

Implementing Lean LaunchPad Methodology into an Engineering Professional Development Course

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Abstract—This paper chronicles the latest collaborative project between the engineering and business colleges at the University of Oklahoma (OU). The focus for this research is to study the effect of introducing and utilizing the Value Proposition concept from Lean Launch Pad (LLP) in an engineering professional development course. LLP is a new way of thinking about innovative ideas and startups that requires a significant amount of evidence from customers to validate ideas before they are pursued. At OU, business/entrepreneurship students have been taught the LLP methodology in numerous courses since 2012. In the spring 2016 semester this methodology was conveyed to a group of engineering students in a course titled ENGR 2002 – Professional Development. ENGR 2002 is a project-based course where students work almost exclusively in multidisciplinary teams. It emphasizes important topics that are outside the technical scope of the engineering degree, such as leadership, project management, engineering ethics, entrepreneurship, and communication.

In this study, four ENGR 2002 sections acted as the control groups, where they were taught the traditional entrepreneurship content in the course and completed the same assignments as were done in previous semesters. However, two ENGR 2002 sections were taught about the LLP process and it was infused into their assignments so they could put the theory into practice. The purpose of the research was to see the impact the LLP methodology has on the quality of the assignment submissions. In order to evaluate the quality of the engineering students' work, business students trained in the LLP methodology reviewed assignments from both of the engineering student groups (the LLP and non-LLP cohorts). When performing a comparative analysis of the engineering students' submissions, there was an expectation of significantly higher quality for those that received LLP instruction and utilized the LLP methodology in their assignments. The results showed modest improvements, but more dramatic increases are expected with some pedagogical modifications. There were many lessons that were learned as a result of this study that are described in the paper. These lessons will serve as a valuable data points in future integrations of LLP in engineering courses at OU or other universities. By continuing to foster the collaboration between the engineering and business colleges at OU an increasing number of students are gaining valuable cross-disciplinary knowledge and experience that will be beneficial to them in their careers.

Keywords—*professional development; team-based learning; entrepreneurship; experiential learning; peer-learning; Lean LaunchPad; LLP; Value Proposition*

I. INTRODUCTION

The 2014 FIE Paper, Developing an Engineering and Entrepreneurship Collaborative Project [1], provides an account of the teamwork and collaboration at the University of Oklahoma (OU) occurring between the College of Engineering (CoE) and the Price College of Business. That work described the initial project of utilizing both faculty and students from the OU Price College of Business to provide instruction and project judging for the students in the College of Engineering. This was primarily handled in the offering of the course titled ENGR 2002 – Professional Development [2]. This course is required by almost all of the students in the CoE at OU. Along with other topics, this course introduces the concepts of innovation and entrepreneurship through both lecture and experiential learning. For this portion of the course, lectures are delivered via faculty from the OU Price College of Business Division of Entrepreneurship and Economic Development. Experientially, the students learn by the requirement that they form into teams, conceptualize a concept for a new product, and present their findings in a final presentation to a group of assembled experts. This project has been a great success and has provided a benefit to a number of students. In addition to learning about the basics of entrepreneurship, many of these engineering students also enrolled in OU entrepreneurship courses following their experience in ENGR 2002 and some have even been selected for internships at the Center for Creation of Economic Wealth (CCEW) at OU.

In this paper, the furtherance of that collaborative effort between the engineering and business colleges is described. Specifically, following several successful semesters of the above described system, a plan to introduce the Lean LaunchPad (LLP) methodology for entrepreneurship into ENGR 2002 was conceived and implemented in the spring 2016 semester. The LLP methodology was brought forward and shepherded by Steve Blank at Stanford University and Jerry Engel at the Haas School of Business at UC Berkeley [3]. The OU Price College of Business, as an early-adopter of this methodology, has further

developed its rigor and implementation of LLP. It was this adoption, plus other factors, that led the charge for it to be integrated into the ENGR 2002 course.

