

The von Liebig Effect!

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The 1980 enactment of P.L. 96-517, The Patent and Trademark Law Amendments Act, usually referred to as the Bayh-Dole Act, dates the current authority for the transfer of new technology from university laboratories to the private sector (1). The University of California, San Diego (UCSD) through its Technology Transfer and Intellectual Property Services (TechTIPS) program has experienced some success in implementing this Act (2). To enhance the UCSD technology transfer effort, in 1999, the Jacobs School of Engineering and the William J. von Liebig Foundation agreed on creating a novel Entrepreneurial Center within the pending construction of the Powell-Focht Bioengineering Hall (3). This article is a report of the Center's first four years of operation and the "von Liebig Effect" on the commercialization of UCSD Jacobs School of Engineering faculty inventions and a culture of entrepreneurship.

Background

The William J. von Liebig Foundation and officials of the Jacobs School held preliminary discussions about creating an Entrepreneurial Center (EC) within the planned Powell Focht Bioengineering Hall (Figure 1). The pending construction of the Hall was based on the Whitaker Foundation Leadership Award to the Bioengineering Department. Imbedded in the grant to the Whitaker Foundation was the basic concept for the EC.

The proposed "von Liebig Model" contained three key elements: graduate entrepreneurial education, competitive faculty seed-grants and business advisors to speed commercialization. The basic premise was that these elements would create a broadened culture of entrepreneurship and invention ideas within the Jacobs School and the University.

The concept of "entrepreneurism" is based on the hypothesis that all Jacobs School faculty, students and fellows should *have a working understanding of the risks associated with the commercialization process and that will accelerate innovation and technology advancement*, thus help them be more innovative in their respective careers in industry, government or academia.

The von Liebig Foundation pledged its support in July 2001. The UCSD Faculty Senate approved the concept and the Center began operation in 2002. The move to the Bioengineering Hall was completed

in 2003. The Center's unique entrepreneurial environment was built out and equipped through the von Liebig gift. Annual reports are provided to the Foundation and their officials visit the Center from time to time.

Model Return on Investment

In its first four years of operation, the Center's scorecard has exceeded initial expectations. By creating a culture of entrepreneurship and backing it up with seed grants and faculty friendly business advice, the Center has:

- Worked with about two-thirds of the Engineering faculty,
 - Awarded 48 seed commitments totaling about \$2.5M,
 - Trained over 200 graduate and post-doctoral students.
- Evaluation of the first 36 seed investments showed the following:
- Negotiated thirteen licenses,
 - Created 8 start-up companies,
 - Returned \$48M in revenue to the University.

The developing "von-Liebig Model" enhances the traditional university technology transfer program using these guiding principles:

