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## **AC 2011-1672: PROOF OF CONCEPT, LLC: A PRIVATE COMPANY FACILITATING UNIVERSITY ENTREPRENEURSHIP AND INDUSTRY INTERACTION**

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# **Proof of Concept, LLC: A Private Company Facilitating University Entrepreneurship and Industry Interaction**

## **Introduction**

This paper describes a private company that sits at the interface of the corporate and academic worlds. Although created as a for-profit entity that does not involve a formal partnership with the University, the company supplements a role traditionally handled by university corporate relations offices: delivering funded, challenging multidisciplinary projects to student teams. *Proof of Concept* is a contract engineering firm that leverages University resources through a series of “fee-for-use” rental agreements for key equipment (e.g. wind tunnels, SEMs, anechoic chambers, etc), providing engineering R&D services with a core competency in early-stage reduction to practice of technology-based ideas. Teams are formed on a per-project basis, consisting primarily of upper-division engineering students, with key faculty expertise and technical advising provided through consultant agreements. Typical products are “skunkworks”-type operations, with rapid development, prototyping, and validation of client technology. All Intellectual Property generated during the project is owned entirely by the client. This model removes many of the constraints of industry partnerships and technology transfer, and is currently being used by the University as both an incubator for student/faculty/staff innovation as well as a means to acquire solid, industrially relevant projects for Senior design students.

## **Problem-Based Learning within a Multidisciplinary, Industrial Project-Based Context**

Problem-Based Learning (PBL) has been an extremely successful model for both medical and technology education;<sup>1,2</sup> our experiences with multidisciplinary student teams working on industry-provided challenges in a Problem-Based Learning environment confirm this. PBL begins by presenting a challenging, realistic problem to a small group of students. The group defines or redefines the problem and analyzes it systematically. The concepts required to solve the problem are then agreed upon, and group members assign themselves specific tasks to acquire that knowledge *on the basis of what needs to be known to solve the problem.*<sup>3</sup> Knowledge acquired must be shared among group members, then integrated with existing information to develop possible solutions to the problem. This process is iterated until a satisfactory resolution to the problem is reached. Throughout the process, an educator is present to assist as a *facilitator* rather than as a primary source of knowledge.<sup>4</sup> It has been shown that under this model, students acquire skills essential to continue self-directed learning, rather than trying to remember information that has varying levels of relevancy.<sup>3</sup> The outcomes of programs applying Problem-Based Learning have been extensively evaluated in educational literature<sup>1-6</sup>. PBL-educated students have a more holistic approach to their subject, more readily integrate new information, adapt to change, and work well as members of a team.<sup>3</sup>

For PBL to be successful, certain requirements must be met; we have found that a commercial product development environment is a natural fit to a major subset of these requirements. Companies that develop technology-based products, and startup companies that are at an early stage, are of particular value since creation of these products inherently involves multidisciplinary teams. Through our experience in developing an Industry/University Consortium for biomedical device companies,<sup>7</sup> we believe that industry provides an enabling

means for framing Problem-Based Learning within a *Multidisciplinary, Project-Based* context that exposes engineering students, working in teams across multiple disciplines, to meaningful, real-world challenges.

While the benefits are clear, there are a number of challenges in establishing and maintaining the deep level of required industrial interaction. These challenges include intellectual property ownership policies, developing an infrastructure that allows for simultaneous work on the confidential projects of competing companies, balancing the constraints of the academic schedule with the needs of the sponsoring company, and oversight for quality of project deliverables. From an industry perspective, universities often impose fundamental barriers to identifying, requesting, tracking, and funding multidisciplinary projects. At Cal Poly, there are, and will continue to be, a number of large companies who are motivated to provide challenging, relevant projects in spite of these issues, and indeed, irrespective of a “deliverable” beyond the interaction with potential future employees. This deep level of involvement is limited to large, established companies, however, and has the potential to result in “safe” project topics that are not of significant scope and relevance. For every company that is willing to work within the constraints of the current mechanisms for funding student projects, there are likely a much greater number who would very much like to offer challenges to student teams, if there were a streamlined process that adequately protected their commercial interests, had a contract deliverable that they were purchasing, and reduced the project risk to an acceptable level.