In order to measure how effectively the LLP methodology is integrated into the ENGR 2002 course, the students were segregated into four sections that received only the instruction about creating a business plan that is normally taught into the course and two sections that received additional instruction in LLP. Both the non-LLP and LLP cohorts received the traditional course instructions about entrepreneurship and the Business plan, showed in weeks 2 and 12 of Table I respectively. The Entrepreneurship Introduction is delivered by a leader in the CCEW at OU and the Business Plan presentation is delivered by a professor in the Price College of Business. An additional lecture (only provided for the LLP cohort) that provided an overview of LLP took place in week 3 in the spring 2016 semester. The LLP overview was also taught by a professor from the Price College of Business. More information about the content of these lectures is described in the next section. In addition to the division of the ENGR 2002 sections, the metrics by which the student concepts are normally judged in the course were adjusted to include more emphasis on innovation and concept quality. By comparing the cohorts, the authors hoped to identify clear measures that might indicate the effectiveness of the LLP methodology in the instruction of entrepreneurship to engineering students.

II. ENGR 2002 – HISTORY

In 2012 the course titled ENGR 2002 – Professional Development went through a complete and total redesign to provide a more team-based learning focus and to emphasize important areas that are outside the technical scope of the engineering degree. The topics that were emphasized in the new course design were: leadership, project management, engineering ethics, entrepreneurship, and communication. The emphasis on communication was addressed in nearly all aspects of the course. The first communication focus is achieved through a teamwork structure. Most of the work in the course is done in four different team projects that have a new student makeup and a new student leader for each project. This allows every student in the course the opportunity to serve as a leader as well as work under many different types of leaders during the semester. In this and many other ways observational peer-learning is heavily emphasized in the course. Public speaking and presentation skills are also heavily stressed by each of the four projects; whereas each includes a presentation in front of their classmates as well the instructors of the course and in some cases guest judges. As the students in the course judge each presentation, peer-learning occurs as they observe good and bad presentation habits and also learn many new things from the information that is being presented to them. Technical writing is also comprehensively emphasized in the course. There are collaborative writing assignments associated with each project as well as multiple individual writing assignments throughout the semester. One of these individual writing assignments is titled the *Great Idea Abstract*. This assignment has traditionally

been solely focused on the students writing a summary of a creative entrepreneurial idea that they conceive, but in the spring 2016 semester a change was made to integrate the LLP methodology into this assignment. This LLP integration is discussed in detail in the next section and serves as focus of this research study.

The most unique part of ENGR 2002 as compared to other engineering professional development courses [4-6] is the heavy emphasis on entrepreneurship. Table I shows the entrepreneurship content that is traditionally taught in the course (prior to the addition of LLP) and the approximate week of the semester in which it is typically covered. A brief summary of these activities are provided below, but more in-depth descriptions are recorded in prior work [1].

TABLE I. ENGR 2002 ENTREPRENEURSHIP CONTENT OVERVIEW

Week Numbers	Entrepreneurship Activity
2	Guest Speaker – Entrepreneurship Introduction
3	Guest Speaker – Lean LaunchPad (LLP Cohort only)
2-4	Kickstarter/Crowd Funding Writing Assignment
3-11	Great Idea Abstract Writing Assignment
12-15	Group Project 4 – Great Idea
12	Guest Speaker – Business Plan
13	Lecture – Technical Ideation
13-14	Technical Ideation – Individual Writing Assignment
14	Lecture – Idea Protection and Intellectual Property
12-15	Elevator Pitch – Group Writing Assignment
15	Great Idea – Group Presentations
12-16	Business Plan – Group Writing Assignment
16	Final Quiz – Including questions over entrepreneurship

Early in the semester a guest speaker delivers a presentation over the basics of entrepreneurship and the importance of it for engineers. This early contact builds scaffolding for more detailed activities that will follow later in the semester. In order to expose the ENGR 2002 students to entrepreneurial ideas they learn about crowd funding and are required to search for examples that are interesting to them online at kickstarter.com that focus on engineering solutions and write a technical paper summarizing the idea and predict whether or not it will be successful. While projects 1 through 3 are taking place during the first 11 weeks of the course, the students are given the Great Idea Abstract writing assignment to be done individually while working on these other group projects. By giving the students several weeks to come up with a great idea, the creative process is not rushed.