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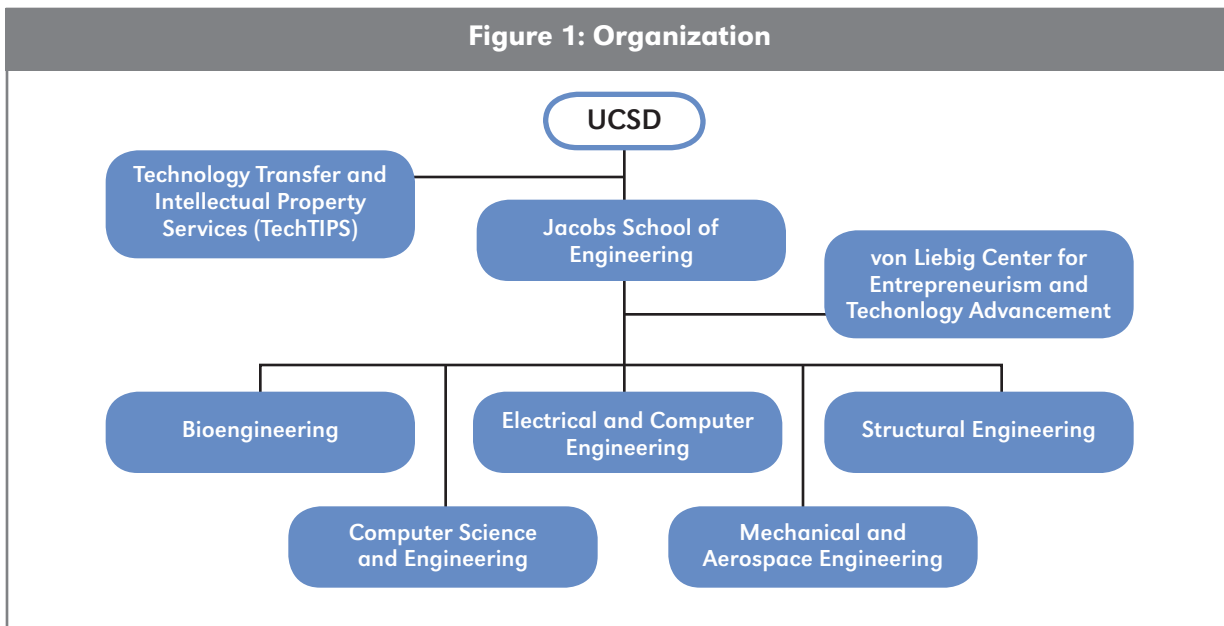
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Figure 1: Organization



- Create an understanding of “commercialization success elements.”
- Educate post-docs and graduate students about entrepreneurship.
- Link faculty domain business advisors with faculty innovators.
- Provide competitive commercialization seed-investments.
- Shepherd IP in conjunction with licensing office.
- Encourage faculty to continue teaching and research.
- Provide faculty continuing advise on commercializing their discoveries.

The von Liebig Model was implemented with a relatively modest investment and without any modifications of existing policies or procedures at UCSD. Venture capitalists have commented *“TTIPS and the von Liebig Center are excellent to work with.”*—Bioengineering

Inspiration

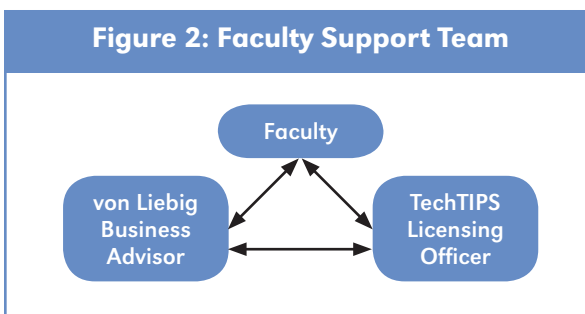
The inspiration for the Center was the timing of the confluence of interests of the William J. von Liebig Foundation and Jacobs School of Engineering. The symbol for the Center is the butterfly, which Bill von Liebig felt was a symbol of the mystery and beauty of life because of its intriguing transformation from caterpillar to butterfly. This symbol captures our goal of translation of University ideas into products and services. The Foundation mission statement “Empowering Vision... Transforming Ideas... Enriching Life...” also helped inspire the Center’s mission of Education, Seed-Investments and Commercialization.

Faculty Support Team

The faculty commercialization support team builds from the initial “walk-in” of the Jacobs School faculty member. [Figure 2] This can occur in any number of ways such as email, telephone, or by using the Center’s front door. With faculty interest shown, the Center assigns a business advisor that matches the domain of the invention, such as software, structures, life science, electronics and several others. Also, there is a team member from TechTIPS, the UCSD office of technology transfer that represents the University in invention disclosures, patents and licensing matters. So for each invention, the three-person team is formed indefinitely. The faculty can discuss any aspect of the commercialization process with his/her “venture team.”

The business advisors (advisors) are paid as consultants by the Center. In fact, the starting five domain business advisors are considered a “dream team.” Each had individual success being a key player in previously commercializing a technology. With their own experience also came some financial success

Figure 2: Faculty Support Team



and a desire to contribute through their efforts to the University, even though most are not graduates of UCSD. The advisor consulting rate is well below market for the caliber of these consultants. The advisors are well networked in the Southern California and National venture capital communities.