### **Current Funding Mechanisms & Limitations**

At Cal Poly, there are three primary mechanisms for industry support of student projects:

1. As a donation to the College or Academic Department.
2. As a cost-reimbursable or fixed price contract through our Sponsored Programs Office.
3. As a student-centered project whose primary purpose is student learning.

Although there is minimal paperwork associated with *Mechanism 1*, this method of project funding is not suitable for meeting the needs of most companies. It suffers from a lack of a deliverable – because funding is in the form of a (tax deductible!) donation, there can be no expected *quid pro quo*. While this mechanism can allow companies to provide project topics and mentorship, it does not address their need to see results. Additionally, companies can expect no ownership of any IP generated using this mechanism. The result is little commercial value to this funding mechanism.

*Mechanism 2* is primarily geared for those projects that require significant faculty expertise. The contracts associated with this funding mechanism are well established, and it does provide sponsors with limited IP protection and contract deliverables. The paperwork is significant, however, and companies with small projects are unlikely to bother. The other fundamental characteristic of this mechanism is that accountability for project success is tied to the faculty member serving as the Principal Investigator; this is fine for projects that directly serve his or her research, but is a heavy responsibility when the goals of performing the project are for the education of students.

*Mechanism 3* is a recent development which addresses some, but not all, of the challenges associated with funding student-centered projects. This mechanism involves a more streamlined contract process and significantly reduced indirect costs relative to a standard cost-reimbursable contract. The tradeoff, however, is in limitations on project scope and sponsor goals. Because the contractually-stated *primary purpose* of this funding mechanism is student learning, the risk to the sponsoring company of receiving a suitable deliverable is quite high. Additionally, faculty mentors may not receive significant compensation under this mechanism. The intention is that their time is compensated through their normal faculty teaching and service workload. This leaves a large accountability gap, as well as placing many faculty outside of their comfort zone – effectively asking them to serve as de-facto project managers in the more highly multi-disciplinary projects that are the most useful to students. Finally, this mechanism is highly coupled to the academic calendar and requires significant planning to fit a given project into an academic environment; this makes it unsuitable for short-turnaround projects.

Because of the limitations of current funding mechanisms, Cal Poly does not have an adequate vehicle for companies to sponsor highly multidisciplinary, student-centered projects under conditions of acceptable risk. There exists a gap in funding mechanism to support student projects, where the fundamental IP is provided by the sponsor (and thus there is an expectation to retain all IP), where students, not faculty, are the primary source of work, and where there is a contract deliverable on a schedule that matches the need and requisition cycle of the sponsor and is not constrained by the academic calendar.

### **A Solution: Proof of Concept, LLC**

To address the abovementioned challenges, we have established a private company that sits at the interface of the corporate and academic worlds. *Proof of Concept, LLC* is a contract engineering firm that leverages Cal Poly resources and student skills on behalf of its clients through a series of “fee-for-use” rental agreements with the University for key equipment (e.g. wind tunnels, SEMs, anechoic chambers, etc).<sup>8</sup> Cal Poly is recognized as a very practical, hands-on, applied research university, and this is reflected in the way that Proof of Concept is marketed to potential clients: we provide engineering R&D services with a core competency in early-stage reduction to practice of technology-based ideas. Typical products are “skunkworks”-type operations, with rapid development, prototyping, and validation of client technology. All Intellectual Property generated during the project is owned entirely by the client.

POC was created as a for-profit entity that does not involve a formal partnership with the University. This arms-length relationship is key to the success of the model: it assures clients that they are signing agreements with a private company who’s reputation lies in delivering quality results; it assures the University that there are appropriate firewalls in place to ensure that State of California resources are not being used for commercial gain.

Proof of Concept is a virtual organization with low overhead and a highly flexible infrastructure. Teams are formed on a per-project basis, consisting primarily of upper-division engineering students from multiple disciplines who are hired as Proof of Concept employees for the duration of the project. Key faculty expertise and technical advising is provided through consultant agreements. Physical resources are rented on an as-needed basis through “fee-for-use”

agreements with the University that price key equipment at market rates, and claim no ownership to innovation that occurs during the rental period. The main assets owned by Proof of Concept, LLC, are software packages. This is because most of the software in use by Cal Poly is through academic licenses, and Cal Poly does not have the rights to “rent out” their software.