Project 4 called *Great Idea* begins during the last quarter of the semester and continues until the final week of the course. During this project the students are required to film a video of

their elevator pitch, create a business plan, and deliver a presentation to an audience that includes their classmates as well as business professionals. Unlike the other project presentations they do earlier in the semester, the Great Idea project presentation allows the judges to ask questions at the conclusion of their presentation. Lectures are given between weeks 12 and 14 to help the students gain the knowledge necessary to complete the project. Some of the topics of the lectures include how to write a business plan, what makes a good elevator pitch, how to protect the intellectual property of an idea, and the concept of ideation. During the ideation lecture students are taught how to personally become more innovative by looking into the Innovator's DNA [7]. In the spring 2016 semester 2 of the 6 sections of ENGR 2002 (the LLP cohort) had one additional lecture over the Lean LaunchPad entrepreneurship philosophy and were also given a more demanding Great Idea Abstract individual assignment that forced them to put the LLP methodology into practice.

III. LEAN LAUNCHPAD INTEGRATION INTO ENGR 2002

In 2011, successful entrepreneur Steve Blank introduced the Lean LaunchPad class at Stanford University where he was serving as an adjunct professor. Blank was certain that there was a better way of thinking about and launching new ventures. Historically, startups were perceived philosophically as simply "small big businesses". The Lean LaunchPad approach redirects that thinking to consider launches as an altogether new species of entity.

Connecting with Professor Jerome ("Jerry") Engel at UC Berkley and Alex Osterwalder, author of Business Model Generation and creator of the Business Model Canvas [8], Blank began promoting Lean LaunchPad as a new and innovative concept to startups. Lean LaunchPad has been widely regarded as one of the most innovative developments in startups in years and has found wide acceptance at both the academic and practitioner levels. OU, as well as many others, bases its entrepreneurship programs and classwork in large part on LLP. The Lean LaunchPad Educators Teaching Guide states: "The Lean LaunchPad class was developed primarily from graduate level experience at several of the nation's leading universities. It's been taught both in engineering and business schools, as well as to post-graduate teams under the National Science Foundation program. However, we believe the methodology has broader applicability, and it is being adapted for use in undergraduate programs." [9] The wide acceptance of LLP was demonstrated in 2011 when the National Science Foundation announced the Innovation Corps (I-Corps) program that is based on the LLP methodology [10]. The I-Corps program funds projects to aid in the transfer from the research phase to commercialization. It utilizes an iterative process to starting a company, much like research is conducted by engineers and scientists.

The OU Price College of Business first implemented the concepts behind the Lean LaunchPad in the fall of 2012. Revising the pedagogy of Strategic Venture Development, a graduate level entrepreneurship course, the OU Price College of Business instructed MBA candidates in the methodology and philosophies surrounding the mechanism. The Lean LaunchPad produced almost immediate results at OU. A successful company that is still active launched from the very first course offering. LLP now underlies a number of course syllabi at both the undergraduate and graduate levels.

One of the principal concepts of the Lean LaunchPad is the Value Proposition. The Value Proposition is taught at OU as a combination of two questions:

1. *What is the pain the in the market?*
2. *What is your solution?*

This Pain/Solution statement format has been used continuously at the OU Price College of Business since its adoption of the LLP methodology. The business students learning the LLP methodology, including those engaged to review the concepts of the Great Idea Abstract submissions cited in this study, are trained regularly in their coursework to identify pains and to innovate solutions for those pains. The ENGR 2002 engineering students in the LLP cohort who received additional instruction in LLP were walked through several hypotheticals and exercises dealing with the Pain/Solution (Value Proposition) Statement so they would be able to apply this knowledge to the Great Idea Abstract assignment.

For the current study, some of the students enrolled this semester in the aforementioned Strategic Venture Development as well as its Teaching Assistant were asked to review the submitted Great Idea Abstract papers from ENGR 2002. Having been trained in and executed concepts in the Lean LaunchPad methodology, each volunteer was uniquely qualified to review the offerings through that lens. Each of the reviewers were given little to no instruction regarding the ranking of the concepts. With given only the written instructions for the concept deliverables (described in part A of section IV) the reviewers were asked to rank each submission on a scale of 0 to 100. "0" indicated an unacceptable idea and "100" indicated the best possible idea.

