, November 2013.

primeUC

Launched in 2015 as part of the President’s Innovation and Entrepreneurship Initiative, primeUC is a competition for promising early-stage startups from across the UC system. For the first competition, which was hosted by QB3, \$300,000 in seed funding prize money was provided by primeUC’s initial industry partner, Johnson & Johnson Innovation. To qualify, participants were required to be life sciences companies; be founded by a UC faculty or staff member or a UC student, postdoctoral fellow, or alumnus; and have raised less than \$1 million in private funding. Twenty finalists from across the UC system, chosen out of more than 260 entries from the pharmaceutical, diagnostics, medical devices, and consumer health sectors, made pitches to a panel of 50 judges at the competition’s culminating event in December 2015. The grand prize winner received \$150,000, and three others received \$50,000 each. All four will also receive legal services valued at \$40,000 from the UC Hastings Startup Legal Garage. Although participation in the initial primeUC competition was limited to life sciences companies, if private sponsors from other industries can be identified, the competition scope may be expanded in the future.

Capitalizing on UC Innovation

In December 2015, UCOP committed up to \$250 million as a core investment in a new venture capital fund that will primarily invest in startups coming out of the University of California system. Funds will come from the university’s endowment, and will not use tuition or other state funds. UC Investments (Office of the Chief Investment Officer of the Regents) will also invest a total of \$25 million in other investment funds (Local Funds) being raised across the UC system, that target promising seed and early-stage companies coming out of the campuses. Criteria for those local funds will include investment of at least 70% of capital in UC startups, particularly companies at the angel and seed investment stages; attractive returns; \$1 million in capital raised independently; and the return of a portion of any profits to their campus.

Governor Gray Davis Institutes for Science and Innovation

The largest and most significant UC system-wide initiative is the Governor Gray Davis Institutes for Science and Innovation network, which was launched in 2000 (under the name California Institutes for Science and Innovation) by then-Governor Davis to promote interdisciplinary research, leverage the resources of the UC system, and increase UC's impact on the state's economy in strategic fields. In the original call for proposals, UC was asked to create three new world-class centers (a number later increased to four) to promote discoveries in basic research and educate new generations of scientists who can translate those discoveries into applications and innovations that lead to new industries, businesses and jobs in California. To be designated an Institute, participation by at least two campuses was required. The state initially contributed \$100,000,000 for buildings and facilities at each center, with a small increment allocated to operations, for \$400,000,000 total. A 2:1 match of non-state funds, primarily from industry and the federal government, was required to support research and operations.

Today there are four Governor Gray Davis Institutes for Science and Innovation: QB3 (California Institute for Quantitative Biosciences), CITRIS (Center for Information Technology Research in the Interest of Society), Calit2 (California Institute for Telecommunications and Information Technology), and CNSI (California NanoSystems Institute).

QB3

Driven by UC San Francisco, UC Berkeley, and UC Santa Cruz, QB3 (California Institute for Quantitative Biosciences) focuses on the convergence of information technology with life sciences, building on the biology departments of all three campuses, UCSF's medical program, UC Berkeley's engineering and physical sciences programs, and UC Santa Cruz's strength in computational biology. Launched in 2004, QB3 currently has 1,200 researchers and staff. Funding for research comes predominantly from the federal government, primarily the National Institutes of Health (NIH). Major focal points include diagnostics, synthetic biology, therapeutics, and translational medicine.

CITRIS

CITRIS (Center for Information Technology Research in the Interest of Society) focuses on the application of computer science and the development of societal-scale information systems to meet California's future social and economic needs. Participating UC campuses include Berkeley, Davis, Santa Cruz, and Merced, with Berkeley concentrating on health, energy, and the relationship of data to democracy; Davis on clean energy, healthcare, and sustainable cities; Santa Cruz on sustainable energy and computer networking applications; and Merced on solar energy, robotic systems, intelligent infrastructure, computer networking applications, and data and democracy.

Calit2

Calit2, a two-campus multidisciplinary research institute, combines academic expertise with industry experience to leverage leading-edge information technologies at the convergence of the Internet and wireless communications. Its participating campuses are UC Irvine and UC San Diego. Calit2@UCI provides access to state-of-the-art labs and easily configurable open space for faculty and students engaged in environmental, transportation, emergency management, healthcare, education, and entertainment-based projects. UC San Diego's Calit2 research center, the Qualcomm Institute, focuses on technologies that enable advances across multiple sectors and industries including wireless communications, photonics and cyberspace, as well as nanotechnology and micro-electro-mechanical systems (MEMS).

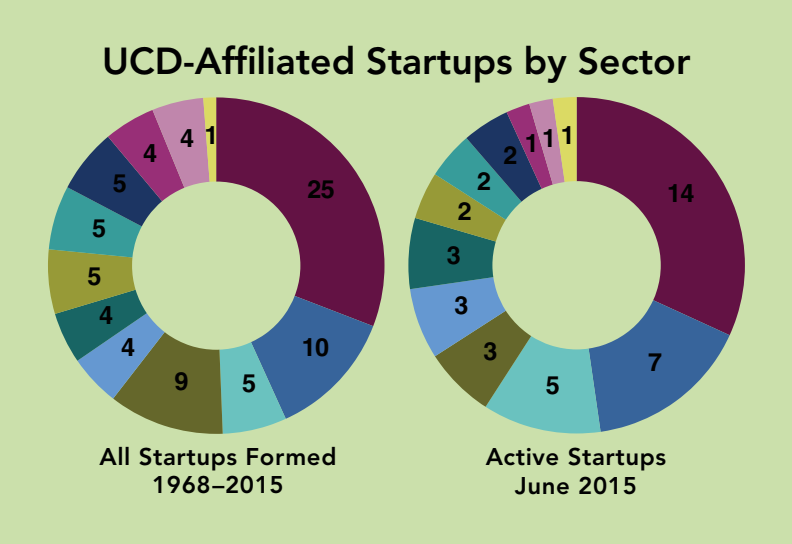
CNSI

CNSI (California NanoSystems Institute) focuses on industry collaboration to advance the commercialization of discoveries in nanotechnology and nanoscience. Areas of research include health and medicine, information technology, energy, and the environment, addressed through research on the control, manipulation and manufacture of materials at the nanometer scale. Its partner campuses are UCLA and UC Santa Barbara.

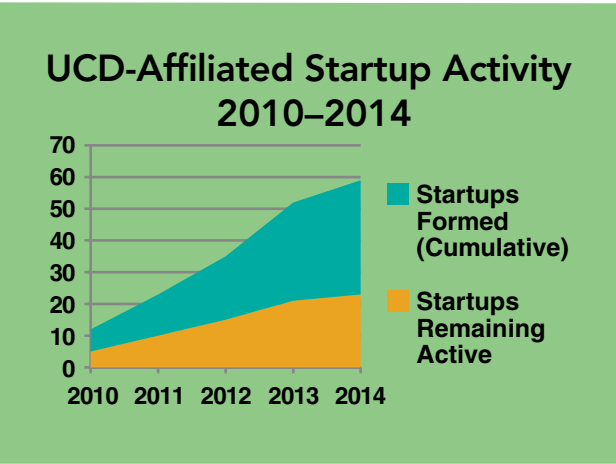
Locations of the Governor Gray Davis Institutes for Science and Innovation



UC Davis Startup Activity at a Glance



- Medical Therapeutics
- Medical Diagnostics
- Energy
- Agriculture
- Medical Devices
- Communication, Information, Data
- Environmental Services
- Advanced Materials
- Electronic Systems and Components
- Software and Services
- Research Tools
- Transportation



81 UCD-Affiliated Startups Generated Between 1968 and June 2015

44 UCD-Affiliated Startups Still Active in June 2015

30% Portion of UCD-Affiliated Startups Still Active in June 2015 That Have a Sustainability Focus

University of California, Davis

With a total enrollment of over 35,000 students, UC Davis (UCD) has become an important economic engine for Northern California. In the 2016 QS World University Rankings, UCD is the No. 1 university in veterinary science and holds the No. 2 rank in agriculture and forestry. Its College of Agricultural and Environmental Sciences plays a uniquely important role in supporting California’s agricultural sector, with activities ranging from

the breeding of new plant varieties to the development of novel food and nutritional technologies. The Davis campus is also home to a noted college of engineering and to schools of management and medicine. Thanks to its environmental, energy efficiency, and lighting centers, the university has also developed a reputation for innovative research in the energy sector. As the northern-most innovation anchor in the Bay Area/Northern California

mega-region, the campus supports a broad range of entrepreneurial activity in the greater Sacramento area and maintains strong links to the financial, legal, and entrepreneurial resources of the Bay Area. In fiscal year 2014–15, UC Davis received a total of \$786 million in extramural research funding—\$427 million from the federal government, \$110 million from the State of California, and \$249 million from other sources.

Technology Licensing

The **Office of Research** oversees technology licensing, industry collaboration and entrepreneurial support initiatives at UC Davis. Its Technology Management and Corporate Relations division handles the interface of research activity with on- and off-campus resources in three principal areas: the management of intellectual property (InnovationAccess), collaborative agreements with industry (Office of Corporate Relations), and startup activity (Venture Catalyst).

InnovationAccess is responsible for managing the technology licensing and patenting process, providing assistance to both faculty and non-faculty research employees. Since its formation in 2004, it has facilitated \$130 million in licensing revenue, through more than 902 licenses and 2,000 inventions, as well as more than 315 patents. It also manages 2,930 active contracts. In 2014, 42% of the technology disclosures filed on the Davis campus were in medicine and biotechnology; 23% in agriculture, food science and veterinary medicine; 19% in engineering and computing; and 16% in other disciplines. InnovationAccess works closely with Venture Catalyst on a number of programs including the **Inventor Advantage Program**, through which university inventors who found startups can defer up to \$15,000 in accrued costs related to patents that represent the foundation for their startups.

According to its Office of Research, UC Davis ranked among the top 5% of US universities in 2014 in the number of new startups it supports. Since its formation in 2004, InnovationAccess has helped launch 79 companies (60% of which are still active), which raised \$160 million in investment and created 220 jobs.

Entrepreneur Support

Business Plan Competition

The **Big Bang! Business Competition**, now in its 15th year, provides entrepreneurs in the UC Davis community with access to training, mentorship, networking and funding. Typically, over 60 teams enter the contest and more than 1,500 people attend its workshops and programs. The winning team in 2014, *Nevap*—a biomedical device company—received \$10,000 in support, which was parlayed into \$1 million in seed investment within six months.

Entrepreneurial Education and Support

The **Child Family Institute for Innovation and Entrepreneurship**, based at the Graduate School of Management, works across the Davis campus to accelerate technology commercialization. Its focus is upstream—helping researchers and early stage entrepreneurs to understand the commercial potential of their work and build entrepreneurial networks. The Institute started with the proposition that the campus has strong technical people without a business background, while people at its business school lacked technical background, suggesting the need for a more connected innovation ecosystem. Its programs, which are coordinated with the Office of Research, include the annual Big Bang! Business Competition, the Entrepreneurship Academy, Angels on Campus, the Ignite Conference, and the Business Development Fellows and Keller Pathways Fellows programs. Since 2006, the Institute has supported more than 1,200 researchers and academics, and has enabled the launch of more than 50 companies that have to date attracted nearly \$200 million in investment.

The **Entrepreneurship Academy** is a three day, intensive (12–14 hour per day) educational program for entrepreneurs and innovators taught by faculty, investors and industry partners, directed toward turning research into marketable products. Each academy may involve as many as 70 presenters and mentors for approximately 50 participants. Cross-disciplinary in nature, academies include the Biomedical and Engineering Entrepreneurship Academy (unique in its co-sponsorship by the College of Biological Sciences, the School of Medicine,

the School of Veterinary Medicine, the Biomedical Engineering Department, and the Office of Research), the Ag Innovation Entrepreneurship Academy (supported by the UC Davis World Food Center and AgStart and designed around entrepreneurs in food- and agriculture-related fields), the National Labs Entrepreneurship Academy (focused on the commercialization of science and engineering innovation coming out of Lawrence Livermore and Sandia National Laboratories), and the UC Entrepreneurship Academy (focused broadly on science and engineering technology commercialization).

Launched in mid 2013, **Venture Catalyst**, a companion unit to InnovationAccess within the Technology Management and Corporate Relations division of the Office of Research, provides enabling services and resources that support university-based entrepreneurs across all disciplines. Its principal vehicle is the **Smart Toolkit for Accelerated Research Translation (START™)** suite of services and programs, which offers campus startups access to legal, banking, market research, mentoring, and pitch coaching services, among other entrepreneurial resources. One example is the Venture Catalyst **SBIR Workshop**, which helps participants file SBIR applications and is open to campus and general public participants with co-promotion by the Institute for Innovation & Entrepreneurship, the UC Davis-HM.CLAUSE Innovation Center, the Davis Roots business accelerator, and the regional AgStart and MedStart programs. A new addition to the Venture Catalyst offerings, announced in 2016, is the Chancellor's Innovation Awards, which recognize faculty, community partners and industry leaders for their success in developing new technologies, social platforms or other innovations based on university research and academic endeavors. Awards categories include Innovator of the Year (which offers up to two \$10,000 cash prizes), Community Partner, and a Lifetime Achievement Award.

Incubators and Accelerators

Venture Catalyst START also offers the **DRIVE™ (Distributed Research Incubation & Venture Engine) Program**, which supports inventors with business incubation through a distributed network of thematically oriented facilities both on and off-campus. The **UC Davis-HM.CLAUSE Life Science Innovation Center**,

located in South Davis, is its first off-campus company-sponsored incubator, combining the resources of the university with those of seed specialist company HM.CLAUSE. Residents have access to wet laboratory, office and contiguous greenhouse spaces, suitable for biotech, medtech and agtech startups, as well as support services from Venture Catalyst. The Innovation Center housed four companies in 2015.

The DRIVE™ Network also includes **Area 52** and **Hacker Lab**, which offer prototyping, machining, computing, and co-working space for startups. Area 52, opening in late 2016, will be the second off-campus facility in the DRIVE network. A collaboration with Sierra Energy, Area 52 will focus on advanced manufacturing, with an emphasis on medical devices, agricultural technology, alternative energy, robotics, and aerospace. Residents will have access to office space, a machine shop, a composites shop and wet labs, with tools to enable the more rapid development of products so that startups in those sectors can reach an investable stage faster. Both university and local entrepreneurs will be able to rent office/lab space, or purchase memberships that give them access to the workshops.

Another facility, the **Engineering Translation Technology Center (ETTC)** is associated with the College of Engineering, and plans are underway for an additional off-campus incubator in Sacramento in close proximity to the UC Davis schools of medicine and nursing. The strategy in developing these centers is to stay close to industry and to market supply and demand through small modular incubators with maximum flexibility.

Funding

STAIR™ (Science Translation and Innovative Research) Grants, a program initiated in 2014, provides proof-of-concept funding for technologies with commercial potential. The goal is to support translational science and innovative research, for example by helping to create a prototype, by moving the research process from a small to a large animal model, or by otherwise demonstrating commercial feasibility of cutting edge technologies developed by campus researchers. This process helps determine whether a technology could serve as the basis for a viable startup. Finalists (fourteen

in 2015) are assigned volunteer industry advisers, who help sharpen their ideas and deepen their understanding of the commercialization process. For the winners of the competition, \$250,000 is available for year-long awards of up to \$50,000.

The **Angels on Campus** mentoring program lets entrepreneurs meet with angel investors to pitch their ideas and receive feedback on their potential for commercialization in a risk-free environment.

UC Davis Faculty Members Bring Discoveries to Market

SAGE Therapeutics, which develops therapies to treat rare central nervous system disorders, was founded in 2010, based on research driven by Professor Mike Rogawski, and concluded a foundational IP license agreement in 2015. SAGE did an IPO in 2014, and currently has a market capitalization of \$1.5 billion.

RF Biocidics, a manufacturer of radio frequency equipment for the treatment of food to eliminate pathogens, pests, and fungi, was founded in 2008 by Professor Manuel Lagunas-Solar. Headquartered in West Sacramento, it has received approximately \$10 million in equity financing to date.

Governor Gray Davis Institutes for Science and Innovation

The UC Davis participation in CITRIS (Center for Information Technology Research in the Interest of Society) focuses principally on clean energy, efficient cities, and access to clean water and healthcare for rural communities. Entrepreneurs at Davis have access to the CITRIS Foundry based at UC Berkeley, where they can access design, manufacturing and business tools for launching startups at the intersection of hardware, software, and services.

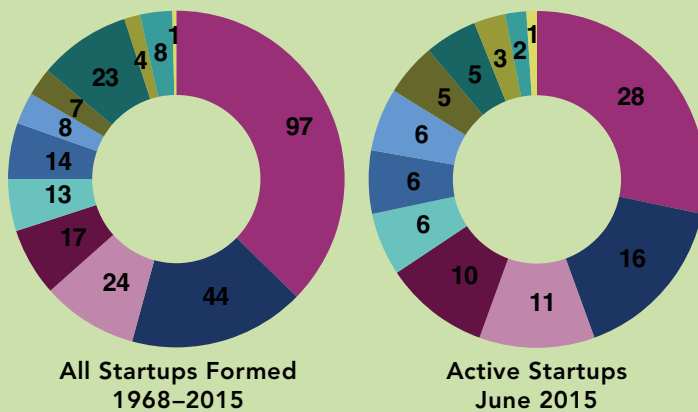
Associated Programs and Facilities

UC Davis seeks to nurture a thriving innovation ecosystem that fosters entrepreneurial activity in the Sacramento-Davis region, including through cooperation with facilities not under UC management. An example is **Davis Roots**, a nonprofit accelerator that leverages the talent from the university. Every nine months, Davis Roots accepts 4–5 startups for its mentorship program, which helps the companies prepare a nine-month strategy, including product and launch goals. Once the strategy is developed, participants have access to office space for designated periods. Supported by the City of Davis, Capital Corridor Ventures, Amazon Web Services, and Five Star Bank, services are provided to startups in exchange for a small share of equity.

UC Davis also provides sponsorship support to other regional initiatives such as **AgStart**, which supports food and agtech entrepreneurs, and **MedStart**, which focuses on medical technology and devices. AgStart provides co-working space, mentors, business services, and events, for fees ranging from \$100–\$500 per year, and offers incubator space for \$200 per month. MedStart provides access to investors, law firms, hospitals, and technology and healthcare experts, with support in areas such as business planning, go-to-market strategies, and regulatory compliance. Participants also have access to a network of collaborative and co-working spaces in the greater Sacramento region, including wet lab and general laboratory space.