The advisor provides commercialization strategies to the team. If the invention's technical data is incomplete, the advisor may recommend that the faculty compete for a seed-investment. The advisors help identify the business interests of the audience when the faculty are preparing presentations for the seed-investment competition and potential investors. When awarded funding, the faculty innovator and advisor develop a commercialization plan with milestones and deadlines. Advisors oversee the release of milestone tranches from the seed-investment, and evaluate faculty progress. Also, the advisor continues to assist with the project, even if the faculty member is unsuccessful in competing for a seed-investment. Typically the faculty comment something like, *"The team of people from von Liebig and TechTIPS have been extremely helpful in handling all the necessary paperwork and in assisting with the commercialization process."*—*Computer Science and Technology*

Incentive Seed-Investments

The original gift from the von Liebig Foundation was particularly valuable for developing the seed-grant program. The seed-investments provide opportunities for faculty to move their invention through some critical steps along the commercialization pathway. For example, the grants facilitate efforts such as market research, studying IP prospects, developing prototypes, or making design improvements.

The seed-grant competition is open to all Jacobs School of Engineering faculty and may include collaborating investigators from other UCSD Schools, such as the School of Medicine. The maximum award was originally \$50,000 (now \$75,000) with no indirect costs. Upwards of \$600,000 per year was invested in faculty discoveries.

An unanticipated benefit of the seed-investment program is that faculty wrote additional publications based on the work accomplished with this support. This will be described later in the section under "program evaluation."

The grant application process is Web-based and peer-reviewed. The review becomes the basis for programmatic decisions by the Center Directors. Twice yearly the Directors issue a solicitation for faculty to email their intent to compete for an incentive seed-grant. This may be the first contact for this faculty member with the Center.

The letter-of-intent provides a snapshot of the scope of science, engineering and technology that will likely be presented to peer reviewers. This information is the basis for selection of outside reviewers and planning the review sessions. The business advisors are central to the recruitment of outside reviewers. They and the Center Directors recommend outside reviewer candidates for each of the domain technologies. Then the business advisors help recruit the reviewers from the community, including such places as the Tech Coast Angels, local industry and other successful individual entrepreneurs. Professional venture capitalists are usually not included because it creates conflicts, as well as it being impossible to include all the groups who might potentially be interested in an invention.

Review Process

Panels of domain reviewers are assembled on consecutive days for life sciences, telecommunications and software, and miscellaneous technologies. Each reviewer is required to sign the Center's nondisclosure agreement for confidentiality, as well as having received copies of the applications under consideration, review criteria and scoring sheets. The faculty team leader usually presents the project essentials supported by team members as developed and practiced with their business advisor. The presentations may include a technology demonstration.

The presentation is limited to about fifteen minutes, followed first by questions of the reviewers and then questions by business advisors and Center Directors. Licensing officers from TechTIPS participate in the review. The total time for the project presentation and Q & A is about thirty minutes. Then all reviewers, advisors and Directors score the potential for invention commercialization. In general, six to eight applications are reviewed each day. At the conclusion of the review session, all reviewers rank the day's technologies top to bottom including constructive comments for all presenters.

The costs for the review process are modest. Reviewers are provided parking, continental breakfast and lunch buffet. Following the ranking of proposals, the review materials are collected and destroyed. A Center intern or staff averages the rankings and scores of outside reviewers and separately for advisors and Directors, as well as, the combined total. This analysis serves as the basis for subsequent award discussions and recommendations.

Awards Recommendation

Shortly after completing the review process, the business advisors and Center Directors assemble to

rank all the applications using the scoring analysis and other information. The Center Executive Director outlines the dollar amount budgeted for funding awards and present program considerations. Each of the applications is then discussed by daily ranking and then by a combined ranking of all the applications.