IV. METHODOLOGY

The basis of this study came from the hypothesis that students exposed to the Lean Launch Pad methodology, specifically focused upon the Value Proposition, will develop better concepts than those instructed in a more traditional approach to venture concept development. In order to gather evidence to prove this hypothesis, two sections were given instruction in LLP and a modified version of the Great Idea Abstract assignment, while four sections served as the control group. The control group, which will be referred to as the non-LLP cohort, were not given instruction in LLP and were given the standard Great Idea Abstract assignment that has been assigned

in ENGR 2002 in close to the same form for the last three years. A summary of the traditional non-LLP version of the assignment as well as information of how ideas are selected for the basis of the project groups is shown next in section A. Then in section B, the modifications made to the LLP version of the assignment are described.

A. Great Idea Assignment, traditional non-LLP version

The following is the assignment given to the students of the four non-LLP sections:

Write one paragraph (300 words max) that clearly states the market problem and an initial plan of how your idea will address the problem. Before writing your paragraph you should read the final project assignment so you will understand the requirements. After submitting this abstract, you will be given the final list of abstracts (without author information) along with a voting template to rank the top 10 ideas that you want to work on. The nine final project groups and ideas will be selected based on your rankings. Your final project group will start out with the idea from the abstract, but it can be modified to a different topic if desired. If your abstract is selected to be one of the nine final project themes then you will have the first right of refusal to be the team leader on the final project. You will also receive 10 bonus points. There are 6 guidelines that your idea must follow or you will receive a point deduction:

1. The idea must be realistic.
2. The idea must be one that could result in a business, instead of a one-time project.
3. The idea can't be something you have already done or are currently doing in a job or in school.
4. The idea shouldn't try to completely solve huge problems such as world hunger or lack of clean water.
5. The idea must be of technical subject matter that requires the development from engineers.
6. If you are proposing an idea that currently has market competition or is already patented, then you need to outline why your idea has a competitive advantage or does not violate the patent (nobody is going to give you money to copy an already existing product or patent).

B. Great Idea Assignment, LLP version

In modifying the Great Idea Abstract assignment to include the LLP methodology many decisions had to be made that conflicted with each other. One author was the expert in LLP and he preferred to add as much LLP content as possible and also include much more rigor to the Great Idea Abstract assignment. While the other author was the coordinator for the ENGR 2002 courses and the instructor of one of the two sections of the LLP cohort and he was deeply concerned with adding additional time required by the students and if they would be disgruntled if they talked to students from other sections that had an easier assignment. In the end, a compromise was made and the following modifications were made to the Great Idea Abstract assignment and a one hour long lecture over LLP was added to the course schedule. The

following shows the additional requirements added to the Great Idea Abstract assignment for the students of the two LLP sections:

For this assignment you are required to Research and study a "Market Problem" with regards to a "Great Idea" that you conceive. Utilizing the skills and knowledge gained in the lecture over Lean LaunchPad, you need to:

1. Identify a pain in the market.
2. Propose an initial solution to that pain. Keep in mind you don't have to have all of the details figured out in the solution (that is what your final project group is for).
3. Conduct a series of no fewer than three (3) interviews with potential customers to get feedback on your solution/pain.

You will submit between 2 and 4 paragraphs in the Great Idea Abstract submission. Paragraph 1 will cover items 1 and 2 above. Paragraph 2 will include a brief summary of the feedback you received from your interviews. If the interviews affirm the solution/pain (in your opinion) then you will only have 2 paragraphs. If the interviews reject your solution/pain (in your opinion), you must write a third paragraph. In this paragraph you will do the same thing you did in paragraph 1, but with a new solution/pain. The pain can be the same, something new, or a modified version of the original. For example, you might find through the interview process that the pain you came up with was really not a pain at all. In that case you would want to start with a completely new pain. You are not required to do interviews for the second solution/pain included in paragraph 3, but you are allowed to if you have time and a desire to do so. In that case you would summarize the interviews in paragraph 4. If your second solution (summarized in paragraph 3) is also rejected you can stop there or continue this iterative process, but in the end don't include more than two solutions/pains in your write up. For the 2 to 4 paragraphs in the submission you are limited to 500 total words.