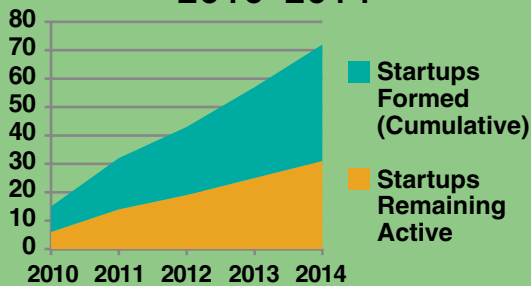
UC Berkeley Startup Activity at a Glance

UCB-Affiliated Startups by Sector



- Software and Services
- Electronic Systems and Components
- Research Tools
- Medical Therapeutics
- Energy
- Medical Diagnostics
- Medical Devices
- Agriculture
- Communication, Information, Data
- Environmental Services
- Advanced Materials
- Transportation

UCB-Affiliated Startup Activity 2010-2014



260 UCB-Affiliated Startups Generated Between 1968 and June 2015

99 UCB-Affiliated Startups Still Active in June 2015

49% Portion of UCB-Affiliated Startups Still Active in June 2015 That Have an Information Technology Focus

University of California, Berkeley

Established in 1868, Berkeley was the first campus in the UC system. Located in the San Francisco Bay Area adjacent to the dynamic technology and life sciences centers of Silicon Valley, San Francisco, and the East Bay, UC Berkeley (UCB) is a major research center. Its system for supporting technology commercialization is one of the most developed in the UC system. The campus is home to an active, entrepreneurial faculty

with over 60 current faculty members who have started one or more companies.

In the 2014-2015 fiscal year, UCB received research funding totaling \$691.1 million—\$378.2 million from federal funds, \$107.2 million in state and other government funds, \$138.1 million from nonprofits, \$41.6 million from private industry, and \$26 million from the University of California.

Technology Licensing

Berkeley's technology licensing programs are led by the Office of the Vice Chancellor for Research. Its **Office of Intellectual Property & Industry Research Alliances** (IPIRA) focuses on "technology push" (strategies where faculty-developed patents are offered to industry), as well as "technology pull" (strategies to move Berkeley technologies closer to the market by attracting private companies through industry partnerships.) In fiscal year 2014, ten companies were founded based on UC Berkeley-licensed IP.

Over 17 industry affiliate programs have been established by UC Berkeley to help companies stay abreast of cutting-edge academic research and scout for talent. Companies, such as Intel (which has multiple campus relationships), BASF, Apple, and Google serve on industrial advisory boards and support basic research in response to university-issued requests for funding. Industry-sponsored research is academic, peer reviewed and published, but closer to the market and to commercial applications than research originating purely through federal grants. These programs also help Berkeley stay relevant to companies in its innovation ecosystem.

Research centers and institutes, also known as organized research units (ORUs) are another partnership structure through which research is undertaken at UC Berkeley. UCB multidisciplinary research institutes that are supported primarily with corporate funding include the Energy Biosciences Institute, the California Research Alliance, the Immunotherapeutics and Vaccine Research Initiative, and the Innovative Genomics Initiative (which was primarily established with gift funding).

Entrepreneur Support

Business Plan Competitions

Berkeley hosts a number of business plan competitions, including **Big Ideas@Berkeley**, run by the Blum Center for Developing Economies, where interdisciplinary teams in nine categories compete to receive up to \$10,000 in grant funding.

Part of the Haas School of Business, the **Berkeley-Haas Entrepreneurship Program** (formerly the Lester

Center for Entrepreneurship) provides on-campus entrepreneurial training and support, primarily for business students. The Program hosts three competitions: **LAUNCH** (startup accelerator competition), the **Global Social Venture Competition**, and the **Venture Capital Investment Competition**. LAUNCH, for example, is a multi-stage startup accelerator competition in which accepted competitor teams are paired with serial-entrepreneur mentors and are led through a rigorous curriculum ranging from scalable business model design to startup law to networking and pitching investors. At the culmination of the three-month-long accelerator phase, the teams compete for prize money: \$50,000 was awarded to finalists in 2015, with the winning team receiving \$25,000.

Entrepreneurial Education and Support

Through the Haas School of Business, UC Berkeley is a collaborator (along with UCSF and Stanford) in the **Bay Area NSF Innovation Corps** (the Bay Area regional National Science Foundation-sponsored I-Corps node), which offers a curriculum-focused bootcamp program that engages participants in moving products out of the lab and into the market. Haas is also a co-founder with the School of Engineering and the Office of the Vice Chancellor for Research of the campus startup accelerator SkyDeck, and is planning to build further connections with Berkeley's School of Information and School of Law.

Alphabet Energy

One example of a successful Berkeley-Haas alumnus is *Alphabet Energy*, a company founded in 2009 whose thermodynamic material turns waste heat from exhaust into electricity, providing a platform for waste heat recovery products. Founded by Matthew Scullin, Adam Lorimer, and Peidong Yang, Alphabet Energy has received nearly \$2 million in research funding from the US Department of Energy, the US Army and the US Air Force, and has raised over \$30 million in funding from venture and other investors.

The engineering school's **Pantas and Ting Sutardja Center for Entrepreneurship & Technology** (SCET), a ten-year-old institution associated with the College of Engineering, is focused on the study and practice of "technology-centric" entrepreneurship and innovation. The Sutardja Center is broadly organized on the model of an "innovation collider" that brings together industry, academia, students, investors and entrepreneurs in a learning environment to "collide" and create ventures, solutions, and research-driven commercialization. Built from a single course in 2005 into a program of courses and lectures that now serves more than 1,000 students each semester, the Center has fostered dozens of successful startups. SCET's offerings include

the **Berkeley Method of Entrepreneurship Bootcamp**, a class that helps students acquire fundamental skills in new venture creation;

the **A. Richard Newton Distinguished Innovator Lecture Series**, which brings accomplished individuals from successful companies such as Google, Yahoo! and Facebook to tell the unique stories of their journeys through the innovation cycle;

the **Challenge Lab Course**, an industry-focused course on technology innovation, designed to provide an enabling environment for undergraduate startups to form teams and develop ideas;

Collider Projects, a research-centric program open to all Berkeley researchers and students in advanced studies, through which successful teams win cash prizes from partner companies to help develop their ideas or are eligible to participate in campus incubators such as SkyDeck or Venture Lab;

the **Venture Lab**, an incubator that helps Berkeley participants to launch startup companies in a real world setting through faculty-led guidance in business model development and identification of early-stage financing and by providing access to the SCET network of mentors; and

the **Delta Prize**, which provides a 2.5-month mentoring program for 3–5 finalist teams, culminating in the awarding of \$15,000 annually to the top 2 or 3 teams that have shown the most progress with their ideas.

Through the **Global Innovation Collider Program**, SCET brings academics and innovators from around the world to Berkeley to learn the Berkeley Method of Entrepreneurship. It also connects with industry through the Engineering Leadership Professional Program (ELPP), a four-month MBA-alternative for mid- to upper-level technology managers in market-leading firms. Among others, corporate partners include Google, Cisco, Yahoo! and Samsung.

The **Jacobs Institute for Design Innovation**, which opened in August 2015 at the School of Engineering's Jacobs Hall, provides resources for projects that are at the intersection of technology and design. The institute provides collaborative spaces for students, teachers, and practitioners in diverse fields in order to encourage innovation. Jacobs Hall can accommodate more than 500 students in its studios, which function as classrooms for over 20 courses and lab spaces for independent makers affiliated with UC Berkeley. Current student projects include an energy harnessing rocking chair (*Volta*), a digitized stethoscope (*Eko Devices*), and a walking tool for the elderly that changes shape in tight spaces (*Ninja Walker*).

Established in 2010, **BPEP** (the Berkeley Postdoctoral Entrepreneurship Program) provides members of Berkeley's post-doctoral community with entrepreneurship support and hosts professional development workshops. It was founded by postdoc Naresh Sunkara in collaboration with an advisory board of faculty members from UC Berkeley, QB3, and the Berkeley-Haas Entrepreneurship Program.

In the fall of 2015, Berkeley's law school saw the launch of the **Berkeley IP Lab**, a program patterned after the Legal Garage already operating at UC Hastings and designed to help biotechnology startups manage intellectual property issues. In its initial semester, eleven law students first participated in a seminar course on intellectual property law, after which the student cohort was paired with a similar number of biotechnology startups in a practice project led by the head of law firm Wilson Sonsini Goodrich & Rosati's patents and innovation counseling practice. In subsequent semesters the program will be expanded to include other types of technology startups. IPIRA and Berkeley's SkyDeck

accelerator helped launch the program, assisting with the recruitment of supervising lawyers from other law firms and of startups for the practice project.

Another experiential learning initiative sponsored by the law school is **Startup@BerkeleyLaw**. A collaboration between the Berkeley Center for the Law, Business and the Economy (BCLBE) and the Berkeley Center for Law and Technology (BCLT), the program supports law students with an interest in the legal issues surrounding entrepreneurship and provides legal education and services for the Berkeley startup community at large. One of the key components of Startup@BerkeleyLaw is the New Business Practicum (originally established in 2007), which brings law and Haas School of Business students together in teams to advise entrepreneurs on the non-IP-related legal issues involved in starting a business, including managing risks and establishing key relationships with workers, investors and consumers.

Cleantech to Market (C2M) is a one-semester program of the Energy Institute at Haas that provides commercialization support for cleantech technology teams seeking to explore and develop market opportunities. Begun as a student-led initiative at Lawrence Berkeley National Laboratory and now in its eighth year as a campus initiative, C2M is supported by Wells Fargo, Goldman Sachs, PG&E, Dow Chemical, Saratoga Energy, and Wilson Sonsini Goodrich & Rosati, and its graduate teams have collaborated with more than 100 researchers and entrepreneurs from Berkeley, Caltech, Stanford, Lawrence Berkeley National Laboratory, and Berkeley Lab's Cyclotron Road accelerator program. The program starts with technology applications and selection (January–March), followed by team formation (April–July), and technology assessment, market exploration, and the public and private presentation of findings and recommendations (August–December). Each year, 40–50 cross-disciplinary teams are selected from over 20 Berkeley graduate programs, and they receive more than 1,000 hours of support from professionals with deep expertise in areas such as company formation, funding, and licensing. The program culminates in an in-depth market report for each project, a public symposium, and the development of presentation materials often used in seeking funding. Recent C2M successes include *Imprint Energy*, which secured

\$6 million in Series A funding; *Building Robotics*, which received \$1.4 million in funding from Google Ventures; and *Cinder Bio*, which was awarded \$20,000 in the US Department of Energy's "First Look Out West" (FLoW) startup competition. Follow-on funding for C2M projects and alumni exceeds \$100 million.

The **Bio-Manufacturing to Market** program provides hands-on experiences in which UC Berkeley science and engineering undergraduates as well as students from Laney Community College collaborate with startup, medium, and large-sized companies in the East Bay. Over the past three years, the program has involved more than 70 university and community college students in collaborative projects with local industry clients in a broad range of sectors including bio-manufacturing and bio-medical device design. Projects have varied from chip fabrication for the single-cell Western blotting system, to the manufacture of microfluidic devices for early stage cancer detection, to analyzing the market potential for biogas technology across the United States. Several Bio-Manufacturing to Market student participants have been hired as permanent, full-time staff by their respective industry collaborators. Linking UC Berkeley with a local community college and with local startups and bio-manufacturing companies has helped create a talent pipeline that is developing and scaling technologies for advanced manufacturing sectors in the Bay Area.

The Bio-Manufacturing to Market program is a member of the San Francisco Bay Area Biomedical Manufacturing Network and is part of the US Advanced Manufacturing Jobs and Innovation Accelerator Challenge grant, which is funded by the US Departments of Commerce, Energy and Labor, the US Small Business Administration, and the National Institute of Standards and Technology (NIST).

UC Berkeley is one of the founding members of the **Biomedical Manufacturing Network**, which was formed after winning the Challenge grant in 2013. The Network, which works to support biomedical entrepreneurship, manufacturing, and commercialization, is convened by a partnership of regional entities that also includes Laney College, the Workforce Development Board of Contra Costa County, and the federally-funded Tech Futures Group—which has a special initiative to give

small biotech companies access to specialist advisers in intellectual property, fundraising, financial planning and projections, and federal grants. Among other achievements, the Network has provided manufacturing and business services to more than 100 biomedical companies, has organized 25 biomedical meet-ups and technical workshops/summits, and has developed a database of over 1,000 university and federal lab technologies available for transfer to companies.

New plans at the UC Berkeley campus call for the conversion of the 100,000 square foot former Berkeley Art Museum into the **Idea Lair**, an undergraduate entrepreneurship center and technology showcase with modular space. The proposal has been approved, but it is estimated that \$30 million will be needed to seismically upgrade the building.

Incubators and Accelerators

SkyDeck, UC Berkeley's first startup accelerator, is located in a 10,000 square foot space in downtown Berkeley. Startups that have moved beyond the idea stage to achieve a basic level of organizational traction receive office space, mentoring and \$2,000 in funding for six months (renewable for another six), with the goal of attracting private investment and achieving an accelerated path to market. Fifty-five advisers currently support twenty startup teams, each with a lead adviser. Of its current startup founders, 98% are Berkeley graduates.

SkyDeck began with operating funds from the office of the Vice Chancellor for Research, the School of Engineering, and the Haas School of Business, with additional funding contributed more recently by the Office of the Chancellor. Other support comes from corporate partners such as Ericsson, OSIsoft, Midea Group, Venable LLP, Analog Partners, and Wilson Sonsini Goodrich & Rosati, who are seeking a closer relationship with university startups. SkyDeck also has informal collaborative ties with Lawrence Berkeley National Laboratory's Cyclotron Road incubator and with QB3.

Future plans call for a SkyDeck investment fund, "Sky-Fund," which will support startups as they are accepted into the program and with follow-on funding rounds

before or after they graduate. Further diversifying the range of companies SkyDeck supports, a new program called "SkyLab" will assist early innovators in the pre-incubation ideation stage through access to contacts and resources. SkyLab participants will be able to take part in SkyDeck programs even if they're not in residence. SkyDeck is also discussing with the City of Berkeley the possible creation of a Berkeley Entrepreneurial Expo and a Berkeley Entrepreneurial Summit.

Recent SkyDeck residents span a range of disciplines, from medical devices for the treatment of neurological diseases (*Cortera*), to data analytics used in agriculture (*FarmX*), 3D printing (*Kudo 3D*), technologies connecting neuroscience and machine learning (*mentl.io*), cancer diagnostics (*Nodexus*), and cloud robotics (*Symbio Robotics*). The facility currently hosts 20 teams, each with a lead adviser. Resident teams have attracted over \$93,000,000 in investment and have produced an estimated 650 jobs. Seven founders appear on a Forbes "30 under 30" list. Of the 70 startup teams SkyDeck has supported since its founding, all but eight are still in business.

Funding

Bakar Fellows, a program under the Office of the Vice Chancellor of Research, was created in 2010 with a gift to the university for the support of entrepreneurship on campus. Originally envisioned to provide support to early-career faculty whose research shows commercial promise, the program opened up to all faculty entrepreneurs in 2016. Each year, five fellows are selected by a committee of faculty entrepreneurs and industry advisers who evaluate the feasibility and potential impact of technologies. Winners may be supported for up to five years. Twenty-one active fellows from science, engineering, architecture, computer science and life sciences are currently receiving translational research support for both early-stage startups and technology licensing activities. Five have formed companies, some of which participate in other campus incubators like CITRIS Foundry or SkyDeck. As of early 2016, Bakar Fellows have formed startup companies generating more than \$200 million in outside investments.

Bakar Fellows Translate Discoveries Into Practical Solutions

Four startups formed by Bakar Fellows exemplify the range of technologies the program supports.

Founded in 2013 by two fellows, Michel Maharbiz and Jose Carmena, *Cortera Neurotechnologies* designs medical devices aimed at revolutionizing the treatment of incurable neurological conditions. It is currently collaborating with Lawrence Livermore National Laboratory, UC Berkeley, UCSF, Cornell University, New York University, and Medtronic on a Defense Advance Research Projects Agency (DARPA) grant to develop an implantable neural interface with the ability to record and stimulate neurons in the brain, for use in the treatment of neuropsychiatric disorders such as Post-Traumatic Stress Disorder (PTSD), traumatic brain injury, and chronic pain.

Emerging Objects, founded by Associate Professor of Architecture and Bakar Fellow Ron Rael, designs 3D printed materials, some at unprecedented sizes including full-scale architectural applications, and has a focus on sustainability and recycled materials. For example, its "cool brick" masonry system comprised of 3D-printed ceramic blocks can be used to build walls that passively cool interiors in desert climates through the process in which water held in the micropores of the ceramic evaporates, bringing cool air into an interior environment.

Founded by Associate professor of Engineering and Bakar Fellow Lydia Sohn, *Nurix* is commercializing a Protein Regulation Platform that can enable therapies for cancer, inflammatory diseases, and immune disorders. In February 2013, the company was awarded a \$300,000 SBIR grant from the Department of Health and Human Services. By May 2014, the company had raised \$25 million in venture capital. Two high profile partnerships with biotechnology companies led to a \$150 million deal with Celgene in September 2015.

Zephrus Biosciences, co-founded by Kelly Gardner and bioengineering professor Bakar Fellow Amy Herr, provides tools that enable protein analysis at the single cell level, permitting new insights into the biology of cancer, stem cells, neurology, and human disease. Supported by Berkeley incubators QB3 and SkyDeck, in 2014 it was awarded a \$350,000 SBIR grant by the Department of Health and Human Services, and it has received \$1.9 million in seed funding from Life Sciences Angels, The Angel Forum, the Stanford StartX Fund, and Mission Bay Capital, to support development of its scWestern system for protein analysis. The company was acquired by Bio-Techne Corporation in March 2016.

Another initiative established with philanthropic support is the **Signatures Innovation Fellows Program**, which supports innovative research by UC Berkeley faculty and researchers in the data science and software fields, with a special focus on projects that hold commercial promise. Inaugurated in spring 2015, the program currently supports two Fellows, Alexei Pozdnukhov, whose project focuses on urban mobility analytics, and Jasjeet Sekhon, who is working to improve tools for public opinion research.

Governor Gray Davis Institutes for Science and Innovation

UC Berkeley participates in both CITRIS (the Center for Information Technology Research in the Interest of Society) and QB3 (the California Institute for Quantitative Biosciences).

