FINAL TECHNICAL REPORT

Bio-Manufacturing to Market pilot project
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Executive Summary

The Bio-Manufacturing to Market pilot project was a part of the AMJIAC, the Advanced Manufacturing Jobs and Innovation Accelerator Challenge grant.

This internship program set out to further define and enhance the talent pipeline from the University and local Community Colleges to startup culture in East Bay Area, provide undergraduate STEM students with opportunities outside academia, and provide startup companies with much needed talent.

Over the 4 year period of performance, the Bio-Manufacturing to Market internship program sponsored 75 undergraduate STEM students who were able to spend anywhere from one to six semesters working with local Bay Area startup companies and DOE sponsored facilities/programs in the biotech, bio-manufacturing, and biomedical device fields.

While some students' internships were focused on the development of medical device technology, many students worked on projects directly related to reduction of US reliance on fossil fuels, such as, for example, assisting in the refinement of the following technologies: using microbes to transform carbon dioxide and other gases into protein, high-value oils, and bio-based products, which can be used in a variety of consumer and industrial applications; and transforming waste gas streams into affordable, biodegradable materials while creating a positive environmental impact.

Introduction

This pilot project helped to fill a much needed gap in providing undergraduate STEM students with opportunities to translate knowledge and experience gained in academic laboratory settings to the local startup environment—where they 1) learn various processes for how to scale the technology under development 2) develop a better understanding of how this technology fits into the marketplace (eg Who is your customer? What does your customer want/need? How much is your customer willing to pay?) and 3) honing their ability to communicate their research and (often confidential) findings to a lay audience.

Background

We learned that while many undergraduate STEM students have ample opportunity to work in an academic laboratory setting, they may not necessarily be employed on projects that have immediate relevance to the world outside academia. At UC Berkeley we have observed that, over the past several years, many of our undergraduate students are hungry for opportunities that will allow them to have greater positive impact on the world. Additionally, students have cited the fast pace of innovation that occurs in a startup or industry setting as preferable to the slower pace experienced in an academic lab. Furthermore, such internship programs have helped to prepare our students for potential careers beyond academia. In sum, this pilot project has helped to respond to our students' desires and needs.

Results, Discussion and Accomplishments

The following key points articulate the highlights the outcomes of the Bio-Manufacturing to Market pilot project.

The project set out to achieve the following Task:
Task 1.0 Identification of industry partners and defining student projects
Task 2.0 Building of student teams, and recruitment of students
Task 3.0 End of semester student project presentation
Task 4.0 Developing an administrative infrastructure for "Bio-Manufacturing to Market" pilot program.

Over the course of the four years, the program met and, in most semesters, exceeded the milestones articulated in the milestone schedule. In sum, the only the limiting factor for scaling the program was funding. Over the course of the pilot, we experienced increasing demand from both under graduate students and start up partners.

Learning/training outside the academic laboratory and professional development

- Provided students with mentors outside their academic lives.
- Provided students opportunities outside their academic research labs to understand the challenges inherent in taking a technology or product from bench scale to the market place. To this end, most student projects involved (in some shape or form) optimizing processes for product scale up.
- Where appropriate STEM student interns and MBA student interns worked on projects to perform market assessments--learning how to define the start up's market, learning about customer segmentation, and product/service alignment with their target market.
- Where appropriate student projects involved refining raw technology to move toward prototype.
- Where appropriate, some students embarked on assessing product life cycles.

Translation across disciplinary boundaries, engagement with public, dissemination to communities of interest

- Because startup companies tend to be small in nature, Bio2Market student interns were often involved in startup team meetings where critical/strategic decisions were being made, and were often permitted to offer guidance and feedback, as well as to present recent findings regarding their own experiments.
- The program required that each student keep a public facing blog in order to document their progress throughout the semester. They were advised to communicate the nature of their work to an educated lay audience which required that they either avoid and/or translate technical jargon and concepts in order to learn how to communicate their research to as broad an audience as possible.
- Additionally, each student was required to work with their fellow interns to present either a team poster or team powerpoint lightning talk at the end of each semester to a public audience (outside the University) via our Berkeley-Emeryville BIO mixer events. The team nature of these presentations required/encouraged students to go beyond their solo projects and coordinate with other student interns who, while working for the same startup, may have been working on projects up or downstream from them. This requirement served to encourage students in the program to gain a more holistic perspective of the startup and the entire product/technology development pipeline.
- The Berkeley-Emeryville BIO mixer events typically attracted 70-80 participants each semester and represented a broad swath of industry stakeholders. The

students were often further engaged by these audiences through fielding frequently challenging questions during Q&A sessions that followed.
- Further to the above, each student was required to sign an NDA for their respective startup company partner. Therefore students had the additional real-world challenge of describing their semester long projects while staying within the boundaries of their NDA.

While it is not practical nor feasible to document the impact the program has had on all 75 student participants over the past 4 years, below are highlights of the program's impact:

- Six students were offered (and accepted) full time positions with our partner startup companies.
- Emphasis on increasing numbers female participants. Of the 75 student participants, 45% (34) were female.
- The program has developed positive and ongoing relationships with 12 startup companies plus two DOE mission focused facilities.
- The program's partnership with Wareham Development, and the Cities of Berkeley and Emeryville continue to thrive.
- The program has helped UC Berkeley develop a set of best practices for how to create meaningful internships for undergraduates in the startup milieu.
- In their own words, here is a sample of the student experience and its impact upon their lives: http://vcresearch.berkeley.edu/bio2market/fall-2016-participant-blog
- A news article featuring Bio2Market student participant, Shilpi Mathrani and internship start up partner, can be found here: http://news.berkeley.edu/2016/02/25/bio-manufacturing-to-market-program/

Conclusions and Recommendations

In sum, the 4 year pilot "Bio-Manufacturing to Market" program has demonstrated much needed and desired opportunities for students to experience scaling and commercialization of technologies outside an academic laboratory setting. Fundraising efforts to support an internship program modeled after the "Bio-Manufacturing to Market" are underway. Additionally, lessons learned and best practices achieved throughout this program are informing a new initiative at UC Berkeley which aims to give every undergraduate student, regardless of major, an opportunity for a "discovery" experience. It's very clear that internships with startup companies, in the spirit of the

Bio-Manufacturing to Market program, will be an important component of this new discovery initiative.