Whether or not we felt that the right balance of additional LLP content versus the additional time requirements was found will be discussed in the conclusions section after the results are shown from the study.

It is important to note that all of the Great Idea Abstract submissions from the LLP cohort only had the pain/solution statement included and the interview summaries were stripped out of them so the business student judges would not be able to distinguish between the submissions of the two cohorts. In fact, the business students didn't even know there were two different cohorts in the study and the submissions were randomized and placed into a single document that contained all submissions from both the LLP and non-LLP cohorts mixed together. By following this process, the business students would be assured to have no bias towards the LLP cohort and would serve as impartial referees as they judged the ideas.

V. RESULTS

In order to avoid adding too much burden on the business students that provided the evaluation of the Great Idea Abstracts, the total number of ENGR 2002 student submissions was limited to 100, which were divided into 50 LLP and 50 non-LLP ENGR 2002 submissions. From the LLP cohort, 83% (62 out of 75) of the students turned in a submission. From the 62 submissions, all 50 that followed the instructions and completed the interview portion of the assignment were used in the study. From the non-LLP cohort 84% (130 out of 154) of the students turned in a submission. A random drawing method was used to get the 50 non-LLP submissions that would be used in the study. It is interesting to note that similar percentages of ENGR 2002 students completed the assignment between the LLP and non-LLP cohorts. This provides some evidence that the addition of the three interviews wasn't a major inhibitor to the students completing the assignment and the added time involved likely wasn't a significant factor.

As previously stated 12 of the 62 LLP submissions didn't follow the instructions and many of the 50 submissions that did follow the instructions had a very weak interview section. For example, one student simply said: "The potential customers think it's a good app if you are in a place where you need to repair your mobile phone fast." Many other students included interview summaries that didn't exhumate much information and were very vague. Upon observing that there appeared to be a minimal amount of time spent on the LLP process by many of the students in the LLP cohort, the author's expectations of the results significantly favoring LLP were lowered. The results from the business students who judged the 100 Great Idea Abstract submission are shown in Table II. The judges scored each idea from 0 to 100 and the average scores of the 50 LLP and 50 non-LLP submissions are shown in the second and third column respectively.

TABLE II. BUSINESS GRADUATE STUDENT SCORING RESULTS

Student Judge #	Average Score of the 50 LLP Submissions	Average Score of the 50 Non-LLP Submissions
Judge # 1	71.7 (34)	65.0 (31)
Judge # 2	81.8 (47)	73.9 (42)
Judge # 3	49.9 (35)	46.1 (30)
Judge # 4	56.1 (35)	52.6 (30)
Average	64.9 (37.8)	59.4 (33.3)

The numbers in parenthesis next to the scores in columns 2 and 3 represent the number of submissions that had a score that exceeded the average score of the 100 submissions from that particular judge. For example, Judge #1 has an average LLP score of 71.7 and 34 of the 50 LLP submissions scored higher than the average of the 100 total ideas scored by judge # 1. These numbers in parenthesis were used as a metric to determine which of the ideas the judges viewed positively. Due to the numerous "0" scores by the judges the average scores were lowered by a considerable amount. The "0" score was

used liberally by all of the judges. Of the 400 total scores given, 72 of them were scores of "0". This resulted in many more than half of the scores exceeding the average score than would be expected if the data had a normal distribution. Additionally, there were 40% more "0" scores given to the non-LLP cohort submission than the LLP cohort. This provides some evidence that the LLP cohort had less unacceptable ideas and the LLP process could have played a factor in bringing to light some bad ideas before they were submitted.

Overall, Table II shows that all four judges scored the LLP submissions higher than the non-LLP submissions and the average score was 9.3% (64.9 versus 59.4) higher for the LLP cohort. Additionally, the number of submissions that the judges viewed as positive (as denoted by the values in parenthesis) was 13.5% (37.8 versus 33.3) higher for the LLP cohort. While the results are encouraging, the sample size was not very large so a statistical analysis was needed to determine if the improvements were statically significant.