UC Berkeley's Sutardja Dai Hall is the physical home of the **CITRIS Foundry**, an applied tech incubator that provides residents with work space, equipment, computer time, mentoring and a small amount of financial support—typically \$5,000, in exchange for 2% equity pre-evaluation, or a negotiated percentage if the company has an established valuation. Residents also have access to the Invention Lab, a rapid prototyping facility for hardware companies, and may be introduced to angel and venture investors. Operating support for the Foundry comes primarily from CITRIS but is augmented by a small amount of corporate funding.

Since CITRIS Foundry's launch in 2013, twenty-three companies have been incubated, twenty-one of which are still active. In that period, the number of companies accepted each year has grown from five to ten. Most are focused on IT hardware or software, but some also work on health or education. Participants, who are all early-stage companies but are required to have well-developed teams and basic skills, are admitted in two selection rounds per year in which 40–50 candidates compete. All are expected to form multidisciplinary teams of at least three persons and to incorporate. Applicants are primarily students, with eligibility from across the four CITRIS campuses (Berkeley, Davis, Merced and Santa Cruz), but due to its hands-on,

customized program, all its companies are required to be in residence at Berkeley. However, CITRIS Foundry is looking for ways to extend its services through facilities and mentors at the other campuses.

QB3 has two incubators in Berkeley: **Garage@Berkeley** is located on-campus at Stanley Hall, and the **East Bay Innovation Center** is located off-campus in West Berkeley. The Stanley Hall facility, with 800 square feet and eight lab benches, currently hosts six companies led primarily by post-doctoral students or recent graduates. Space is limited to 3–4 people for each team, and residents stay 2–3 years; those that grow can move on to the East Bay Innovation Center, which provides wet lab space for more advanced companies.

Caribou Biosciences

Launched at Berkeley by Jennifer Doudna and CEO Rachel Haurwitz, *Caribou Biosciences* is at the forefront of gene splicing, a field with wide ranging impacts from the treatment of blood disorders and cancer to anti-bacterial therapies and treatments for household pets. Caribou was incorporated with the help of QB3 Startup in a Box and QB3's venture fund is an investor.

With a business model that includes both partnerships with larger firms and the spinning off of new ones, Caribou is currently commercializing the CRISPR gene-editing technology in Berkeley space leased from QB3 partner Wareham Development. Its list of industrial partners includes Dupont and drug giant Novartis, with the Novartis partnership having led to the spinoff of Intellia Therapeutics, a company focused on using the CRISPR/Cas9 system to develop curative treatments for genetic diseases. In May of 2016, Caribou announced a new partnership allowing the use of the CRISPR-Cas9 gene editing technology platform by animal genetics company Genus. Caribou received \$11.5 million in Series A funding from firms including Novartis, Mission Bay Capital, Fidelity Biosciences, 5 Prime ventures, and a syndicate of angel investors, and the company announced a \$30 million Series B round in May 2016.

Associated Programs and Facilities

The **Berkeley Startup Cluster**, a collaboration of UC Berkeley with the City of Berkeley, the Downtown Berkeley Association, and the Berkeley Chamber of Commerce, helps startups affiliated with the Berkeley campus and Lawrence Berkeley National Laboratory find resources that will enable them to grow in the local community. Offerings include events, help in recruiting local employees, and assistance with finding commercial or co-working space located near the campus.

Creative, independently-run student entrepreneur programs are also supplementing official university programs.

The **Design Engineering Collaborative** (DEC), a student-run organization founded by ten undergraduates, mostly from the College of Engineering, provides student entrepreneurs with a small on-campus workspace (several hundred square feet) and community support to develop and prototype ideas.

Free Ventures was founded by in 2013 four undergraduate students—Cameron Baradar, Sam Kirschner, Kirtan Upadhyaya and Jeremy Fiance—as a student-run accelerator that provides mentors (primarily alumni and investors) and several thousand dollars in support where necessary (which goes primarily to hardware startups). Free Ventures does not take equity. Applications open each semester, with successful applicants participating in an intensive ten-week cycle of activity. For applicants that do not gain entrance to the ten-week program, there is a second level of support through a scaled-down incubator offering a two-hour-per-week program and several hundred dollars in support. To date, the program has supported 25 students who have raised more than \$25 million in venture funding in the last two years.

Free Ventures was followed in 2014 by **Cal Hacks**, a student-organized “build anything” 48–72 hour hackathon. In its first year, Cal Hacks had a \$250,000 budget, raised by students from private sponsors, with in-kind support from CITRIS. An expanding area of activity, student-led hackathons were organized at nine UC campuses in 2015 and are now connected systemwide through the **UC Hack Alliance**.

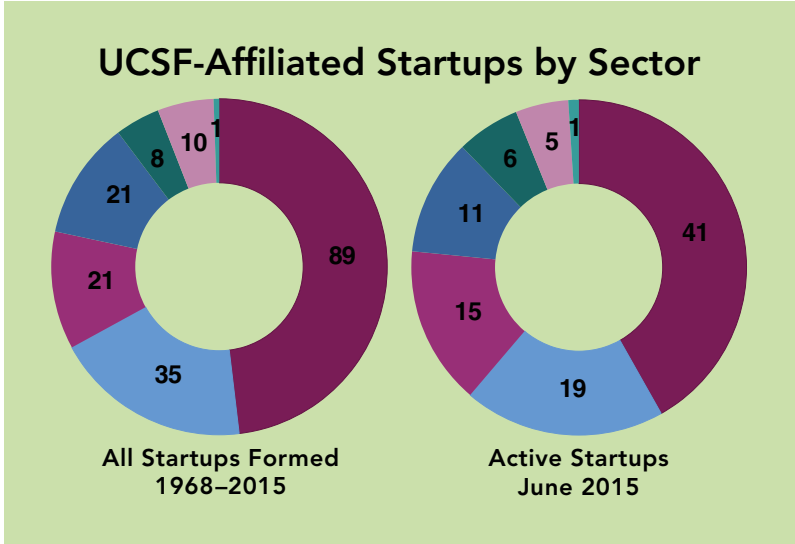
Another initiative, run by students from both UC Berkeley and Stanford, is the **Bay Area Dorm Room Fund**, a venture fund created by national firm First Round Capital, that provides average individual investments of \$20,000 to chosen startups of currently enrolled or recently graduated students from both Stanford and UC Berkeley. In order to mitigate risk, First Run Capital doesn't force failed companies to pay back investments; instead, if the entrepreneurs of the failed startup subsequently go on to create a successful company, debt held by the fund will be converted to equity in the new company. All investment decisions at the Dorm Room Fund are made by students, with returns staying with the campus. Recent investment recipients have included a drone company that has reportedly raised \$34 million in pre-sale revenue, and mechanical engineering, diagnostic, translational research, and hardware and software startups.

These student-led initiatives are the result of a growing movement among students to create a stronger ecosystem for entrepreneurs on the campus who elect to create their own supporting infrastructure.

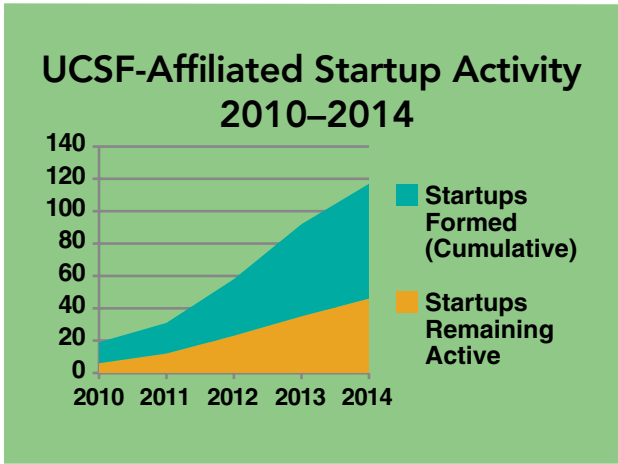
Alumni are also getting into the act. In 2014 Berkeley alumna Joanne Chen, now an associate at Foundation Capital, created the **Berkeley Founders Group**, a private entity fund that each year supports four competitively selected Berkeley startups with \$25,000 in pre-seed funding each (for a total commitment of \$100,000), six months of office space in Foundation Capital's SOMA office in San Francisco, mentorship, and access to the firm's business networks.

Another recent initiative is **The House Fund**, launched in April 2016 with the sole purpose of investing in startups coming out of UC Berkeley. Led by Jeremy Fiance, a UC Berkeley graduate and a former managing partner of the Dorm Room Fund, The House Fund has raised an initial \$6 million to support pre-seed and seed-stage companies with ties to the university. Backed by Sherpa Capital and other venture investors, the fund's investments are expected to average \$50,000 for pre-seed startups and between \$100,000 and \$250,000 for seed-stage companies. To be eligible, companies must have at least one Berkeley student, faculty or alumni founder.

UC San Francisco Startup Activity at a Glance



- Medical Therapeutics
- Medical Devices
- Software and Services
- Medical Diagnostics
- Communication, Information, Data
- Research Tools
- Advanced Materials



185 UCSF-Affiliated Startups Generated Between 1968 and June 2015

98 UCSF-Affiliated Startups (1968-2015) Still Active in June 2015

83% Portion of UCSF-Affiliated Startups Still Active in June 2015 That Have a Life Sciences Focus

University of California, San Francisco

UC San Francisco (UCSF) is a graduate-level campus focused on life sciences and medicine. One of the leading institutions of its kind, it is ranked No. 3 in the nation in both primary care and medical research. UCSF is the only medical school in the United States to rank in the top 5 for both categories. In 2014, it received \$546.6 million in federal biomedical research funding, making

it the second largest university recipient of funding from the National Institutes of Health. From its original campus at Parnassus Heights in western San Francisco, UCSF is rapidly expanding on its new campus in the heart of the Mission Bay district's dynamic biotech and life sciences cluster.

Technology Licensing

The goal of UCSF's **Office of Innovation, Technology and Alliances** is to facilitate translation of UCSF research and innovations for societal benefit. The office partners with industry participants on research and development of clinical programs to create networks between the commercial world and researchers. Through its funding opportunities database, mentor program, classes and resources, the office functions as a catalyzer for entrepreneurs and researchers in the market place.

Entrepreneur Support

Entrepreneurial Education and Support

The **Entrepreneurship Center**, re-launched in 2012, receives limited university funding and temporary support from an I-Corps grant from the National Science Foundation. It supports entrepreneurially inclined students with programs designed to provide the basic tools necessary to take an idea to market. Through coursework and through mentors and advisers drawn from industry, entrepreneurs learn how to develop a business plan, create collaborations, manage team dynamics, negotiate, and prepare for investment. Offerings include an experiential, team-based entrepreneurship course similar to those offered at Stanford and Berkeley. Top-tier speakers are also brought in from Silicon Valley.

The **Lean LaunchPad** course offered through the Entrepreneurship Center helps entrepreneurs determine whether an idea is viable in the commercial marketplace. Using a model originally created by Stanford and Berkeley Professor Steve Blank and now supported by the National Science Foundation and adopted by institutions across the US, UCSF's Lean LaunchPad is tailored for scientists and clinicians in life sciences and has been piloted nationally by the National Institutes of Health since the fall of 2014.

LaunchPad, an unrelated program under the UCSF's Clinical and Translational Science Institute, showcases UCSF innovators through an online platform that tracks and supports successive stages of a product's development.

Funding

UCSF's support chain includes the **Catalyst Awards**, an initiative under the Clinical and Translational Science Institute. A proof-of-concept competition with prizes of up to \$100,000 for medical inventions and \$30,000 for digital ones, Catalyst funds early stage research that has the potential to advance medical treatments and technology.

"I had fallen prey to a very common assumption that I think naïve or inexperienced entrepreneurs suffer and that is thinking that if your idea works, all the additional steps required to bring your idea to the marketplace will just fall into place, like a row of dominoes. Nothing could be further from the truth. When I attended the Lean LaunchPad course, through the interview process we saw our ideas kind of turned on their head in respect to both pricing and what would be the required information that would compel users to buy our product. It probably would have been years before we ultimately realized we were taking the inappropriate path or approach."

—Dr. Hobart Harris, UCSF Chief of General Surgery and Founder of Vitruvian Medical Devices (quoted by Bob Rose, "Entrepreneurship Program Prepares Inventors to Launch Start-ups," *UCSF News*, April 22, 2015)

Governor Gray Davis Institutes for Science and Innovation

UCSF participates with UC Berkeley and UC Santa Cruz in QB3 (California Institute for Quantitative Biosciences), an institute that has in many ways set the standard for incubation and acceleration activities at the Governor Gray Davis Institutes for Science and Innovation and at UC generally. When UCSF's QB3 facility in Byers Hall opened in 2005, Director Regis Kelly focused on how to maximize its economic impact by enabling and supporting scientists who had the motivation and ideas that might one day lead to companies. The **Garage@UCSF** was launched in 2006 as the first technology incubator in the UC system, with initial residency by six companies. Within two years, four had received venture funding and a fifth was acquired by Affymetrix for \$25 million—suggesting to Kelly that the university was sitting on an untapped resource.

Today QB3 supports Startup in a Box, a network of five incubators (Garage@UCSF, Garage@Berkeley, East Bay Innovation Center, QB3@953, and StartX-QB3 Labs in Palo Alto), and an investment firm, **Mission Bay Capital** with two funds—the first launched in 2009 with \$11.3 million in capital, and the second in 2015 with \$25 million. **QB3@953**, opened in 2013 in Mission Bay in the Dogpatch neighborhood close to UCSF's campus, is a full service 24,000 square foot incubator providing space and equipment for more than 50 UC-affiliated and other startups.

To date, 155 companies have been supported by these incubators, creating hundreds of jobs and attracting more than \$600 million in funding. Of the companies in QB3's incubators, one-third are using technologies based on UC licenses. The balance of residents aren't UC-affiliated, but in many cases have chosen to be there in order to be close to UCSF's staff and facilities.

QB3's **Startup in a Box** program offers entrepreneurs help with incorporating, creating a business structure and establishing a commercial bank account, plus an SBIR funding workshop and, most recently, legal support in collaboration with the UC Hastings Startup Legal Garage.

The **QB3 Awards**, launched in 2015, recognize early-stage life sciences innovators and job creators in the San Francisco Bay Area, with awards given in categories such as Diagnostics Startup of the Year, Medical Devices Startup of the Year, Synthetic Biology Startup of the Year, Therapeutics Startup of the Year, Early-Stage Investor of the Year, Most Admired Company, Most Intriguing Company, and Groundbreaking Science.

Bolt Threads

Bolt Threads, a company developing genetically engineered silk for the textile market, was founded in 2009 by three graduate students—two from UCSF and one from UC Berkeley. Their research spun out of then-UCSF-professor Chris Voigt's synthetic biology lab. Bolt Threads has developed proteins inspired by the natural silks made by spiders and has created new technology and a very-large-scale production process to spin the engineered silk proteins into fibers with remarkable properties, including high tensile strength, elasticity, durability, and softness. For several years, Bolt was resident in the QB3 Garage@UCSF incubator, and QB3's affiliated venture fund invested in Bolt's Series A funding. In May 2016, co-founder Dan Widmaier announced onstage at TechCrunch Disrupt NY that Bolt has closed a \$30 million Series B round of venture funding and has partnered with Patagonia. Bolt now has more than 50 employees at their pilot plant in Emeryville.

Associated Programs and Facilities

The recent growth of incubator space located in proximity to UCSF's campus in San Francisco's Mission Bay district is indicative of the catalytic role UCSF has played in creating a university-centered innovation ecosystem that enables life sciences startups. The UCSF campus anchors an expanding life sciences complex that includes biotechnology and pharmaceutical companies that have either spun off from UCSF or have located in the area to be close to UCSF's faculty and research. This complex includes incubators and accelerators that are not sponsored or managed by UCSF but are there to interact with it. In this sense, UCSF's impact can be measured not just by the startups that are directly founded by university faculty and staff or have been supported by formal university programs, but also by activity that is generated in the research and business ecosystem that UCSF catalyzes.

Adjacent to UCSF's Mission Bay campus, three industry programs stand out: the incubator space at FibroGen, Bayer's US Innovation Center and the Illumina Accelerator.

In 2009, QB3 partnered with biotech company FibroGen, the San Francisco Chamber of Commerce and the San Francisco Center for Economic Development to launch **incubator space at FibroGen**, the first off-campus incubator in Mission Bay. Starting with five companies in 2,500 square feet of laboratory space, the space—located in FibroGen's headquarters on Illinois Street—has since grown to accommodate 9 companies in 38,000 square feet in 2016. Of the more than 39 companies that have made use of the space since it opened, three have been acquired, one (*Invitae*) has gone public, two moved to other space in San Francisco, and two moved to space on the Peninsula. Three of the original tenants are still in the facility, and companies can stay for as long as they want; but demand for space is high, and when one tenant leaves another moves in.

Bayer opened its **US Innovation Center (USIC)** in Mission Bay in 2011, expanding from the company's manufacturing center in Berkeley in order to be closer to UCSF and QB3. Focused on discovery research, one of its first moves was to sign a long-term master research agreement to facilitate collaboration between its scientists and scientists at UCSF; eight sub-agreements have subsequently been executed. Through that agreement, Bayer created **CoLaborator**, a life sciences incubator that provides lab space to emerging companies whose technologies are aligned with Bayer's mission. A 6,000 square foot facility, with five tenants currently, CoLaborator is within walking distance from the campus and more than 60 emerging life sciences companies. In addition to UCSF facilities, residents have access to Bayer's research network and its environmental health and safety licenses. UCSF's core facilities are a draw, particularly labs that startups can access for a fee.

Current CoLaborator tenants include *Aronora Inc.*, which develops products for severe thrombotic blood clotting diseases; *Cairn Biosciences*, which performs live cell content screens and assays to better understand the cell biology of diseases; *ProLynx LLC*, which is working to create more steady-state and predictable drugs using technology that overcomes the limitations of release linkers; *Singular BIO*, which develops diagnostic testing for personalized medicine; and *Xcell Biosciences*, which is developing an innovative cell culture solution for utilization in research, drug discovery and personalized patient information.

Illumina Accelerator, also located in Mission Bay close to Illumina's R&D Labs, is a six-month business acceleration program for genomic companies drawn from both academia and industry. It offers \$100,000 in financial support, plus 20% research assistant time and access to sophisticated medical instrumentation. Other services include pitch preparation, partner support, non-exclusive access to Illumina's intellectual property, and biweekly workshops on industry trends, business models, and scalable business methods.

UC Hastings College of the Law

A stand-alone law school located near San Francisco's Civic Center, UC Hastings jumped into the entrepreneur support process with creation of the **Startup Legal Garage**. Launched in 2011 by Professor Robin Feldman, it provides pro bono corporate and intellectual property services to early-stage startups, drawn primarily from local incubators. The Startup Legal Garage has two primary components: classroom lectures, as part of either a tech or biotech course module, and field work supervised by practicing attorneys. As students interested in biotech usually want to be patent attorneys, and those interested in tech want to be corporate lawyers, the biotech module focuses principally on patent law, and the tech module on corporate law.