This process leads to a final ranking, including budget recommendations for each project. While not all faculty receive a seed-investment (success ratio is about 33 percent), the endpoint is to provide an equal opportunity incentive for each faculty member to gain fiscal and intellectual support to license or initiate a start-up company based on their invention. So far, no faculty member has permanently left the University to head their start-up company.

The Executive Director then develops the funding plan of total and partial project awards to as many faculty as the Center's budget for that solicitation will allow. The plan is presented to the Jacobs School Dean. When approved, the results are announced to all faculty within one month of the outside review and about three months from the first notice of the solicitation. The awardees and reviewers are then invited to a follow-up celebration in the Center at the close of a business day. This provides additional opportunity for exchange of information and networking on the new technologies funded for development.

Milestones and Tranches

Following the award announcement, the faculty and business advisor meet to develop a program plan for each project. They agree to milestones, associated costs and deadlines. This process has evolved so that today we have a Center goal of a one-year plan resulting in either license or start-up. Of course not all incentive grants will reach either of these goals. The outcomes of the first 36 seed-investments are outlined in the program evaluation section below.

During the development project, the faculty inventor, advisor, and tech transfer official meet on a regular basis. Based on recommendation of the advisor, funding is released to the faculty inventor in tranches. The tranches are funded in association with completion of milestones towards commercialization.

The business advisors regularly meet with the Center's Commercialization Director to discuss the status of each faculty team and exchange information on potential commercialization avenues. This is an opportunity for cross-fertilization from the business perspective and is also helpful for technical solutions.

Project effort is usually directed towards developing prototypes, conducting market analysis and validating

business assumptions, planning marketing presentations and interviews, in general, developing the factors that are needed for an effective business plan. The Center's Fellows, who are post-docs or Rady School of Management students, are also available for assisting the team with market analysis or almost any other studies that are deemed important to commercializing the technology.

Education Program

From the beginning, the Center's leadership made a strategic decision to develop an education program intended for engineering graduate students and post-doctoral fellows. This decision was based on an assumption that faculty had chosen academic careers (rather than industry or government) and were already overloaded with their own teaching and research responsibilities. Therefore, the graduate students and post-doctoral fellows would have courses tailored to their interests and would become a cadre of talent with an understanding of commercialization; thus providing a window to the faculty's laboratories and their associated inventions. The goal is education for 100 percent, rather than only the few percent that actually start companies, on the elements of entrepreneurship; the "what and why" actions that occur within entrepreneurial organizations.

This Jacobs initiative, determined to offer its students best practices, engaged Professors Karl Vesper, University of Washington, and William Paulin, PhD to convert standard entrepreneurship "how-to" course content and teaching methodologies into engineering and workplace centric "why and what happens" in our curricula. Four courses are taught: Venture Mechanics, Enterprise Dynamics, Applied Innovation, and Corporate Entrepreneurship for Global Competitiveness. Students glean a real-life understanding of the innovation processes and new product/market development in Venture Mechanics. They study designing, building, and managing the innovative business venture within a company in Enterprise Dynamics. They then move to the CEO/Governance level of an Organization, where students examine the later stage of the engineer's career as owner/founder or president in Applied Innovation. Then students study the highly innovative company that grows into a risk-averse large company that struggles to find remedies to promote innovation from within. The latter, is the important message in Corporate Entrepreneurship for Global Competitiveness.

Classes have 25-30 students. Our professors find the engineering students highly motivated and tal-

ented. These students understand and use the business concepts easily and well. In fact, one student entered and won a worldwide Internet business plan competition. He competed against business school teams from all over the world.

About 200 graduate students and fellows have taken one or more courses. Students successfully completing three of the courses receive a certificate of achievement that demonstrates their knowledge and interest in entrepreneurship. Students beyond engineering, as well as, a growing interest within the Jacobs School, will likely lead to an expansion of these offerings throughout the University.

von Liebig Forum

In 2004, the von Liebig Forum was created to provide a venue for “Profiles in Innovation” by world leaders from Industry, Government and Academia. Our Forum speakers present personal perspectives on the “ingredients for innovation” leading to their business success and their vision for the future. These are high profile campus events, two-to-three times during the UCSD academic year. Each Forum is videotaped, edited, archived and available on DVDs to students, faculty and the public.