Typical client projects are 3 months to 1 year in length and require multiple engineering disciplines. *Proof of Concept* clients include both early-stage startups requiring access to a broad base of engineering expertise and infrastructure for prototype development, as well as large, established companies seeking rapid, low-profile technology development in a skunkworks mode. Typical projects support clients in the Medical Device, Consumer Electronics, Sporting Goods, and Aerospace industries, and include:

- Software Development
- Process Automation
- Technology Demonstration Prototypes
- Statistics & Research Data Analysis
- Cytotoxicity/Materials Evaluation Services
- Competitive Technology Literature Assessments
- Solid Modeling + Design & Prototyping
- Physical and Computer Simulation Systems

### **Proof of Concept, LLC as a Source of Multidisciplinary Student Projects**

Proof of Concept, LLC is first and foremost an entrepreneurial venture, started and operated with the goal of making a profit. That being said, however, using POC as a funding mechanism for student projects also removes many of the constraints of industry partnerships and technology transfer. Because the bulk of our workforce is students, Proof of Concept supplements a role traditionally handled by university corporate relations offices: delivering funded, challenging multidisciplinary projects to student teams. Students may use their POC experiences as internships, as Senior Projects, or as independent study. In cases where students are using their POC project work for academic credit, they will work with both academic advisors as well as POC mentors and client representatives. The result is real-world experience in a rapid-pace entrepreneurial environment. Providing this environment to students is especially important for Cal Poly, as we are geographically isolated on the Central California coast (3 hour drive to San Francisco Bay Area or Los Angeles), and have minimal technology-based internship opportunities locally.

Hiring students as employees of a private company removes the burden for delivery of a quality product from the faculty -- accountability for deliverables rests on the company, not on the faculty or the University. In exchange for assuming this risk, Proof of Concept is compensated via a suitable profit margin. Conversely, students are *more* motivated than if they were working on a donation-based project; because they are challenged with solid, industrially relevant projects, because it is a paid job, and because they are doing early-phase technology work for companies that may hire them in the future, their performance level is quite high.

The three following examples are provided to illustrate the breadth of projects, as well as the benefit to the students:

### Applied Research for Biomedical Device

This project involved a multidisciplinary team of Biomedical and Mechanical Engineering students. POC was tasked with taking a broad patent that a major Biomedical Device company had acquired, and developing a series of prototypes such that the company could better quantify the value of the patent and whether to continue internal R&D. Students, working in collaboration with client company engineers, developed and evaluated concepts, performed complex Finite Element Analysis and other performance modeling, produced multiple generations of physical prototypes, and presented the results to senior management of the client company. Result: students are named on company invention disclosures that will likely lead to a patent application, and the client company is pursuing additional work through POC to further develop this technology (a technology that would have otherwise been “orphaned” due to personnel and resource limitations within the company).

### Demonstration Prototype for Startup Company

This project involved a multidisciplinary team of Mechanical, Manufacturing, Business, and Computer Engineering students. POC was tasked with developing a local entrepreneur’s idea into a demonstration prototype so he could acquire additional startup investment. Students worked with the entrepreneur to develop requirements documents, built a fully-functional prototype system that demonstrated the innovation, and performed market analysis to assist the entrepreneur in his funding pitch. Result: the student team acted as the entire workforce for an extremely early-stage innovation, successfully turning an individual’s vision into a working prototype and assisting the startup company with developing engineering function within the context of a marketable business opportunity.