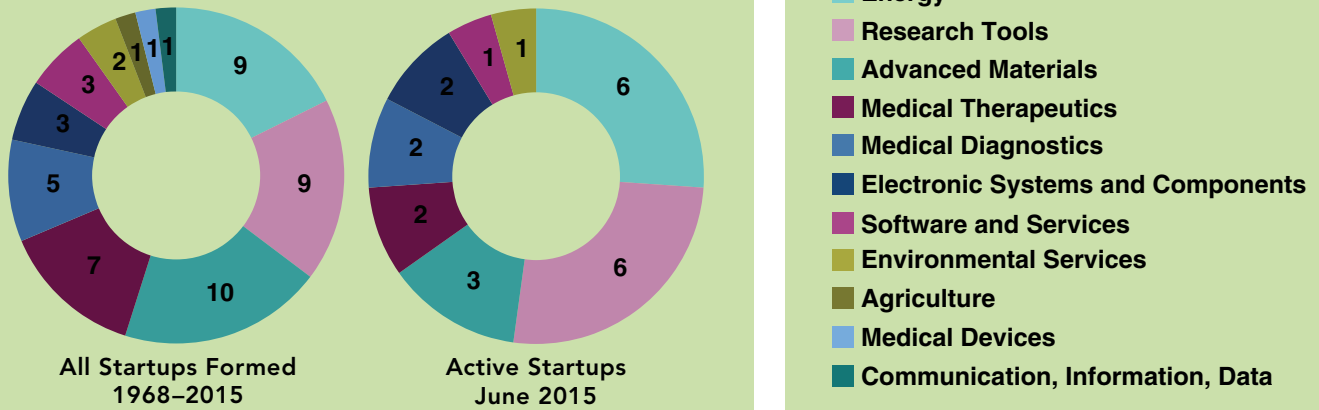
Over one academic year, students participate in a seminar course on which they are graded and receive credit. The fieldwork projects are overseen by a faculty member who provides academic grounding and professional skills training but is not directly engaged with the startup client. In a typical semester, 60 law students (40 in tech and 20 in biotech) work under the supervision

of as many as 60 practicing lawyers from 25 firms on projects with 35 startups, addressing legal topics such as contracts, entity formation, and intellectual property, as well as regulatory issues. The tech module, with a major focus on diversity, accepts projects through incubators such as Hackers and Founders, Women 2.0, Black Founders, Latino Startup Alliance, Open Technology Fund, Code for America, and Girls in Tech. The biotech module accepts clients through QB3.

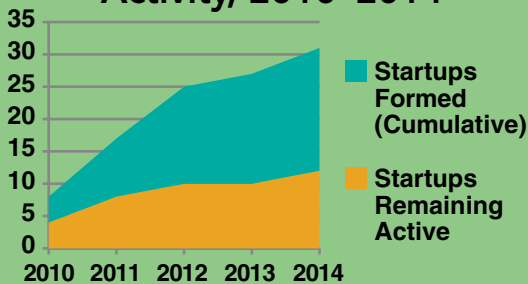
The Startup Legal Garage functions much like a medical residency program, offering students the opportunity to practice their skills in a real world setting. In the process, it provides participating startups with \$15,000–\$20,000 in free legal advice, and affords participating lawyers the opportunity to identify future clients while giving back to the community. In recent years, the program has been supported by grants from two large charitable organizations. Based on the model developed at Hastings, the Berkeley IP Lab was started at UC Berkeley's law school, and other law schools in the UC system are considering similar programs.

Berkeley Lab Startup Activity at a Glance

Berkeley Lab-Affiliated Startups by Sector



Berkeley Lab-Affiliated Startup Activity, 2010-2014



51 Berkeley Lab-Affiliated Startups Generated Between 1968 and June 2015

23 Berkeley Lab-Affiliated Startups Still Active in June 2015

43% Portion of Berkeley Lab-Affiliated Startups Still Active in June 2015 That Have a Sustainability Focus

National Laboratories: Lawrence Berkeley and Lawrence Livermore

The University of California manages two national laboratories in the Bay Area: Lawrence Berkeley National Laboratory, adjacent to the UC Berkeley campus, and Lawrence Livermore National Laboratory, in the Livermore Valley. Reaching beyond their core client, the US Department of Energy, both are working to increase

their contributions to the economy by leveraging personnel and research to commercialize technology and support startup growth.

Cyclotron Road, an accelerator program operated by Lawrence Berkeley National Laboratory (Berkeley Lab)

in partnership with the U.S. Department of Energy's EERE Advanced Manufacturing Office, has as its goal the advancement of energy startups toward commercialization. Established in 2014, its first cohort drew 150 applicants, with 10 finalists and 6 awardees, selected by experts drawn from science, venture capital, industry, and government. Residents are provided with lab space, access to sophisticated equipment, support from Berkeley Lab scientists, mentors, stipends, and project funds (approximately \$100,000–\$300,000, depending on the project), with the goal of moving cutting edge ideas beyond research to scalable market impact. With the philosophy that one business model doesn't fit all, as their projects develop residents may be introduced to venture investors or to corporations with which they can partner—with the overarching goal of commercializing energy breakthroughs. Successful applicants are required to make a full time commitment for two years. The distinct approach taken by Cyclotron Road addresses the challenge of commercializing hard science—hardware that requires more time and research to develop than the typical IT startup. Following its first year of funding by EERE, the program's first cohort attracted nearly \$5 million in follow-on funding through competitive grants and private investments; two projects have been awarded funding by ARPA-E, the US Department of Energy's advanced research investment arm. Cyclotron Road launched its second cohort of residents in February 2016, with projects including next generation batteries, advanced materials, biomanufacturing, and solar technologies.

Operated by the University of California and Bechtel Corporation, Lawrence Livermore National Laboratory (LLNL) plays an important role in the innovation ecosystem of the Bay Area's Tri-Valley region as lab personnel and others in the community start companies. Some LLNL-affiliated companies have already enjoyed success. While most are still in the startup phase, four companies founded by LLNL scientists—*Cadence Design*, *Cepheid*, *Digital Globe*, and *Rambus*—currently have a collective market value of \$11 billion.

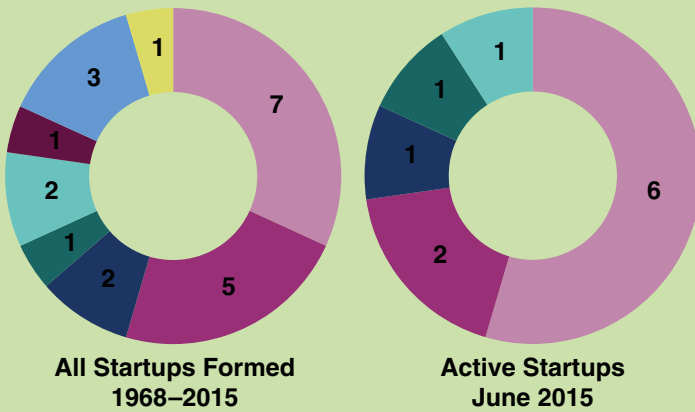
Through the [Livermore Valley Open Campus](#) (a partnership with Sandia National Laboratories/California) and other outreach efforts, LLNL is developing a

closer engagement with industry to help grow the Tri-Valley area into a technology innovation center. The laboratories are partnered with [i-GATE](#), an iHub incubator and innovation program supported by four local cities (Livermore, Pleasanton, Dublin, and Danville) that works to move startups from the idea stage to first-round funding. It provides collaborative workspace, mentorship, training and networking support to startups either beginning in or moving to the region, including LLNL researchers and companies whose products are based on LLNL technologies. Graduates of i-GATE include *TerrAvion*, a precision agriculture technology startup that uses aerial imaging to monitor crop health down to the individual plant, and *KalpTree Energy*, which has developed a solid-state battery technology that produces increased battery capacity at competitive costs. i-GATE's first six companies have together raised more than \$8 million.

LLNL also supports aspiring entrepreneurs inside the lab community through initiatives like the National Laboratory Entrepreneur Academy and LabCorps. A startup bootcamp for laboratory scientists jointly sponsored with Sandia and held twice in 2015, the [National Laboratory Entrepreneur Academy](#) helps researchers master the process required to turn a scientific idea into a product or company. LLNL in partnership with Sandia is also a participant in the US Department of Energy's national [LabCorps](#) pilot program to accelerate the transfer of new clean energy technologies from national laboratories into the commercial marketplace. The program creates teams consisting of a national lab technologist with a clean energy technology idea, an industry mentor, and an entrepreneurial lead, who work together to find promising pathways for the commercialization of the new technology. The teams, under the tutelage of experienced LabCorps teaching and mentoring faculty, are guided through the process of customer identification and value proposition development culminating in the "pitching" of the teams' business ideas to a panel of experienced entrepreneur judges. Two LLNL/Sandia project ideas were selected in March 2015, with the winning national labs innovators each receiving \$75,000 to continue to develop commercialization plans for their technologies.

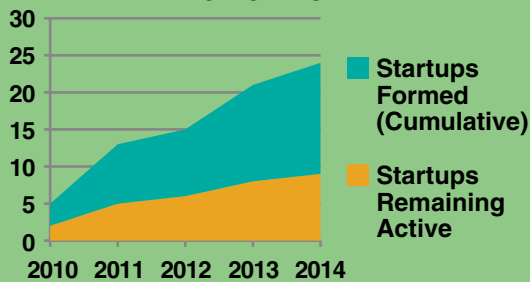
UC Santa Cruz Startup Activity at a Glance

UCSC-Affiliated Startups by Sector



- Research Tools
- Software and Services
- Electronic Systems and Components
- Communication, Information, Data
- Energy
- Medical Therapeutics
- Medical Devices
- Transportation

UCSC-Affiliated Startup Activity 2010-2014



22 UCSC-Affiliated Startups Generated Between 1968 and June 2015

12 UCSC-Affiliated Startups (1968-2015) Still Active in June 2015

58% Portion of UCSC-Affiliated Startups Still Active in June 2015 That Have a Life Sciences Focus

University of California, Santa Cruz

One of UC's newer campuses, UC Santa Cruz (UCSC) opened in 1965 and as of fall 2015 hosts 16,231 undergraduates and 1,637 graduate students. The campus enjoys a strong reputation in genomics and astronomy as well as energy storage and is home to the Jack Baskin School of Engineering established 1997. Across all five UCSC academic divisions (including the School of Engineering), faculty and researchers regularly receive more than \$100 million annually in external funding.

Partly due to its smaller scale, but also to a slower embrace of entrepreneurial and commercially oriented activity, Santa Cruz has come late to the technology commercialization and startup process. This is in part a reflection of underfunding, as activities such as entrepreneurial engagement have been difficult to support. As interest in entrepreneurial activity and technology commercialization grows, the culture on campus is changing, and entrepreneurial programs

are shifting from being largely ad hoc toward becoming more directed.

Technology Licensing

Three staff members in the **Office for Management of Intellectual Property** currently focus on patents and licensing and will soon be joined by two others working on industry partnerships, and possibly another to focus on economic development. In 2014, the University had 46 active patent cases, 12 issued patents, and 33 disclosures (a number it hopes to double in the near term). Most licensees are faculty.

Entrepreneur Support

Entrepreneurial Education and Support

The **Center for Innovation and Entrepreneurial Development** (CIED), building on part of the Division of Graduate Studies, acts as an entrepreneurial resource for graduates, undergraduates, faculty and staff. It builds on groundwork laid by Dr. Narinder Kapany and other faculty since 1979 and on the experience of another initiative—the Baskin School of Engineering’s Center for Entrepreneurship (C4E), which started in 2011 and has since been folded into CIED. In addition to seminars and workshops to support networking and skills training, CIED hosts events such as **Hack UCSC**, an engineering-focused hackathon; **Pitch Slam!**, a startup pitch event; and the **Business Design Showcase**.

In its educational role, CIED coordinates closely with Crown College, a UCSC residential college with a central focus on emerging technologies. Together, CIED and Crown College offer an 8-week **Summer Entrepreneurship Academy** (SEA) to help entrepreneurs turn their innovations into businesses. CIED also coordinates in the development of a graduate minor and a certificate program in innovation and entrepreneurship.

With a still-nascent startup community, Santa Cruz faces challenges building a self-generation startup ecosystem. One issue is the gravitational pull of nearby Silicon Valley, and the possible concern of startup entrepreneurs and their employees that if the company were to fail, other employment opportunities might not be available in the Santa Cruz area. With the shift in campus

interest toward entrepreneurial development, catalyzing a local entrepreneurial community has become a priority, and successful UCSC graduates are playing a part.

As the campus works to build critical mass in Santa Cruz, it has a unique opportunity in Silicon Valley, at the UCSC Silicon Valley Extension campus. Located in a building near Highway 101 in Santa Clara, the campus hosts almost as many students as the main campus, most in continuing education programs with a technology focus. With its location in the heart of Silicon Valley, the campus has the potential to grow as an entrepreneurial hub but at present remains lightly funded, with ~\$1 million per year. UCSC would like to add fourteen more faculty members, but that will require greater critical mass.

PhD Research Leads to Exascale Cloud Storage System

UCSC alumnus Sage Weil has transformed his PhD thesis into a highly successful open source software product—the data storage system called Ceph. Already a founder of the web hosting company DreamHost when he came to Santa Cruz to study data storage, Weil developed Ceph—an open source software-defined storage system that runs on commodity hardware—with other students at the Baskin School of Engineering. After completing his degree in 2007, he founded the spinoff *Inktank* as a commercial company to offer paid support for Ceph. In 2014, Inktank was acquired by open source software provider Red Hat for \$175 million. Ceph is now the leading storage system for the OpenStack community. In 2015, Yahoo announced that Ceph would be the basis for its new exascale-class storage system called Cloud Object Store that it will deploy first for its Flickr photo sharing service.

In May 2015, Weil gave back to the university with a \$500,000 gift which, with matching funds from the UC Presidential Match for Endowed Chairs, will establish a \$1 million endowment at Santa Cruz for the Sage Weil Presidential Chair for Open Source Software. Additional gifts from Weil totaling \$2 million will support continuing research at UCSC’s Center for Research in Open Source Software.

UCSC also has a long-term lease on 77 acres at Moffett Field. A superfund site, the property will require extensive environmental mitigation and \$110–\$220 million in investment before becoming suitable for development. UCSC is currently in discussions with a major technology company on an agreement under which the private partner would provide the necessary infrastructure investment in return for use of 80% of the property, which would give the university 500,000 square feet of space in up to four buildings. Should that occur, incubators would be included in the new facility. The larger vision is that UCSC Silicon Valley would one day serve as a portal to Silicon Valley not just for Santa Cruz but for the entire UC system.

Much of the energy around startups is coming from the UC Santa Cruz Genomics Institute, an initiative that connects the schools of Engineering, Physical and Biological Sciences, and Social Sciences. In recent years a half dozen startups have come out of faculty labs, primarily in engineering.

Incubators and Accelerators

The number of startups generated by the campus overall is still small, and not yet enough to support an incubator. With its programs growing, however, planning has begun for an off-campus facility with opening expected in the summer of 2017. The new facility will accommodate 15–20 companies and will be in large part privately funded, with bench and office space leased to occupants on a square foot basis.

Circle Pharma

Circle Pharma was founded based on a technology developed by UC Santa Cruz's Scott Lokey and UCSF's Matt Jacobson. Circle is developing macrocyclic peptides—essentially small circular proteins—as therapeutics that can reach targets that conventional drugs cannot. QB3's Collaborative Startups program brokered a major partnership between Circle and pharma giant Pfizer, in which QB3's venture capital fund also invested.

Governor Gray Davis Institutes for Science and Innovation

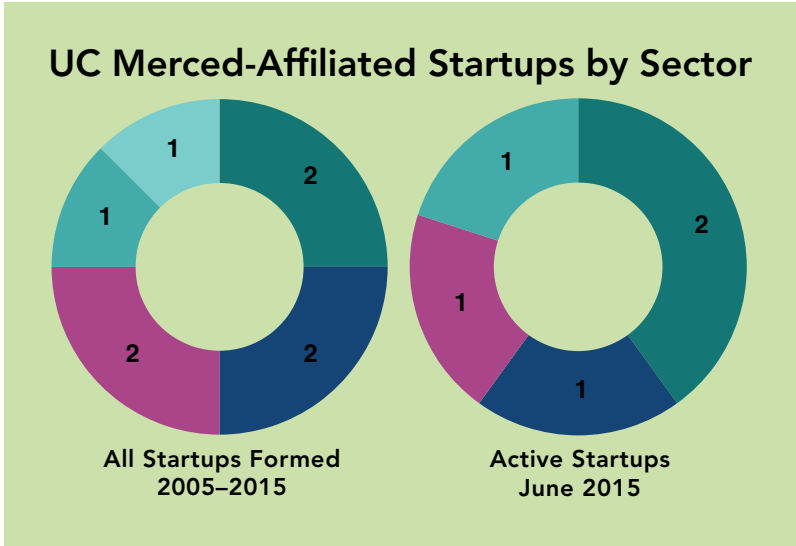
QB3 and CITRIS jointly occupy the fifth floor of the UCSC's new engineering building. Life sciences researchers can access both sophisticated laboratory equipment and entrepreneurial support through QB3 programs and facilities such as the QB3Garage@UCSF and the QB3Garage@Berkeley, Startup in a Box, and venture investment from Mission Bay Capital. The new off-campus incubator will build on those offerings. CITRIS provides access to equipment and space for research, including industry-sponsored space that enables collaboration. (Cisco is a major partner.) Another CITRIS office at UCSC Silicon Valley primarily provides services connected to the CITRIS Foundry.

CITRIS also provides space to house the Network Management and Operations Lab, which gives students the opportunity to work with Cisco Engineers on networking projects with real-world applications. CITRIS also collaborates with the UCSC Baskin School of Engineering's Center for Sustainable Energy and Power Systems, which works with the City of Santa Cruz on the goal to make the Santa Cruz Municipal Wharf energy self-sufficient.