Forum speakers have included William Wulf, PhD, President, National Academy of Engineering; Irwin Jacobs, Chair BOD, Qualcomm; Alfred Mann, CEO and Chairman of BOD for Mannkind Corp.; Bill Stensrud, Managing Director, Enterprise Partners Venture Capital; David Feigal, PhD, former Director CDRH, Food and Drug Administration; and Ivor Royston, MD, Managing Member, Forward Ventures.

The Forum begins with a presentation by the invitee on their “profile in innovation.” The Forum physical configuration is then reset for a one-on-one interview that adds depth to many aspects of the innovators experiences and personal life. The Forum ends with a period of questions and answers with the audience. Total length of a Forum is about one and half hours.

The Forum has numerous benefits for students and faculty. Some speakers are former UCSD faculty members with successful careers in the private sector and an enduring interest in academic research, education and the University. Speakers have opportunities to meet with groups of faculty and students outside the Forum. Several have had Q & A sessions with the students of the von Liebig education courses. The event is concluded with a reception, usually in the von Liebig Center.

A few weeks later, the Forum is televised by UCSD TV locally in Southern California and then

statewide. The total potential TV viewing audience is 16 million. Viewing is also available on the Internet and DVDs.

Fellows and Interns

The Senior Fellows are national and internationally recognized experts from industry, government and academia who have demonstrated outstanding contributions to entrepreneurship, technology advancement and society. University approval was needed for the Fellows program to provide many faculty privileges and consultant compensation for services. Fellows are in residence once or twice each academic year to lecture and consult with faculty and students.

Interns are usually UCSD graduate students. Most are hired for the summer and now some are from the new UCSD Rady School of Management. The interns assist the Center Directors and the business advisors. They are usually given specific tasks associated with a seed-grant project or event planning for the Center. They perform market research and market analysis, carry out business development to assess prospects for emerging technologies, perform financial analysis and work closely with Von Liebig staff, advisors and Jacobs School faculty in commercialization planning.

Seed-Investment Program Evaluation and Deal Flow

With the guidance of the Center Directors and business advisors, the interns conducted a survey of the first 36 seed-investment projects and a few projects funded by Center for Commercialization of Advanced Technologies (CCAT). Projects active for six months or longer were included in the study. Interestingly, results from the TechTIPS office showed that the number of University disclosures increased substantially in parallel with the operation of the Center.

The CCAT program, supported by Congress and funded by the Department of Defense, is a public-private collaborative partnership between academia, industry and government. Local partners are San Diego State University (SDSU) Research Foundation, the Security Network, the Space and Naval Warfare Systems Center Pacific and the von Liebig Center. The consortium-style CCAT intends to bridge the gap that exists between the generators of technology, the Department of Defense and the commercial marketplace.

The evaluation survey of the 36 seed-investments showed over 30 percent of the von Liebig projects resulted in commercialization. The total Center

commitment for these seed-investments was about \$2.0M. There were 13 license agreements, with 22 percent of von Liebig projects (8) resulted in the creation of a start-up business. Some businesses garnered investments in excess of \$1 million. Half of the projects received additional grants, contracts, or license and investment after receiving von Liebig grants. The total number of follow-on investments was \$8.3 million, an average of over \$230,000 per project. Including start-up acquisitions, the private sector investment in the licenses and start-ups has equaled \$48M. The data for licenses and company valuations is largely proprietary, but license and investment money represents a significant portion of the total project follow-on funding.

The von Liebig Center program also has positive effects on the dissemination of research findings. Surprisingly, nearly a quarter (25 percent) of funded faculty reported they had additional publications as a result of von Liebig funding. Overall 70 percent of projects received a tangible benefit from the funding in terms of either additional funding of the project or the ability to publish work that would have otherwise not been reported.