### Academic Project for Aerospace Company

This project is currently in discussions for implementation next year and will involve a large (8-person) team of engineering students participating as part of an academic, faculty-mentored, 3-quarter multidisciplinary senior project sequence. Although the sponsoring company is an established supporter of student projects at Cal Poly, the internal funding source and champion for this particular project is not comfortable with a purely educational objective; they require a strong contract deliverable in order to seal the deal. POC’s proposal is a hybrid: the company will sponsor the senior project sequence as a student-centered project (Mechanism 3), with a separate contract entered through POC that would ultimately make POC responsible for a deliverable. In this case, POC will be acting as the sponsor’s on-site representative for periodic Design Status Reviews, etc.; at the conclusion of the academic project, POC will perform any effort necessary to add value to the academic exercise and prepare the final deliverable, thus reducing the risk to the project sponsor. The result from the University perspective is an extremely complex and interesting project that would not have happened if POC did not exist.

## **Proof of Concept, LLC as an Incubator for Student/Faculty/Staff Entrepreneurship**

In addition to the benefits that a company like Proof of Concept offers to external clients, there are some significant benefits to *internal* clients beyond just providing student access to stimulating projects. Internal clients include students, faculty, and staff who would like to develop a technology-based innovation. Because of POC’s combination of flexibility, access to a wide range of physical resources and technical expertise (both internal and external to the University), project management capabilities, and link to the investing community, POC has

recently been viewed as a resource in Cal Poly's entrepreneurial efforts. POC is a tenant in Cal Poly's new Technology Park, and can serve as a de-facto incubator for student/faculty/staff innovation, providing key infrastructure to campus innovators and assisting them in their efforts to bridge the gap between idea and seed funding. Indeed, while Proof of Concept generally operates on fixed-price contracts, it is open to sharing in the risk/reward of its clients through stock warrants or other equity mechanisms. In this sense, POC can serve in the role of initial investor to campus innovators, through its ability to produce hardware instead of actual dollar investment.

Creating an "Entrepreneurial Ecosystem" is a huge challenge. San Luis Obispo County is just now reaching the critical mass to support a healthy, technology-based entrepreneurial community. Proof of Concept has the ability to act as the interface between community efforts and Cal Poly efforts in entrepreneurship. An example sequence of events would be as follows:

*A student's idea originally formed as part of a engineering club activity is developed through a formal entrepreneurship class, where she joins other passionate students; the resulting team enters University business plan competitions, where they receive mentorship and coaching as well as the potential for award money; teams that succeed in the competitions are offered the opportunity for additional, intensive mentoring through a summer bootcamp sponsored by a local angel investor network; at this point, the student entrepreneurs use POC to continue to develop their technology to a level sufficient to receive seed funding. The gap is bridged, one moderate step at a time.*

### **Performance Metrics and Keys to Success**

Proof of Concept, LLC was established in the summer of 2009, and is still developing its customer base. There are a number of clear metrics, though, that are easily tracked to assess the value of the company to the broader goal of engineering education. These metrics include the total number of client companies, the number of students per year involved in projects, and the dollars generated by university rental of equipment to POC. The *quality* of the projects with respect to PBL are slightly more difficult to quantify, yet just the fact that clients are paying for products is a screen that all projects are industry-relevant, require the application of specialized skills, and are multidisciplinary in nature. The percentage of return clients is a metric that is a direct measure of the quality of the student products. It is the author's intention to follow up with a quantified discussion of these metrics, and the overall impact on the University, once a sufficient client base has been established. Until then, there are a number of observations as to the keys to success in replicating this mechanism in other institutions:

- Need a faculty champion with an entrepreneurial nature, willing to take on the personal financial and professional risk. This is a significant challenge for replication at other institutions, but it can be made easier by disseminating the tools (e.g. fee-for-use contracts) and models of success.
- Need a series of well-defined University fee-for-service contracts that clearly articulate the terms of equipment rental from an external organization.

- Need a Sponsored Programs office who values the opportunity to look beyond traditional academic funding mechanisms.
- Need a faculty who values increased industry interaction.
- Need clear guidelines for avoiding potential conflict-of-interest issues, such as a faculty member who is acting on behalf of POC also responsible for issuing a grade to a student who is a POC employee. In cases like these, the private company must be willing to *not* take on jobs (or hire students, or participate in a particular academic exercise) that would put them in a position of conflict-of-interest.
- Need a continuing, open dialog between the University and the company to establish rigorous firewalls between state and private resources. These resources include both physical and intellectual capital (i.e. POC should not be allowed to circumvent University intellectual property policies).

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