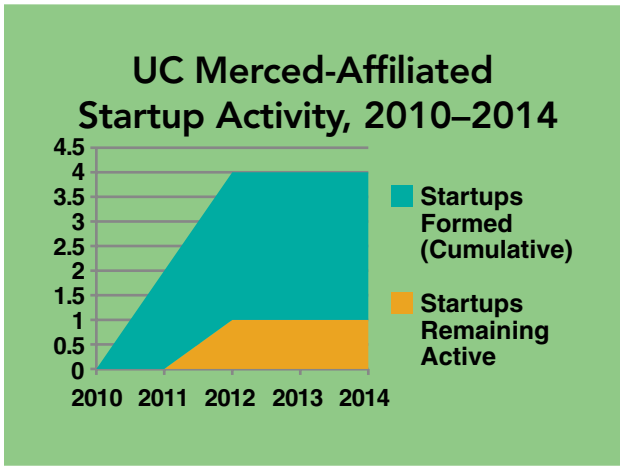
Associated Programs and Facilities

Off campus, links with the business community are growing. Launched in 2014 with UCSC support, Santa Cruz Works is a partnership of the university, the city, investors and professional service providers, that works to attract and retain technology talent in the area, particularly among Santa Cruz graduates. A promotional initiative, it showcases technology companies, publicizes job opportunities and technology developments, connects the private and public sectors, and hosts tech community events. UCSC is also a sponsor of Santa Cruz Tech Beat, a news digest and information resource for the technology community in the Monterey Bay area.

UC Merced Startup Activity at a Glance



- Communication, Information, Data
- Electronic Systems and Components
- Software and Services
- Advanced Materials
- Energy



8 UC Merced-Affiliated Startups Generated Between 2005 and June 2015

5 UC Merced-Affiliated Startups Still Active in June 2015

60% Portion of UC Merced-Affiliated Startups Still Active in June 2015 That Have an Information Technology Focus

University of California, Merced

The newest of UC's ten campuses, Merced plays an important role as an economic catalyst for California's Central Valley—the heart of the state's agricultural industry, but a region that is challenged by high unemployment and low education levels. The campus opened for graduate education in 2004 and undergraduate education at UC Merced began in 2005. Of the ten UC campuses, Merced

has the lowest level of grant funding for research, with just \$21 million received in fiscal year 2014–2015. UC Merced's divisions include an engineering school, a biomedical program (but not a medical school), and programs in computer science, materials science, and renewable energy. It also plans to create a school of management, with a significant entrepreneurial focus.

The campus has 6,237 undergraduates and 448 graduate students as of November 2015, and it is expected to expand enrollment to 10,000 by 2020. As that occurs, UC Merced is planning to add 100 new faculty members in STEM disciplines, which should magnify its long-term economic impact.

Technology Licensing

Starting with a blank slate, UC Merced has taken an innovative approach to its technology functions, emphasizing economic development and community engagement, with intellectual property management as a subset rather than a driver. Activity is handled by the **Office of Business Development**, within the Office of the Vice Chancellor for Research and Economic Development (ORED). Traditional licensing has been moved from the foreground to the background, in favor of an emphasis on industry outreach and new venture development.

“Because Merced is young, it’s a place you can do things differently. Our main metrics are our relationships, the investments that those relationships attract, and what return we are getting out of those relationships. Recognizing the need to build relationships was the impetus for the Bayh-Dole Act, and our program is designed to honor the spirit and letter of that mandate.”

—Peter Schuerman, Associate Vice Chancellor for Research and Economic Development

Entrepreneur Support

Entrepreneurial Education and Support

Most on-campus activities promoting entrepreneurship are built around the School of Engineering and are linked to **Innovate to Grow**, an annual showcase for innovation. Its **Mobile App Challenge**, partly managed by CITRIS, is an app development competition with a primary focus on energy, education, civic engagement, environment, and health. In 2014, \$5,000 was awarded as the grand prize, as well as gift cards, tablets and internship opportunities. The **Innovation Design Clinic** allows students to gain technical and real-world skills by joining multidisciplinary teams that work to overcome design challenges for local nonprofits. And the **Engineering Service Learning** program engages students to solve problems faced by community partners.

Incubators and Accelerators

The **UC Merced Venture Lab**, a 3,000 square foot incubator (scheduled to expand to 6,000 square feet in 2017), opened in October 2015 in downtown Merced. Its principal collaborators are the City of Merced and a Small Business Development Center (SBDC) that is funded from a grant to UC Merced from the US Small Business Administration. Supported by the Office of the Vice Chancellor for Research and Economic Development and by low-cost (\$1 a year) rent from the city, the goal of Venture Lab is to assemble investable new ventures by team building, by identifying opportunities, and by tapping the innovation assets of UC Merced. The **UC Merced Small Business Development Center** also serves as the regional SBDC hub for 15 counties in central California, with six offices and an Innovation and Technology Commercialization program that links UC Merced with Cal Poly San Luis Obispo, CSU Bakersfield, CSU Fresno, and CSU Monterey Bay. Services include educational workshops, consulting and training for entrepreneurs and small businesses, and help in accessing SBIR funds through a federally-supported CSU-Chico-based web portal, CalSBIR.com. By co-locating the Merced SBDC office with the Venture Lab, UC Merced has laid a foundation that, over time, will allow startups in the incubator to benefit from its services.

The Venture Lab opened with 45 members, including students, faculty, and staff; nine advisory board members; and 21 mentors. Its core strategy is to start with ideas rather than patents, helping members progress from the ideation phase to investable businesses, through assistance with market research and commercialization planning. Participants receive mentorship and support from the university, the business community, and entrepreneurs and investors who advise the program. The partnership with local government is important, as the City of Merced is looking to diversify its economy—which currently offers few business opportunities outside of agriculture—and wants to retain more of UC Merced’s graduates as long-term members of the community. While the incubator and the downtown area are seven miles from the campus, frequent shuttles make the downtown area accessible for students and faculty, and the university’s presence will grow further when approximately 500 administrative and other employees move downtown to a new administrative headquarters.

Funding

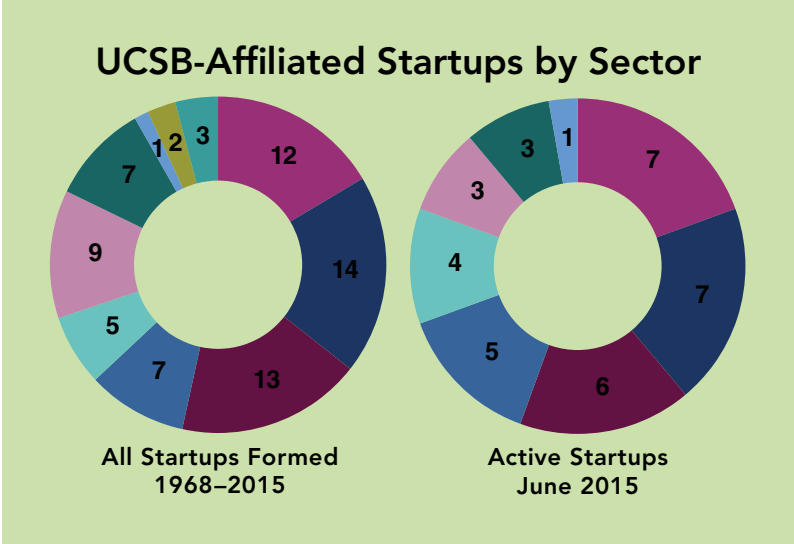
The annual **Chancellor’s Innovation Awards** is a program developed to inspire UC Merced staff members to develop transformative ideas that improve processes, customer service, staff engagement, organizational structures, or workplace environment. The top prize is \$5,000, with runners-up receiving smaller amounts. In 2015, the first place award went to CatVax, a mobile web application to streamline vaccination assessment for both end users and health center personnel. CatVax is now under development through the Venture Lab with the goal of

creating an end product that could be used throughout the UC system and could be marketed to other universities and health agencies, creating a potential revenue source for UC. The second place Chancellor’s Innovation Award went to Where’s the Bus, a GPS system that tracks bus locations and occupancy levels in order to improve campus transit’s ease of use. Third place recognized a smart scheduling model for energy saving by managing heating and cooling to automatically correspond to an occupancy calendar for specific rooms in facilities such as classroom and office buildings.

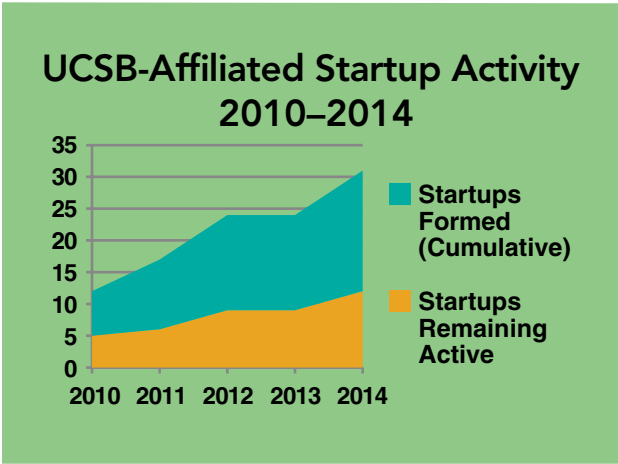
Governor Gray Davis Institutes for Science and Innovation

As a participant in CITRIS, UC Merced focuses on four core initiatives. The i4Energy Initiative employs sensors and other emerging technologies to gather, manage, and utilize information on energy conservation and expenditure from the household level to the grid. The Health Care Initiative aims to improve access and reduce disparities and costs in healthcare by developing and integrating technology advances in telehealth, sensors, services, and gaming. The Intelligent Infrastructure Initiative addresses water, urban development, and transportation issues by developing and deploying intelligent “cyber-physical” systems to better manage resources and promote sustainability. The Data and Democracy Initiative creates tools to foster public engagement on social, political, and economic issues by exploring the relationships between digital media and democratic practices.

UC Santa Barbara Startup Activity at a Glance



- Software and Services
- Electronic Systems and Components
- Medical Therapeutics
- Medical Diagnostics
- Energy
- Research Tools
- Communication, Information, Data
- Medical Devices
- Environmental Services
- Advanced Materials



73 UCSB-Affiliated Startups Generated Between 1968 and June 2015

36 UCSB-Affiliated Startups Still Active in June 2015

47% Portion of UCSB-Affiliated Startups Still Active in June 2015 That Have an Information Technology Focus

University of California, Santa Barbara

Founded in 1958, UC Santa Barbara (UCSB) anchors the University of California on the Central Coast and currently enrolls roughly 20,000 undergraduate and 3,000 graduate students. In 2013-14, UCSB received \$209 million in research awards, including \$163 million in direct and indirect federal funding. Its highly-ranked College of Engineering claims more research funding per capita than any UC counterpart.

The Central Coast region has a small but growing community of homegrown technology companies and is particularly strong in photonics (which involves the use of light to transmit large amounts of data at very high speeds). The integrated photonics manufacturing sector has developed in tandem with UCSB, which has spun out a number of photonics companies including *Aurion*, *Agility*, *Calient Technologies*, *Soraa*, *Aerius Photonics*,

and *Freedom Photonics*. Reflecting this strength, in July 2015 UCSB was designated by the federal government as the West Coast Center of the National Photonics Institute, a public-private consortium dedicated to advancing the research and manufacturing of photonic technology. Investment in the Institute is expected to exceed \$600 million in public and private funding.

Technology Licensing

Established in 2005, the **Office of Technology and Industry Alliances** (TIA) has two main responsibilities: the management of intellectual property developed through UCSB research (including licensing) and the management of agreements with industry partners that support research collaboration. It receives an average of 90 new invention disclosures a year and has a current portfolio of over 650 technologies, 48% of which are under active licensing agreements. That portfolio spins out an average of 4–6 startups per year, with 7 formed in fiscal year 2014. Currently 33% of licensees are startup companies. Approximately 30% of those startups are formed by former graduate students or postdocs.

Entrepreneur Support

Business Plan Competition

Support for entrepreneurs isn't new to the campus. The **New Venture Competition** has been operating for sixteen years, offering UCSB students an annual opportunity to advance their business ideas. Interested participants form teams, receive incubator-style coursework training, and later present their ideas at a New Venture Fair. Finalists present at the New Venture Finals, where all teams receive cash prizes. The 2015 Grand Prize winner, *Milo*, received \$20,000 out of a pool of \$40,000, for an electronic wristband that monitors the blood alcohol level of the wearer.

Entrepreneurial Education and Support

In 2010, the Office of Technology and Industry Alliances established its **Startup Support Program** to provide support for potential entrepreneurs in the UCSB community through coaching, help in preparing business

plans, presentation training, and connections to an extensive network of potential investors, partners, and service providers.

UCSB's **Technology Management Program** (TMP) offers students a team-oriented and project-based entrepreneurship and business education curriculum focusing on state-of-the-art business methods, strategies for technology commercialization, new venture creation, and best practices for fostering innovation. It offers both a nine-month Master of Technology Management program and certificate programs in technology management tailored for undergraduates, graduates and PhD candidates. TMP also gives students access to an extensive network of advisers and includes an Executive-at-the-Table (EAT) program which offers students the opportunity to share a meal and talk with business executives.

Governor Gray Davis Institutes for Science and Innovation

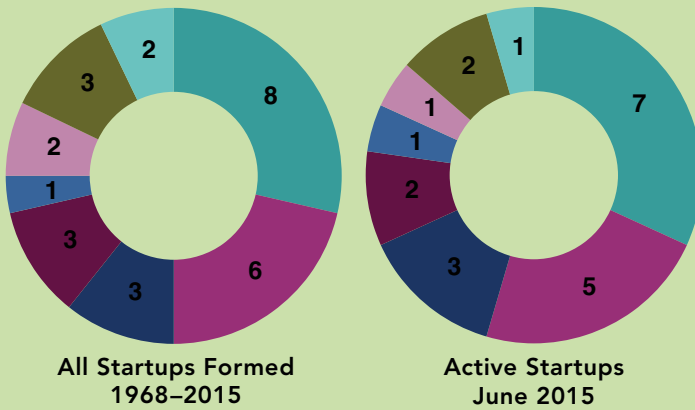
UCSB participates with UCLA in the California NanoSystems Institute (CNSI). Facilities at UCSB include a biology laboratory, a clean room, and a microfluidics lab where, on a fee for service basis, users can access sophisticated equipment that would not otherwise be available to startups. CNSI also recently launched a 600 square foot incubator with wet lab space, the only lab of its kind on the Central Coast. Under its business model, space is leased out by the half-lab bench, with residents receiving mentorship support as needed. Incubator members can also access CNSI facilities at discounted rates equivalent to those paid by on-campus researchers. In the fall of 2015, the incubator hosted two student companies, and it has room for an additional six. Of those two companies, one (*Milo*) initially entered through a CNSI prize at the New Venture Competition that provided the first three month lease, while the other (*Apeel*) has been paying for storage and bench space.

Associated Programs and Facilities

UCSB engages with the local community through the **Goleta Entrepreneurial Magnet** (GEM), an off-campus incubator operated in partnership with the City of Goleta and the Goleta Valley Chamber of Commerce.

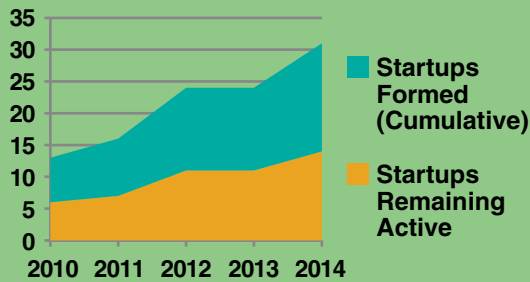
UC Riverside Startup Activity at a Glance

UCR-Affiliated Startups by Sector



- Advanced Materials
- Software and Services
- Electronic Systems and Components
- Medical Therapeutics
- Medical Diagnostics
- Research Tools
- Agriculture
- Energy

UCR-Affiliated Startup Activity 2010-2014



28

UCR-Affiliated Startups Generated Between 1968 and June 2015

22

UCR-Affiliated Startups Still Active in June 2015

45%

Portion of UCR-Affiliated Startups Still Active in June 2015 That Have a Sustainability Focus

University of California, Riverside

UC Riverside (UCR) is closely tied to California's Inland Empire region to the east of Los Angeles. With roots in the Citrus Experiment Station, founded in 1907, the UCR College of Letters and Science was created 1954. Riverside's fall 2015 enrollment includes 18,608 undergraduates and 2,931 graduate students. In fiscal year 2015, UCR received a total of \$124.3 million in research contract and grant funding, including \$79.9 million in federal funds.

Technology Licensing

The UCR Vice Chancellor's **Office of Research and Economic Development** is responsible for oversight of research, external funding for research, corporate partnerships and technology commercialization. Three of its departments are highly focused on promoting technology transfer. The goal of the Corporate and Strategic

Partnerships unit is to build relationships between the campus and companies that enhance the discovery, translation, and application of knowledge to real-world problems. The Sponsored Programs Administration helps campus researchers to find and utilize external funding. The Office of Technology Commercialization facilitates the development, protection and commercialization of UCR's campus research and intellectual property. Inventions come from a range of technical areas including plant varieties, plant genomics, biomedical science, materials science, engineering, and life sciences.

Entrepreneur Support

To guide its initiatives and increase its economic impact, in 2013 UC Riverside established the **Technology Partnerships Advisory Committee** (TPAC), an external advisory board created to support campus technology commercialization efforts. TPAC is composed of local CEOs and entrepreneurs with relevant expertise and experience. UCR's Director of Economic Development works closely with external partners including the City and County of Riverside, state agencies, the City of Los Angeles, and the Port of Los Angeles to attract companies to the region.

Entrepreneurial Education and Support

Faculty and students can also receive assistance from multiple **Entrepreneurs in Residence**. In the future, the university plans to create a Center for Entrepreneurship to serve as the central point for entrepreneurial activities on campus, as well as connections to off-campus resources. Within the Center, UCR's Director of New Ventures will orient faculty and students to the commercialization process, providing mentorship and support for those wanting to take the entrepreneurial leap.

Incubators and Accelerators

In 2014, in collaboration with both the City and the County of Riverside and business leaders, UC Riverside launched the first local high tech incubator. **Riverside ExCITE** (Center for Innovative Technology and Entrepreneurship) seeks to generate advanced technology jobs in Riverside County. With 5,000 square feet of space in downtown Riverside (about two miles from the campus), it focuses primarily on software startups and currently houses 4–6 companies in the education, legal, medical, and oil industries. Most have a direct affiliation with the university and have received SBIR grants and/or angel

investment. The facility is in a former county building provided at no cost, with residents paying minimal rent. Occupants get high-speed internet access, mentorship, and professional support, with the ultimate goal of graduating companies that will stay and grow in the area.