Structure of the Center

In 1999, Dr. Robert Conn, then Dean of the Jacobs School, presented a description of a “pilot program” for what and how the current Center would operate, and the potential risks and rewards to faculty and UCSD. After careful deliberation, the UCSD Academic Senate approved the concept. Current Dean Frieder Seible’s vision for the von Liebig Center was an area within the Bioengineering Hall that was easily recognizable as having a special function: namely, promoting entrepreneurship education and commercialization of University inventions. The Center is located in the lower floors of the Bioengineering Hall. The space includes a video conference room used for classes and myriad meetings, a reception area, the so-called butterfly room, lots of office space, an informal meeting area with a kitchen area for informal breaks and receptions, and a second conference room.

The Center has a number of simple but novel visual technologies that distinguish it from the other offices and laboratories in the Hall. Faculty, students, staff and visitors do recognize that the space is for business and commercialization. To capture key and innovative ideas, white boards cover many of the Center walls and are used by small and large groups. The video/conference room is used as the classroom for the Center courses, symposiums on

commercialization, and multi-organizational video conferences.

The Butterfly Room requires special discussion of its benefits to the Center. The inspiration for the Butterfly logo was described above. The room is a 16 ft. x 12 ft rectangle with six modern style chairs in a circle with no table. It is very basic and informal, and yet has become the focus of many “deals” and decisions. Perhaps it’s the glass door with the engraved butterfly symbol or the simple layout of the chairs. For reasons that are unclear, the room seems to engender a feeling of “doing business together” and many deals are made.

The Center has four full-time staff: An Executive Director serving as Chief Executive Officer, a Commercialization Director, Business Manager and Office Assistant. The Deputy Director and Associate Director are part-time. Seven business advisors are hired as consultants, essentially on a one day per week basis. The total Center operating budget is less than \$1M per year with \$600k of this budgeted for the two grant solicitation/grant award cycles.

A lesson learned was that temporary seed-investment grant office space for von Liebig projects has yet to be regularly used by project teams. The original Center design envisioned incubator office space for project meetings and program planning. These offices have seldom been used for this purpose. However, there is considerable interest in expanding the activities of the Center to other Schools of the University and the Center has the space to accommodate this expansion.

Future Objectives

The Center has proven its effectiveness, adjusted processes and can now explore ways to provide services to other campus faculties, such as The School of Medicine and School of Natural Sciences. The Center was asked to evaluate the University’s existing technology transfer process and make recommendations for making the system world class. The survey of faculty and report to the Chancellor was completed, approved and implementation is underway.

We anticipate continual improvements for the Center’s “team” innovation transfer process. Collectively we plan to engage our Directors, business advisors, fellows and interns to research new business models, for example, in the bioengineering industry; new business models are needed for regeneration medicine and systems biology. Fundamental to the long-term future of the Center will be developing an endowment that can support the legacy established

by the von Liebig Foundation Gift for commercializing Jacobs School of Engineering and other UCSD School's inventions and innovations.

Summary

The von Liebig Effect has been substantial and is continuing to evolve. Clearly it is having an effect on the Jacobs School culture for understanding and accepting the risks associated with innovation and commercializing University inventions. While it is too early to establish, there is evidence accumulating of a growing spirit of entrepreneurship among our students, fellows and faculty.

We are grateful to the William J. von Liebig Foundation for having the vision to invest in this opportunity to have an "Effect" and create a culture of entrepreneurship within the Jacobs School and to accelerate the commercialization of UCSD inventions. ■

References:

1) Bayh-Dole Act of 1980 (PL 96-517) and H.R. 6933 Public Law 96-517.

2) UCSD Technology Transfer and Intellectual Property Services; http://invent.ucsd.edu/index_flash.htm

3) Chien, S. and Bioengineering Faculty: Application to the Whitaker Foundation for the Continuation and Extension of the Development Award and the Initiation of a Leadership Award. May 1, 1998.

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