Funding

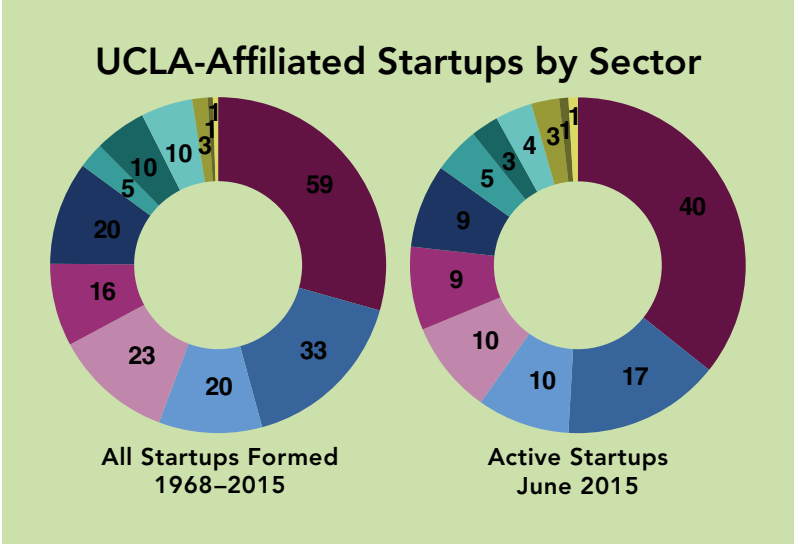
Another UCR entrepreneurial initiative is the **Proof of Concept for Technology Commercialization Award Program** offered by the Office of the Vice Chancellor for Research and Economic Development. The program awards up to \$35,000 for larger projects, and a median of \$20,000 for smaller projects, to support inventions whose intellectual property is not yet licensed. Selected through a business plan competition, the proposed inventions have to meet a market need or have a competitive advantage against products already in the market. Plans submitted must have a detailed product description, a budget, a marketing strategy, and a roadmap to commercialization after the program's completion.

Associated Programs and Facilities

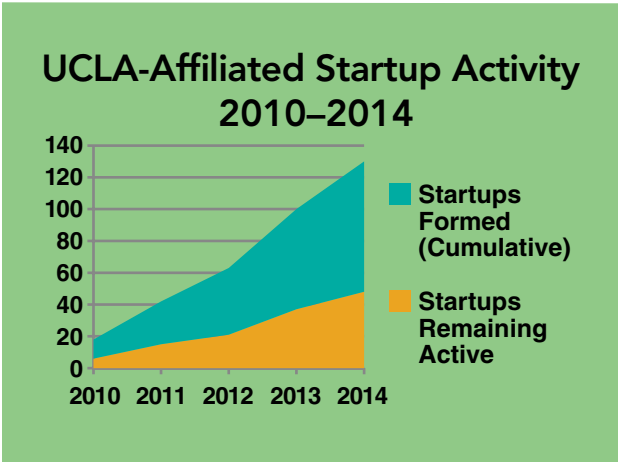
Although it has no direct affiliation, UC Riverside has close ties with two corporate-sponsored incubators near the campus. The **Bourns Technology Center** is a startup incubator supported by Bourns, Inc., a company active in the telecommunications, computer, industrial, instrumentation, automotive, consumer, audio, and medical sectors. Bourns Inc. has been engaged with UC Riverside for many years, and UCR's Bourns College of Engineering was named in recognition of a generous gift from the Bourns Foundation in 1994. Located two miles from the UCR campus and housing 4–5 companies led mostly by engineers and material scientists, the Bourns Technology Center and its current occupants are closely connected to UC Riverside.

SolarMax Technology Inc., a local manufacturer and installer of solar panels, sponsors another non-affiliated incubator with connections to the UCR campus. The **SolarMax incubator** supports startups whose technologies or business models align with the company's mission of creating and implementing green energy solutions. While none of the current occupants is using UC-licensed technology, the company has donated \$1 million in solar panels for a UCR solar test bed system and has sponsored research that may one day generate companies it would want to incubate.

UC Los Angeles Startup Activity at a Glance



- Medical Therapeutics
- Medical Diagnostics
- Medical Devices
- Research Tools
- Software and Services
- Electronic Systems and Components
- Advanced Materials
- Communication, Information, Data
- Energy
- Environmental Services
- Agriculture
- Transportation



201 UCLA-Affiliated Startups Generated Between 1968 and June 2015

112 UCLA-Affiliated Startups (1968-2015) Still Active in June 2015

73% Portion of UCLA-Affiliated Startups Still Active in June 2015 That Have a Life Sciences Focus

University of California, Los Angeles

Established in 1919, UC Los Angeles (UCLA) is the University of California’s largest campus. Its fall 2015 enrollment includes 29,585 undergraduates and 12,323 graduate students. Offering more than 323 degree programs and majors, UCLA hosts the Ronald Reagan UCLA Hospital and the David Geffen School of Medicine—one of the top medical schools in the nation. The campus enjoys strong partnerships with industry and

had the highest level of licensing royalty income of any UC campus in 2015 (\$71.2 million). UCLA has attracted an average of \$1 billion in total research funding annually since fiscal year 2009-2010, including \$972.5 million in fiscal year 2014-15.

According to AUTM (the Association of University Technology Managers), UCLA was ranked third in the nation

in startup creation in fiscal year 2014. Forbes Magazine also ranked UCLA fifth in the nation on its America's Most Entrepreneurial Universities list in both 2014 and 2015. UCLA supports an entrepreneurial culture through an especially broad array of programs.

Technology Licensing

The **Office of Intellectual Property and Industry Sponsored Research** (OIP-ISR) is responsible for technology transfer and engaging industry to facilitate research collaboration. Nearly five years ago, the Office of the Vice Chancellor for Research undertook a comprehensive evaluation of UCLA's approach to entrepreneurship. The outcome was Westwood Technology Transfer, a 501(c)(3) nonprofit organization created in 2013 with the endorsement of the UC Regents. Composed of UCLA faculty and industry leaders in fields such as biopharmaceuticals, engineering and venture capital, its independent board oversees OIP-ISR activities. By bringing added professional capability and business experience to the table, this new governance framework is designed to assist the campus with decisions on patenting, licensing, investment, risk tolerance, and industry-sponsored research.

Entrepreneur Support

Business Plan Competitions

At the **Knapp Venture Competition**, teams (that include at least one student) compete for funding by presenting business plans to a panel of investors, with \$15,000 awarded to the first place winner. The winning team in 2015, *Spinal Singularity*, is developing a medical device to assist people with spinal cord injury or disease, and it also participated in the UC system-wide primeUC competition, where it received a \$150,000 first place prize as well.

Offering a \$100,000 prize, **The Lowell Milken Institute-Sandler Prize for Entrepreneurs** is a business plan competition that is open to student teams that include at least one UCLA School of Law student or graduate. The competition is part of the law school's Entrepreneurship and the Law initiative, which both trains law students to represent entrepreneurs and provides them with the tools to found their own companies.

Entrepreneurial Education and Support

In 2012, OIP-ISR established the New Ventures team, a business development unit tasked with the goals of strengthening its support for entrepreneurial activity; increasing the engagement of its technology licensing staff with faculty, graduate students, and post-doctoral scholars who want to start companies; and increasing future revenue streams for UCLA—including revenue from off-campus entrepreneurs licensing university intellectual property. Most faculty and students that New Ventures serves are working with university-licensed IP.

OIP-ISR's current startup portfolio is roughly three-quarters life sciences and one-quarter physical sciences, spanning fields such as therapeutics, diagnostics, medical devices, cleantech, advanced materials, and semiconductors. The companies it supports are at all stages, from pre-incorporation to raising venture rounds, and team members work with participants to determine their specific needs. Services include connections to service providers and investors, and assistance with investor presentations. Proof-of-concept support may be in the cards for the future, but would require significant new funding and participation from external stakeholders.

OIP-ISR operates two primary entrepreneurship programs. Open to students and faculty, **Startup in a Box** began in 2014, based on the original Startup in a Box program at QB3, and is designed to equip entrepreneurs with the tools they need to found and grow companies. The **Entrepreneurs-in-Residence** (EIR) program, launched in 2013, provides UCLA startups with volunteer mentors from industry, the investor community, and the entrepreneurial community. Its inaugural mentor group included a former vice president of regulatory affairs and quality assurance with experience in a number of biotechnology companies, an angel investor and former investment banker, a former vice president of strategy at a Chinese automotive company, and a former CEO for biotechnology and executive director for research and development at Amgen.

OIP-ISR also supports recurring events including First Fridays, Pathways to Commercialization, the Medical Device Partnering Conference, and the Code for the Mission App Competition. Launched in 2012 and held

on the first Friday of every month, **First Fridays** is a networking and informational event designed to grow the entrepreneurial community by connecting guest speakers with entrepreneurs from on and off campus. **Pathways to Commercialization** and the **Medical Device Partnering Conference** bring investors to the campus, where entrepreneurs can be showcased. The **Code for the Mission App Competition** engages the community in the development of apps that help advance UCLA's mission of education, research, and public service. In 2015 it had three tracks: games that enhance learning, sustainability, and community wellness. Each track winner received a \$5,000 prize and an opportunity to place the app in UCLA's app store.

UCLA is also home to the **Harold and Pauline Price Center for Entrepreneurial Studies**, based at the Anderson School of Management. Its curriculum covers venture investment, small business management, and business plan writing. Extracurricular programs focus on entrepreneurship and experience-based learning, including internships, summer jobs, and six-month consulting projects for teams of 3–5 students. The Center hosts entrepreneurship conferences and speakers and organizes the campus **Entrepreneur Association**, UCLA's largest student organization, which also offers mentoring and opportunities for experiential learning. Support for the Center comes from multiple income streams, including donations from corporate sponsors for fixed costs and registration fees for variable costs. Contributions from the Center's board of advisers support an endowment for curriculum development, research, and student support.

The Anderson School also hosts a number of additional programs. Its **Entrepreneurship Bootcamp for Veterans** is a nine-day program designed to give veterans the skills required to launch their own businesses. The **Technology and Innovation Partners Program** gives business and law students practical experience in assessing the commercial potential for products entering the licensing process. The **Advanced Technology Management Institute** sponsors entrepreneur bootcamps and venture competitions, including the **Venture Team Competition**, where multidisciplinary teams of graduate and postgraduate students, working with faculty and industry

mentors, prepare and present business plans for product development and technology commercialization.

The **Institute for Technology Advancement** (ITA) was established by UCLA's Henry Samueli School of Engineering and Applied Science to accelerate the transition to market of innovative research. It sponsors entrepreneur bootcamps as well as the **Student Entrepreneurship Venture Competition**, which is held in coordination with the Easton Technology Management Center, the Technical Entrepreneurial Community, and the Anderson School of Management.

The UCLA **Business of Science Center** (BSC), prepares scientific, engineering, law, medical, and business students for non-academic careers, with a focus on entrepreneurship. It offers a **MedTech Innovation Program** which addresses challenges in biomedical device and diagnostics development by bringing together focused multi-disciplinary teams comprised of UCLA PhD, MBA, law, and medical students who work closely with design students, clinicians, bioengineers, business, and life sciences faculty, as well as industry experts. BSC also hosts an annual **Venture Team Competition**, offering a \$30,000 prize.

More than half of the intellectual property at UCLA is generated by the David Geffen School of Medicine (DGSOM). The school participates in the UCLA Clinical and Translational Science Institute (CTSI), which was created with funding from the National Center for Advancing Translational Sciences, a part of the National Institutes of Health. UCLA CTSI is a research partnership of UCLA, the Los Angeles Biomedical Institute at Harbor-UCLA Medical Center, Cedars Sinai Medical Center, and the Charles R. Drew University of Medicine and Science. It provides research infrastructure designed to accelerate scientific discovery and clinical breakthroughs that improve health and healthcare in Los Angeles County.

CTSI is responsible for the creation of the University of California's **Center for Accelerated Innovation** (UC CAI), which is a collaboration of the UC medical campuses at Davis, Irvine, Los Angeles, San Diego, and San Francisco. Based at UCLA, the UC CAI advances the translation of academic discoveries into drugs, devices,

or diagnostics that benefit patients. Supported by the National Heart, Lung, and Blood Institute (NHLBI) and the National Institute on Drug Abuse (NIDA), its goals are to engage University of California research innovators in entrepreneurship; solicit and select technologies with high commercial potential that align with the missions of NHLBI and NIDA; incubate those technologies to facilitate their translation into commercial products; and create a high-performing, sustainable infrastructure that will serve as a model for academic research centers.

To enhance communication and coordination among campus stakeholders in UCLA's entrepreneurial ecosystem, the Entrepreneurship Council was formed in February 2013 and now includes over 18 different campus groups (including OIP-ISR) and meets on a quarterly basis. In 2014, the Council launched **Bruincubate.com**, a web-based portal piloted by OIP-ISR that is intended to be a one-stop shop for those who are looking for all entrepreneurial groups, resources, and events on campus as well as relevant off-campus resources.

Incubators and Accelerators

Founded in 2012, **Startup UCLA** is a ten-week summer accelerator program designed to provide a community to support students and recent alumni in developing ideas and launching early-stage companies. Participant teams are provided with workspace, guidance, and mentors, and at the end of the summer the teams pitch their companies to a network of local entrepreneurs and investors. Housed along with Startup UCLA in Covel Commons, the **Blackstone LaunchPad at UCLA** complements the Startup UCLA accelerator program by offering free year-round coaching, networking opportunities, and events for undergraduates and alumni. Developed and supported by the Blackstone Charitable Foundation and made available to university campuses worldwide, Blackstone LaunchPad is designed for aspiring student entrepreneurs, regardless of academic major, to introduce entrepreneurship as a career path through coaching, ideation, and business creation support.

The **David Geffen School of Medicine Accelerator** was launched in October 2013 with a focus on enabling UCLA medical faculty to develop and commercialize health related devices, diagnostics, and therapeutics

technologies, as well as digital health applications. It has three specific goals: promoting improved patient outcomes and reducing the cost of healthcare; supporting the interests of the medical school's faculty in translation and commercialization; and generating revenue that will benefit the research interests of the School of Medicine. The Accelerator works directly with the medical faculty to advance the most promising projects with the shortest route to commercialization.

In January 2016, the **UCLA Anderson Venture Accelerator** was launched to provide an on-campus space where students from across UCLA, including the health and computer sciences, engineering, and the humanities, can work to develop new ventures and meet with advisers. The 10,000 square foot space includes training rooms, collaboration spaces and working lounge areas, and is located within easy access distance to the research libraries of the Anderson School of Management.

Funding

The **UCLA Venture Capital Fund**, a nonprofit vehicle that invests in startup ventures by UCLA students, faculty, and alumni, is a community of UCLA alumni and friends whose core purpose is to invest in and promote entrepreneurship at UCLA.

Governor Gray Davis Institutes for Science and Innovation

UCLA partners with UC Santa Barbara in the California NanoSystems Institute (CNSI). Similar to CNSI at UCSB, CNSI at UCLA offers lab facilities providing access to sophisticated research equipment for a modest fee. It hosts eight core facilities totaling 188,000 square feet, including electron, atomic force, and X-ray diffraction microscopes, as well as specialized robotics for molecular screening, and also makes available 8,900 square feet of vertical flow clean room space for CNSI projects and companies. Its wet lab incubator can accommodate up to 16 resident startups and is the only lab of its kind in the Central Los Angeles area. CNSI at UCLA also offers companies workstations and office space in a state-of-the-art co-working area. CNSI's modular entrepreneurship space is designed to meet the needs of early-stage companies by providing access to

infrastructure such as high-end instruments, tissue culture and hood facilities, as well as access to networking opportunities, events and seminars. Admission criteria have recently been expanded to allow access to office space for some startups that are not UCLA licensees. Resident companies can use the Startup in a Box program at the incorporation stage, but for the most part are relatively advanced, with experienced business and technical teams.

Access to lab facilities of this kind, plus a broader suite of supporting services, can make a difference in an emerging company's development. A good example is *Carbonics, Inc.* which aims to lower energy use and improve the performance of electronics through the use of carbon-based nanomaterials. Based on prototyping work done at CNSI's clean room facilities, Carbonics received \$5.5 million in funding from TAQNIA International, a Saudi Arabian company. The relationship began through a partnership between the Center of Excellence for Green Nanotechnologies at UCLA and the King Abdulaziz City for Science and Technology.

Associated Programs and Facilities

Along with other Southern California institutions, OIP-ISR is a collaborating sponsor of **First Look LA**, a technology showcase presented by the Los Angeles Venture Capital Association (LAVA). At this invitation-only event, promising research and emerging startup opportunities from the region's research institutions are presented to investors and entrepreneurs. The New Ventures team coordinates the pitch coaching for participants with UCLA technologies, nine of which were featured in 2015.

"The launch of Carbonics is an exemplary success of the CNSI ecosystem, from the incubator to the core laboratories. Carbonics benefits from the use of the CNSI's clean room core facility, a key infrastructure component to nanodevice prototyping."

—Kang Wang, UCLA Professor and Co-Founder, Carbonics.

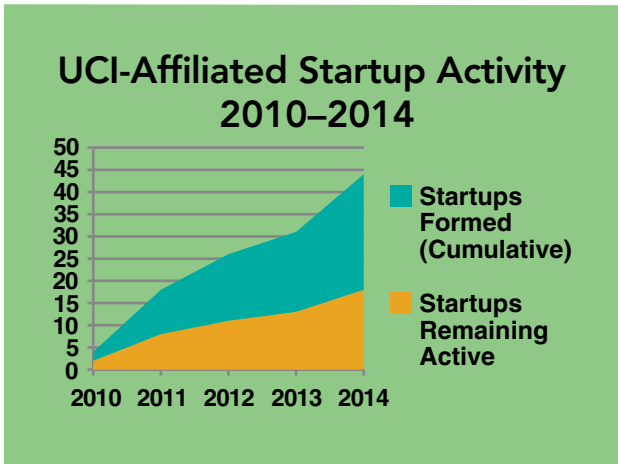
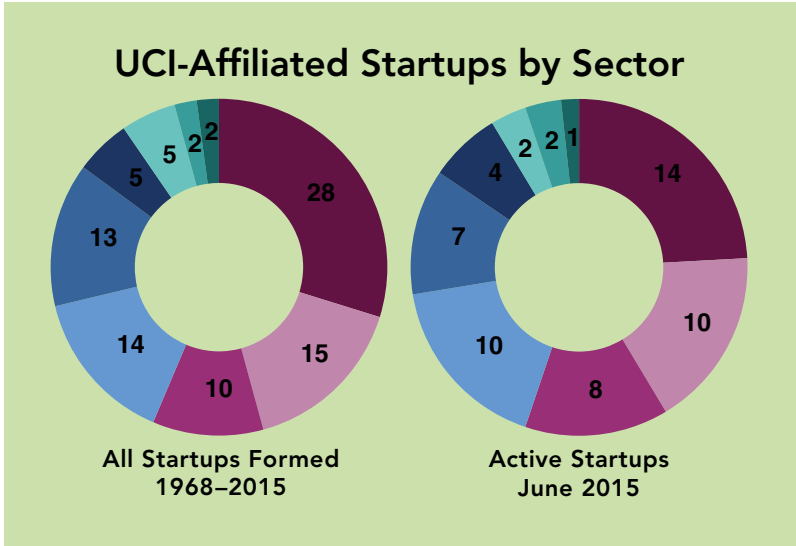
Companies Launched Out of UCLA Improve X-rays, Blood Testing, and Water Purification

Tribogenics, formed in 2009 to commercialize technology developed by UCLA professor of physics and astronomy Seth Putterman and co-founded with his colleague Carlos Camara, has developed a technology that uses the triboelectric effect (a process similar to static electricity) to replace the large and expensive transformers needed for traditional x-rays, enabling the deployment of low-cost, miniature, ultra-portable X-ray equipment. The Los Angeles based company initially raised \$19.7 million in funding from Flywheel Ventures, Founders Fund, and other investors.

Vortex Biosciences was founded in 2012 to commercialize technology based on a discovery by bioengineering professor Dino Di Carlo, whose UCLA team developed a liquid biopsy device that selectively traps metastasizing cancer cells in the blood stream, a technology that may aid in cancer diagnosis and treatment selection. Vortex is now being funded by NetScientific, a global company that invests in technologies to fight diseases such as cancer and diabetes.

Using nanotechnology created by Eric Hoek, a professor in UCLA's Department of Civil and Environmental Engineering, *NanoH2O* was founded in 2005 to develop cost effective reverse osmosis membranes for seawater desalination and advanced water purification. Its formula incorporates nanomaterials and polymers in membrane design, increasing efficiency and reducing the high energy consumption typical of most reverse osmosis systems. Initial investors included Khosla Ventures, Oak Investment Partners, CalPERS Clean Energy and Technology Fund, and PCG Clean Energy and Technology Fund. In 2012, NanoH2O received \$40 million in equity financing from investors including BASF Venture Capital GmbH, Total Energy Ventures International, and Keystone Ventures. Acquired by LG Chem Ltd. in 2014, the company became a new business named LG Water Solutions in 2015.

UC Irvine Startup Activity at a Glance



94 UCI-Affiliated Startups Generated Between 1968 and June 2015

58 UCI-Affiliated Startups (1968-2015) Still Active in June 2015

72% Portion of UCI-Affiliated Startups Still Active in June 2015 That Have a Life Sciences Focus

University of California, Irvine

Founded in 1965, UC Irvine (UCI) has become an important catalyst for innovation and entrepreneurial activity in Orange County. As of fall 2015, its enrollment includes 25,256 undergraduates, 4,861 general campus graduate students, and 1,388 health sciences graduate students. UCI has graduate departments in engineering, business, law, education, nursing and pharmaceutical science, and its School of Medicine is ranked by *U.S. News & World*

Report as one of the top 50 US medical schools for research. UCI has received an average of \$300 million a year in research funding since fiscal year 2005-2006, including \$293 million in fiscal year 2014-2015.

Technology Licensing

The **Invention Transfer Group** (ITG)—formerly the Office of Technology Alliances (OTA)—implements

option agreements that help simplify the licensing process. Option agreements grant the applicants periods of time to evaluate the commercial potential and applicability of technologies while negotiating definitive license rights with the University of California. The Invention Transfer Group fosters the commercialization of UC Irvine technology by granting flexibility and timeliness to operations and negotiations. ITG was recently moved from UCI's Office of Research to become a part of the UCI Applied Innovation initiative, which acts as a conduit to the business community for the commercialization of technology.

Entrepreneur Support

Business Plan Competitions

The **Merage School Business Plan Competition** is sponsored by UCI's Paul Merage School of Business with administrative support from Applied Innovation. Supported by mentors and industry experts, teams of students, staff, and researchers have the opportunity to create a plan and potentially fund their business idea all within 6 months. In 2015, the competition awarded \$50,000 to finalists; the 2016 competition awarded \$100,000 in prize money spread across 12 categories.

Entrepreneurial Education and Support

Developed by a task force under the Office of the Vice Chancellor of Research, **UCI Applied Innovation** was launched in September 2015 with the goal of catalyzing an entrepreneurial ecosystem in Orange County. It supports entrepreneurs from both the campus and the wider community, using an unusual model in which incubators and accelerators, angel investors and venture capitalists, mentors and legal experts—all the resources and expertise new businesses need to succeed—are housed under one roof in a space called The Cove. Located adjacent to the campus at University Research Park, **The Cove** is a 31,000 square foot collaborative space that also incorporates an event venue called The Beach. As of February 2016, The Cove houses 27 student and faculty startup teams, a dozen "ecosystem partners" from outside the university, and roughly 35 staff members.

Applied Innovation provides aspiring entrepreneurs with access to nearly 400 mentors, a number that is continuing to grow. The Cove's **Experts-in-Residence** program, which provides access to experts with specialties ranging from legal and accounting services to investment and market strategy, is complemented by business leadership mentoring programs offered through the Paul Merage School of Business. The **Executive Mentoring Program** matches MBA students with executives from the local business community, and SCORE One-on-One Consulting, run through the Merage School's **Beall Center for Innovation and Entrepreneurship**, offers consulting support for students, researchers, and faculty interested in founding or expanding a business.

Applied Innovation has a newly created \$5 million seed fund (launched in September 2015) that can make pre-angel investments of \$50,000–\$250,000. While patents from licensed technologies generate some revenue, most of Applied Innovation's funding comes from UCI and private sponsors.

The **Blackstone LaunchPad at UCI**, launched in March 2014, provides one-on-one entrepreneurship coaching and mentorship on campus for both students and faculty. Developed and supported by the Blackstone Charitable Foundation, the LaunchPad program began in Miami as a way to help less-advantaged students gain entrepreneurial skills. Made available to university campuses worldwide, Blackstone LaunchPads are in operation on the Southern California campuses of the University of Southern California and UCLA as well as UCI. The Blackstone LaunchPad service model aims to draw out entrepreneurial ideas with commercial potential and pair them with the resources needed to advance their development. With students engaged and ventures launched as its core metrics for success, from its inception through June 2015 Blackstone LaunchPad at UCI has coached more than 750 students, with approximately half moving forward at some level—some as potential high-growth businesses and others more as personal projects—in fields ranging from biotech to taco stands. Several startups have launched successful Kickstarter campaigns, raising a total of \$500,000. In 2016, the program would like to triple the number of students it reaches to 2,500, or 10% of UCI's undergraduate student body. To increase

its visibility, it also runs **Lunchtime LaunchPad**, an informal program that brings in 20 speakers each semester to talk on topics related to entrepreneurship. Expanding its offerings further, in April 2016 it launched **LaunchPad Lunacy**, a new pitch competition with spots for up to 64 aspiring entrepreneurs and a grand prize of \$1,500.

Blackstone LaunchPad at Irvine was funded by the Blackstone Group with \$300,000 over three years, which covers 30% of its budget. UCI's Division of Undergraduate Education and the Provost's Office have contributed, and a private donor has committed an additional \$50,000 for two years. The program is looking for a model for long-term financial sustainability, and creating a privately funded endowment is one option being considered.

Incubators and Accelerators

The **Beckman Laser Institute Photonic Incubator**, an 11,000 square foot facility established by UCI's Beckman Laser Institute and Medical Clinic (BLI), supports the development of new biomedical systems for medical diagnostics, therapeutics, and cellular/molecular analysis. By leveraging BLI's research and clinical infrastructure, it is designed to facilitate commercialization activity by students and faculty. Space is leased to occupants at a moderate cost. As of mid 2015, the incubator had five resident companies, all founded by faculty or students; a sixth was founded by a UCI alumnus who is now an adjunct faculty member. All but one are using UCI-licensed technology.

The Photonic Incubator doesn't help directly with company formation, IP management, or introductions to investors—activities that are managed by Applied Innovation. To be admitted to the Photonic Incubator, participants must be associated with the Beckman Laser Institute or be working in the area of biophotonics (a sub-field of optics and photonics). Funding for residents comes primarily from SBIR grants (with approximately \$15 million awarded to date), from the Department of Defense (for military photonics and battlefield medicine), and from NSF and NIH. Most grant recipients are working in the fields of physics or engineering, to apply photonics to biology or medicine.

Another UCI biotech incubator, **TechPortal Orange**, is located on the UC Irvine Medical Center campus in Orange. It offers 2,400 square feet of wet lab space and 750 square feet of office space which is available for lease to both startups and established companies that are seeking opportunities in a research-oriented medical center environment. Incubating startup companies based on UCI intellectual property is the primary goal of TechPortal Orange, but it also seeks to enable and foster the interaction of external companies with UCI faculty and staff. The mission of TechPortal Orange is to facilitate technology transfer and accelerate the development of translational research into clinical applications.

Governor Gray Davis Institutes for Science and Innovation

A participant with UCSD in Calit2, UC Irvine is home to the **TechPortal**, an on-campus incubator working to commercialize technology developed through Calit2@UCI programs. Overseen by a committee of venture capitalists, faculty, and UCI senior administrators, its residents pay modest rent for shared lab space and access to equipment. TechPortal is exclusively supported by residents' fees; it receives no funding from either UCI or private companies but does get administrative help from Calit2@UCI staff. Since its founding in 2010, it has helped 15 companies, including five in 2015, in fields ranging from biomedical devices to IT and chemicals. All are working with UCI-licensed technologies.

Calit2@UCI also supports startups by providing access to clean room facilities for \$100/hour, a modest cost for the use of equipment that for most startups would be prohibitively expensive. To date, approximately 200 companies have used its facilities.

Calit2@UCI advanced-stage projects that are seeking industry partners and commercialization opportunities are also showcased by the Calit2 Igniting Technology panel presentation series, which offers two events annually, one in the spring and one in the fall.

Graduates of Calit2@UCI Illustrate Its Pipeline

Flint Rehabilitation Devices' technology supports a rehabilitation glove that helps people who have suffered strokes recover hand function. The company was founded by Nizan Friedman, who came up with the idea for the sensor-enabled glove while working on his PhD in biomedical engineering at UCI. The company was incubated at the TechPortal and received \$4.5 million in SBIR funding. Its product received FDA approval and went on the market in 2014 with the help of a two-year grant from the National Institutes of Health that provided \$500,000 to complete commercialization of the glove and \$1 million for further clinical trials to help provide objective measures of the benefits the device can provide to patients. The company currently has twenty employees.

Hiperwall, incubated at Calit2@UCI in 2007–2008, before TechPortal's founding in 2010, makes software that lets companies use commercially available monitors and video displays to create video walls with very high resolution and control that don't require the use of any specialized hardware. With initial support from a National Science Foundation grant, Hiperwall developed inside Calit2@UCI, working with an entrepreneur-in-residence identified by UCI's Office of Technology Alliances (the precursor of the Invention Transfer Group). Hiperwall's first customer was Samsung. Today it has an Orange County office with more than twenty employees, selling products that are used in mission control centers, entertainment venues and classrooms, as well as for digital signage. The company sells in more than 60 countries.

UC Technology Addresses Clean Energy Challenges

Energy efficiency, expanding the use of renewable sources to meet the state's energy needs, and progressively lowering greenhouse gas emissions are major policy priorities for California and, in combination, are contributing to the growth of clean energy technology as an important industry in the state. Fifty-one companies, drawn from eight of the UC system's ten campuses and one national laboratory, are currently using UC technology to address climate-related issues.

One potential game-changer in the energy field is finding a way to harness nuclear fusion reactions, which derive their fuel from water and produce little radioactivity and no carbon dioxide. Fusion—the hydrogen-based reaction that gives birth to sunlight—is in many ways the holy grail of energy production, offering the ideal of a cheap, abundant power source and no nuclear waste. It is also fraught with challenges. While governments are making major commitments, startups are also attracting private investment.

Nuclear fusion startup *Tri Alpha Energy* was founded by UC Irvine graduate Michael Binderbauer and his PhD adviser Norman Rostoker to advance an innovative approach to fusion reaction. Based in Foothill Ranch, the company has raised over \$200 million in investment from the Vulcan Capital venture firm of Microsoft co-founder Paul Allen and from the Rockefeller family. In June 2015, Tri Alpha Energy achieved an important milestone: its machine produced a ball of hydrogen superheated at 10 million degrees Celsius and held it for five milliseconds—much longer than government projects had achieved using the same method.

Associated Programs and Facilities

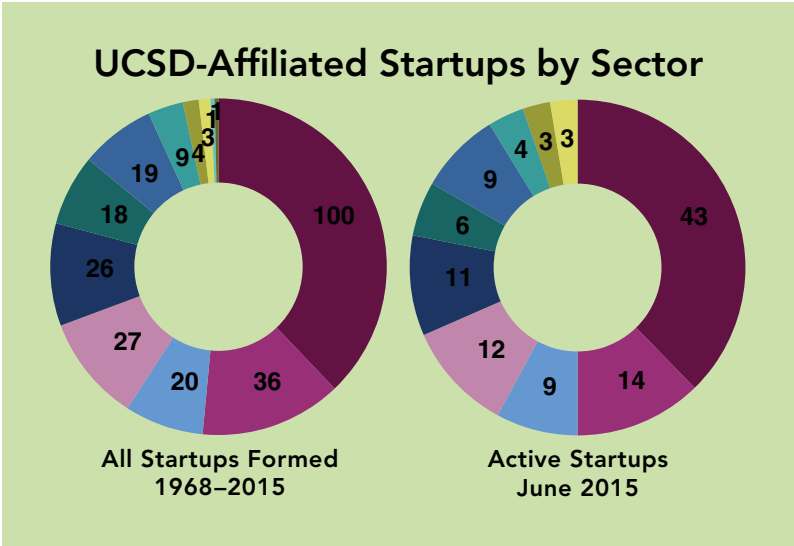
Off campus, **OCTANe** was created 13 years ago with the goal of diversifying Orange County's economy, supporting existing companies, attracting new ones, and retaining UC Irvine's graduates and their skills within the region. While entrepreneurs can use its facilities, there is no shared workspace. Its two main activities are educational programs (approximately 50 per year, including half-day events and signature multi-day events), and LaunchPad, an accelerator that takes early-stage companies with teams that have moved beyond the concept stage and helps to ready them for investment. OCTANe operates as a Small Business Development Center (SBDC), in partnership with the Orange County/Inland Empire Regional SBDC Network.

LaunchPad at OCTANe is distinct in its approach of using predictive analytics, as opposed to traditional mentoring. Companies make pitches to an expert panel with diverse experience, which scores them based on 30 criteria considered important to investors. That scoring is compared to a database of companies that have successfully received funding, and the results are shared with the entrepreneurs so they can better understand

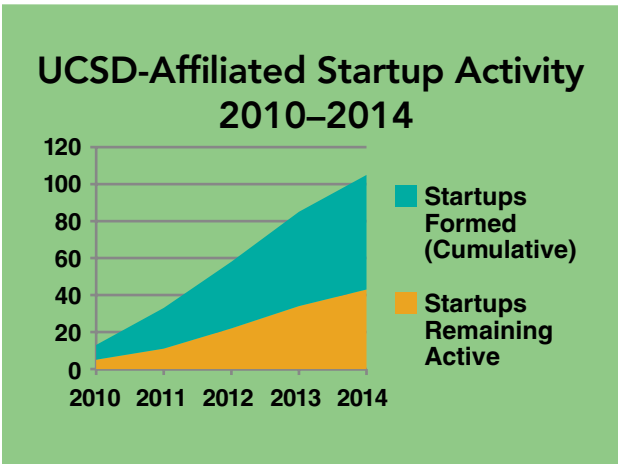
issues that need attention. Where gaps have been identified, OCTANe pairs entrepreneurs with experts who can help solve their issues (e.g., developing a pro forma financial statement), creating a disciplined support process. Companies that continue to advance can receive help with framing an investment strategy and with introductions to investors. As one example, a UCI professor developed a technology to the point where it was ready for a clinical trial; the technology was licensed from the university and received a series of SBIR grants; LaunchPad profiled it with investors, which led to the formation of a company that is currently being assisted by LaunchPad as it looks for post-SBIR funding.

OCTANe's support comes from sponsors in the community, members, events, and UCI, from which it receives an annual grant. In addition to off-campus programs, many OCTANe events take place on campus. Of the 110 companies that approached OCTANe for support in 2014, 50 were taken through the evaluation process. Reflecting its base in the broader community, only five of those companies (10%) came from UC.

UC San Diego Startup Activity at a Glance



- Medical Therapeutics
- Software and Services
- Medical Devices
- Research Tools
- Electronic Systems and Components
- Communication, Information, Data
- Medical Diagnostics
- Advanced Materials
- Environmental Services
- Transportation
- Energy
- Agriculture



264 UCSD-Affiliated Startups Generated Between 1968 and June 2015

115 UCSD-Affiliated Startups (1968-2015) Still Active in June 2015

66% Portion of UCSD-Affiliated Startups Still Active in June 2015 That Have a Life Sciences Focus

University of California, San Diego

Founded in 1960, UC San Diego (UCSD) has played a central role in catalyzing the development of the San Diego region's telecommunications and biotechnology industries. UCSD brought in more than \$1 billion in research funding in fiscal year 2015, a funding level that it also achieved in 2010, 2012, and 2014, with research funding falling just short of the billion dollar mark in 2011 and 2013. In 2015, UC San Diego had 26,590

undergraduate students and 7,145 students at the graduate level, giving it the fourth largest enrollment of all the UC campuses.

Technology Licensing

In 2015, UCSD established a new **Office of Innovation and Commercialization** (OIC) under the oversight

of the Vice Chancellor for Research to strengthen the university's system for supporting technology commercialization and entrepreneurial activity. Designed to align and support campus-wide resources, including technology transfer agreements and initiatives that support student and faculty entrepreneurship programs, its broader objectives include supporting and building connections to San Diego region's economy. New initiatives include the Open Flow Innovation program, designed to more easily and rapidly license technologies to startups through simplified license templates that expedite the technology transfer process, lowering the up-front cost required to start a company. This includes a simplified license for copyrighted software that exclusively transfers the software to the startup in exchange for 5% equity in the company.

Entrepreneur Support

Business Plan Competition

The **Entrepreneur Challenge**, a UCSD registered student organization started in 2006, is a business plan competition focusing on companies at the early-seed stage. In both 2015 and 2016, the competition awarded \$100,000 to finalist teams in the technology and biomedical science fields. Funding for the competition comes from a series of sponsors such as the John G. Watson Foundation, DLA Piper, Label Creative, and Joan and Irwin Jacobs among others. The Challenge's goal is to promote collaborative work among teams of multi-disciplinary professionals and students with the capability of shaping the San Diego region's economy.

Entrepreneurial Education and Support

The **von Liebig Entrepreneurism Center**, part of the Jacobs School of Engineering, began in 2002 by helping entrepreneurs through the proof-of-concept process with business mentoring and advice and has subsequently grown to support a diverse, nationally-recognized program. The center offers for-credit graduate courses on leadership and entrepreneurship, and on-site workshops. With 25 mentors, assistance is available to navigate the licensing process, develop business plans, analyze commercial potential, and engage investors. Proof-of-concept grants are also available for prototype development, and entrepreneurs

are exposed to investment opportunities through the Triton Fund. Applicants reflect a mix of graduate and undergraduate students, faculty, and alumni, primarily from the School of Engineering but ultimately representing a range of disciplines. In its fourteen year history, the Center has enabled the launching of 52 companies, two of which have been acquired, and counts five companies in the Triton Fund portfolio and five residents in the EvoNexus incubator.

Incubators and Accelerators

Supported entirely by philanthropy, **StartR** is a free six-month accelerator program for students and alumni of UCSD's Rady School of Management. Founded by a group of Rady students in 2013, the program offers entrepreneurial teams co-working space on the Rady campus, mentorship, workshops, and access to funding sources across the San Diego region's business community. StartR focuses on technology commercialization in the fields of life sciences and biotech, communications and media, mobile health, and high-tech, as well as social ventures and technology-driven consumer products. At the conclusion of each year's program, the teams present their pitches at a Demo Day which is attended by San Diego region investors and industry experts.

Launched in 2014 as part of the Qualcomm Institute (the Governor Gray Davis Institutes for Science and Innovation Calit2 center on the UCSD campus), **Innovation Space** is a 6,000 square foot incubator run by Qualcomm Institute staff that rents space to entrepreneurs. Its aim is to foster collaborative technology creation and transfer by housing in close proximity to one another project teams and startup companies that engage UCSD faculty and students as well as non-UC parties in the private and public sectors. Faculty screened in a rigorous selection process that judges the potential impact of their technology, applicants must also be incorporated and have one year of funding. Residents can stay 2–3 years.

The Basement provides collaborative space for student innovators developing their own companies and offers the support of over 50 experts and collaborators. The Basement is a 3,000 square foot on-campus space that is managed under the auspices of UCSD's Assistant Vice Chancellor for Alumni and Community Engagement. The

three UCSD alumni who were key drivers in its launch in 2015 are all involved in the venture capital sector, and The Basement enables important connections between alumni and students to foster student entrepreneurship.

Funding

Launched in November 2015 and sponsored by the Office of Innovation and Commercialization and The Basement, the **Proof of Concept Competition** engages undergraduate research teams of 2–4 students. The research projects can be in any industry or field of application, and teams are not required to have already formed startups, but all participants must be enrolled UC students. In the first round, up to ten projects can receive proof-of-concept funding of up to \$2,000 each, which includes automatic placement in The Basement. Winning teams that make it to the second round secure presentation slots at **The Basement Demo Day** and the chance to become one of three winners that receive additional awards of up to \$3,000 in follow-on funding. Winners are selected based on their level of innovation, commercial potential, competitive advantage, and how the proof-of-concept funds would be used.

Governor Gray Davis Institutes for Science and Innovation

UCSD participates with UC Irvine in Calit2, which over 15 years has worked with more than 400 companies and has helped launch 25 startups. Similar to Calit2@UCI, UCSD's Calit2 center, the Qualcomm Institute, operates an accelerator (**Innovation Space**) where qualified faculty startups, industry partners, or national laboratories can lease space for a modest fee inside the Institute's headquarters building on campus, allowing them to benefit from proximity to UCSD collaborators and facilities. As at Irvine, Calit2 plays an important role in providing startups with access to sophisticated equipment.

Companies in San Diego can pay \$100 per hour to use the **Nano3** micro/nano fabrication facility, giving them access to clean room and nano fabrication device laboratories that would otherwise be prohibitively expensive for startups. To help lower the entry barrier for users with limited previous experience in these areas, Nano3 offers hands-on training courses on some of the micro and nano fabrication techniques possible at the facility.

While approximately \$5 million per year of Calit2's budget comes from the University of California Office of the President, this has been matched more than 9:1 by contributions from donors, foundations, industry partnerships, and federal resources.

Associated Programs and Facilities

CONNECT is possibly the mother ship for successful innovation programs in the UC system. Started in 1985–1986 as a UCSD initiative to grow the San Diego region's innovation ecosystem, it has since then been a key catalyst for the region's growing technology economy—a relationship that in turn has helped the university grow its own innovation capacity. Launched with the twin goals of moving research ideas to market and helping San Diego diversify beyond its historic defense industries, CONNECT's story intertwines closely with the City of San Diego, whose mayor and economic development authority had concluded that the city's future would come more from growing companies than from attracting them and had turned to UCSD for help. UCSD's Chancellor Richard Atkinson had previously served six years in Washington, DC as Director of the National Science Foundation (NSF) and understood the value of research and its commercial applications. Engineering dean Bob Conn launched a business support program for students and faculty which brought them together with off-campus leaders in the San Diego business community who were interested in expanding the city's technology and startup community. Following the creation of this nucleus of strategy and support, programs were developed to connect researchers, entrepreneurs, and mentors, with particular support coming from law firms with the resources to support emerging companies.

In 2005, CONNECT separated from UCSD to become an independent nonprofit organization, providing networking and mentoring in the San Diego region for science and technology startups. The program has become less UC-centric as its budget has grown from \$1 million to \$3 million, but close ties continue with UCSD's institutes and departments. Across its organizational history, CONNECT has played a pivotal role connecting UCSD's resources with the region's business community and connecting businesses and service providers in San Diego with each other, stimulating the development of

San Diego's software, hardware, and life sciences industries in the process.

CONNECT's flagship program is **Springboard**, which was launched in 1993 and is possibly the oldest accelerator program in the country. A mentorship program, it helps entrepreneurs form teams, develop business plans, and raise capital. Startups accepted into Springboard work with an assigned Entrepreneur-in-Residence as well as C-level mentors in finance and marketing to complete a series of program "panels" that prepare the entrepreneurs for their final graduation panel and ultimately to pitch for capital. Successful finalists become **CONNECT Portfolio** companies and gain access to CONNECT's network of capital sources. Between 2005 and 2014, 450 companies completed the program, creating more than 4,000 new jobs. Sixty-five percent of Springboard graduate companies were still active as of December 2014.

In 2014, 466 new technology and life sciences startups were created in the San Diego region overall, including 70 in life sciences; 248 in software; 86 in communications, computers and electronics; 16 in defense and transportation; 16 in recreational goods; and 10 in environmental technology; together creating 1,860 new jobs. Overall, the region's innovation economy counted approximately 7,000 companies supporting close to 150,000 jobs in 2014. While not all of this activity can be associated with CONNECT, its activity over time as a catalyst for entrepreneur-led and innovation-related business activity, leveraging UCSD's research capacity, has been pivotal in enabling the region's technology innovation economy to thrive.

Launched in 2010, **EvoNexus** is an independently managed nonprofit technology incubator with locations in La Jolla, downtown San Diego, and Irvine. Created to grow and keep jobs in Southern California, it functions in part as a low cost M&A platform, providing access for larger companies and their venture funds to early-stage companies they might otherwise not discover. Supported by the Irvine Company and other corporate sponsors who contribute \$25,000 per year or more, EvoNexus takes no equity or fees.

Its three Southern California facilities total more than 40,000 square feet of office and dry lab space, hosting 52 companies in 2016, and include a 15,900 square foot facility at University Town Center (adjacent to the UCSD campus). Occupants span disciplines from life sciences and health (including medical devices, genomics, and semiconductors), to mobile apps, web platforms, and software as a service.

Reflecting the fact that companies doing hard science need longer periods than software companies to develop products, residents at EvoNexus can stay as long as two years. Startup companies originate from university campuses (UCSD, UC Irvine, Caltech, and USC) but also include teams transitioning out of established companies or from government programs, as well as serial entrepreneurs. Between 2010 and 2015, EvoNexus incubated over 100 companies, of which 88% were still active in 2015, and nine had been acquired. Because Southern California's pool of venture capital is smaller, EvoNexus looks to the Bay Area as the major source of investment for the companies it supports.

Springboard Graduates Provide Diverse Services

Recent Springboard participants span a range of industries. Founded in 2014, *JAS Neuro Imaging* is a startup diagnostic healthcare service company that uses portable scanning technology to detect Alzheimer's disease. It is currently working in partnership with Brain Sciences, which developed the first ultraportable high performance Positron Emission Tomography (PET) device—a camera that uses fluorodeoxyglucose technology to image the brain.

Quippi, founded in 2012, sells gift cards on behalf of large international retailers as a way for US immigrant consumers to send support to their families back home—initially in Mexico—without paying remittance fees (since those fees are absorbed by the retailers). Nine Mexican national retailers serve on its board, and gift cards are sold in thousands of locations on the US side of the border. Since its founding, Quippi has attracted \$3 million in investment.

Findings and Recommendations

The University of California's programs to support the commercialization of technology through entrepreneurs and startups are diverse and vary from campus to campus. System-wide, they fall into several broad categories: technology licensing, entrepreneurial support and training for faculty, entrepreneurial support and training for students, business plan competitions, incubators or accelerators, and access for startups to sophisticated equipment and facilities. The experience and sophistication of these programs varies considerably.

When measuring results, it is important to remember that many of these initiatives are very young, most having launched been since 2013. So in many respects, these programs are experiments, though not without precedent at other California and US universities. It is also important to recognize that the early-stage level of most life sciences startups requires a longer development ramp-up than the time needed for startups that are less technology intensive and less subject to exacting regulatory approvals. Therefore assessing the economic impacts of life sciences startups requires a longer-term perspective.

When comparing programs at different campuses, it is also important to note that the depth of services they provide and the number of startups they generate generally correlates with the campuses' age and size. Large, established campuses in major urban areas tend to have more highly developed programs and produce more startups, while newer campuses in less urbanized areas

tend to support activity at a smaller scale. Nevertheless, some newer non-urban campuses are showing considerable creativity in the programs they deliver.

Another factor influencing the proclivity of a campus to produce startups is whether it hosts a medical school, graduate programs in life sciences, or graduate departments of engineering or computer science—all of which generate intellectual property at a high level and support significant concentrations of both faculty and students in STEM-related fields.

With the important caveat that every campus is different, the data developed for this report and interviews with program managers and leaders suggest a number of broad conclusions and areas for attention as the University of California considers how to further expand its economic impact.

1.

The University of California system has made a major commitment to programs that support entrepreneurial development and increase its engagement with and contributions to the state's economy. This commitment should be continued and expanded through the sustainable funding of programs and by the promotion on UC campuses of a culture of innovation and entrepreneurship that supports and recognizes entrepreneurial success.

2.

There is an ongoing debate in the university community about the relative importance of technology licensing and entrepreneurial support, two sides of the process of technology commercialization. Many feel that these approaches are at odds: that the licensing process by definition restricts the flow of technology into the economy; that licensing processes can be cumbersome and constitute significant barriers to commercialization; and that the revenue generated by licensing is, on the whole, too small to justify the restrictions it entails. Some licenses, of course, have been extremely lucrative—and many startups founded by current or former UC faculty, staff, postdocs and students are based on UC-licensed intellectual property. This is particularly the case for companies founded by faculty in life sciences disciplines. At a minimum, it is important that UC's process for licensing intellectual property be as navigable and user-friendly as possible, and that flexible ways be found both to meet licensing revenue goals and to expedite the flow of technologies to entrepreneurs who will use them to start companies and produce jobs.

3.

In their more than fifteen years of operation, the Governor Gray Davis Institutes for Science and Innovation have led a cultural change in the UC system that is enabling campuses to work more closely with each other and helping research faculty to work more closely with business. Best practices and other learnings by the Institutes can provide a template for how to increase engagement with industry and harvest technology innovation from across the system.

4.

The state should look for new ways to incentivize University of California initiatives to support new technology commercialization and startup growth—for example, by rewarding campus and business collaborations that produce verified new companies and jobs created. The President's office has proposed legislation (2016) to fund innovation centers at all UC campuses, with associated metrics for company formation. California could also look to the model developed by the State of New York with its Start-Up New York initiative, which (starting in

January 2014) created tax-free zones around all SUNY (State University of New York) campuses outside of New York City and designated private colleges north of Westchester. If qualified new businesses partner with a college or university, create jobs, and contribute to the economic development of the local community, Start-Up New York allows them to operate tax-free on or near the eligible university or college campuses for 10 years.

5.

An issue that leaders of entrepreneurship programs sometimes point to is the cultural differences between programs that are designed to help entrepreneurs found companies and the more traditional university offices or departments those programs are attached to—essentially round pegs placed in square holes. At its base is a concern that commercialization and entrepreneurial programs are insufficiently recognized and prioritized. Some campuses have chosen to bridge this gap by formally repositioning or defining their offices of research or technology licensing to also include an explicit role in economic development. Recognizing that academic objectives will often be different from commercial ones, structural approaches should be considered to ensure that programs designed to enable entrepreneurs and startup activity are fully supported as a university priority—at the campus level and across the UC system.

6.

At a deeper level, the issue of cultural differences also relates to the systems through which faculty are recognized and rewarded—in other words, academic culture. At present, promotion and tenure criteria do not systematically include societally engaged scholarship. But if the university's role in the 21st century calls for greater civic and community engagement, then consideration should be given to more explicitly recognizing the contributions of faculty members to the application of knowledge at the community level.

7.

While formal university programs designed to support and nurture entrepreneurs are important, many companies that impact California's economy have been started by faculty or students who have not gone through

these programs. In many cases this is because when those companies were started, UC's current programs either didn't exist or were in their very early stages, or because entrepreneurs didn't know they were available. The most important way the university can support the economy is by continuing to deliver on its core educational mission—to produce citizens with the skills and knowledge to contribute to society and, in the case of entrepreneurs, to launch companies. The data developed through this report, however, suggests that organized entrepreneurial support programs are an effective way to magnify that impact. Those benefits can accrue not only to UC faculty and students, but also to other entrepreneurs in the community who have access to UC-sponsored facilities and services.

8.

Formal entrepreneurship support programs constitute one part of the university-enabled innovation ecosystems that surround UC's campuses. Many graduates who don't found technology companies nonetheless play important roles in their success. In the San Diego region, for example, there are many more UC graduates serving as chief science officers, board members or executives of technology companies than there are UC affiliated spinoffs. Similarly, UCSD's generation of patent attorneys in the San Diego area has been an important enabling factor in the development of its life sciences sector. Initiatives such as UC Hastings' Legal Garage recognize the critical supporting role played by UC graduates who are not themselves entrepreneurs.

9.

A focus on startups as sources of job creation requires perspective, since startups by definition start small and often fail. UC's experience shows, however, that many of those that succeed will make critical contributions to the economy and to society. Even for those that don't immediately succeed—in California, serial entrepreneurs are common—promoting entrepreneurial thinking and innovative approaches to problem-solving can be important as careers develop.

10.

Entrepreneurship programs receive important benefits from the engagement of private sector collaborators, whether as advisers, mentors, service providers or financial sponsors. Private funding can be particularly critical for facilities such as off-campus incubators that need to be connected to their communities. While generating revenue should not be the primary goal of incubators and accelerators, these facilities can be self-supporting. Facilities that can operate without subsidies are also likely to be more scalable.

11.

The university's UC Ventures Program adds another arrow to its quiver of tools for supporting UC-originated startups. To be fully effective, it will need to do several things: set the relationship between its investments and the share of equity that it takes at a level that is competitive with other funds and incentivizes startups to participate; sustain a portfolio of 25–30 deals in order to increase the odds of large payoffs; and participate on a case-by-case basis in follow-on later-stage rounds so that the university's initial position in a company isn't diluted.

12.

Technology licensing offices can benefit from private engagement as well. A model to consider is UCLA's recent creation of an independent public-private board—composed of industry leaders in fields including biopharmaceuticals, engineering, and venture capital—to oversee the activities of the Office of Intellectual Property and Industry Sponsored Research.

13.

Student-initiated entrepreneurship programs—which may sometimes move faster and be more flexible than university institutions—should be encouraged. The UC Hack Alliance offers a good example.

14.

The diverse programs at individual UC campuses are sometimes siloed and only loosely connected to each other. Without stifling creativity, ways should be found to better integrate and connect them. This may mean,

for example, enabling startup programs to work freely across department and other institutional boundaries. It could also mean having a single point of connection on a campus to guide students and faculty to the services that are most appropriate for their stages of business development or having a working council of all the relevant campus programs to better align and coordinate activities.

15.

Immigrants have a high propensity to invest in technology companies, particularly in California. Half of technology startups in Silicon Valley have been founded by people who came here from other countries, many of them through universities. A dearth of visas, however, forces many more to leave. The New York City Economic Development Corporation recently teamed with City University of New York (CUNY) on an International Innovators Initiative to connect international entrepreneurs with CUNY institutions and enable them to found companies in the city. The entrepreneurs will base their businesses in the partner school's incubator, a process which allows them—as part of an institution of higher education—to avoid the H-1B lottery. The initiative will also help them to create independent boards of directors, establishing an employer-employee relationship under which the company can sponsor an H-1B petition on the entrepreneur's behalf. The University of California is considering a similar initiative.

Impact and Opportunity

UC's campuses often constitute the core of innovation ecosystems in their regions, generating technology and producing job and business growth. It is important to remember that California is a state of distinctive regions, with wide social and economic variations. The University of California's ten campuses, each with a special relationship to its community, reflect this diversity. For this reason, strategies to support entrepreneur-led growth should come principally from the campus level, including administrators, faculty senates, students, and campus partners in the business community.

A traditional academic view, still held by some faculty, is that community engagement and support for entrepreneurs and startups is outside the scope of what a university should be doing. Without distracting from its academic mission, however, community engagement must be a key part of a 21st century research university's DNA and deeply woven into its mission. There is a growing interest in starting new companies—from faculty and particularly from students. This cultural shift represents an opportunity for the state. Viewed from this perspective, the university's support for entrepreneurs and startups should be seen not as a shift away from traditional academics, but as an important way to amplify their impact.

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