By comparing all 200 scores (50 from each of the 4 judges) from the LLP and non-LLP cohorts the p -value was calculated to determine statistical significance. Using a two-tailed, unequal variance type T-Test, the p -value was calculated to be 0.089. This result was found to be statistically significant using the significance level of $\alpha = 0.1$. While the sample size is not large enough in this study for definite claims to be made, with the positive results that were observed there is hope that if a larger study was performed the hypothesis (following the LLP methodology will result in better concepts from the Great Idea Abstract assignment) could be clearly validated with statistical analysis.

VI. BUSINESS STUDENT JUDGES FEEDBACK

By continuing the collaboration between the engineering and business colleges at OU, engineering students are receiving a more well-rounded education that includes important business and entrepreneurship principles. The business students are also benefited by exposure to the perspective of engineers and the novel ideas that they come up with that are often more technical in nature than they are accustomed to seeing within their own college.

All of the business student judges stated that they felt the collaborative project was a positive experience. Some of the feedback from these student is summarized in the following paragraphs to give a sense of the impact it made on them.

One judge was very interested in the idea of interacting with students in a different college. This judge stated that the experience "provided me with a very interesting inside look to the thoughts and ideas of the students of our engineering college. I have always felt the education system is built in silos and I wanted to know what was going on in the silo next door. It is always interesting to hear from different groups than the one I most closely associate with. There are usually extremely different ways of thinking and different approaches to problem solving."

Another judge was very excited for the opportunity to help other students. This judge stated: "I truly enjoyed reading these ideas. Even though there was a lot to read, I believe students will benefit from our feedback and recommendations. It was beneficial for me, too, because I became aware about the weaknesses and opportunities of their ideas and concepts and I was able to make good recommendations for the students."

A good synopsis of the judging experience was given by a third judge that stated: "I thought overall it was interesting to see what new ideas were coming from undergraduates. Some of them were more thought out than others, but overall I saw three or four really good ideas that could be implemented realistically. I think it is beneficial to try and encourage engineers to take entrepreneurship classes and to facilitate the interactions of business students with science minded people. Many scientists have a hard time trying to explain their research or product to investors and so it is hard to get funding to try and commercialize their ideas. By having the two work together, we can expedite the research and commercialization process and increase the likelihood of success for their research and their efforts."

VII. CONCLUSIONS

This paper showed how Lean LaunchPad methodology was introduced in an engineering professional development course. Encouraging results were achieved in this study, but modifications are needed in order to make improvements. First, by worrying too much about the additional time commitment of the ENGR 2002 students the amount of LLP instruction and level of rigor of their assignment was found to be inadequate. To truly understand and exercise the LLP methodology more than 3 interviews are needed. Better instruction on how to conduct the interviews and who to interview are also important modifications that need to be made. It is not realistic to expect significantly better Great Idea Abstract results if the LLP methodology is not executed in a more thorough fashion.

Another issue was related to the grading of the assignment. During the first year after the original modification of the ENGR 2002 course was made in 2012 we found that the students struggled to come up with a "great idea" concept when working as a group. The groups would often spend multiple weeks coming up with an idea and then not have adequate time to complete the work required in the project. To correct this problem the Great Idea Abstract assignment was initially created to force the students to come up with an idea earlier and have multiple ideas created that the students could vote on and assemble into teams around the ideas that were the most popular. This method worked great to correct the original issues, but not enough grade points were allocated to it. If the LLP version of the assignment is continued the amount of points allocated needs to be greatly increased so the students will be compelled to put forth more effort. A clearly defined judging rubric also needs to be created so the students understand what is required as they conduct the interviews.

Many of the interview summaries from this study consisted of students just asking a few of their friends a series of basic questions and then commenting in the interview summary that everyone they interviewed all thought the idea was good. That really isn't thorough enough to truly test the LLP process and likely negatively affected the results of this study.

Overall, the study described in this paper shows some promising results at a first attempt in integrating the Lean LaunchPad methodology into an engineering course. It also shows a novel method of how business and engineering can collaborate on a course and how both types of students can be benefited. With some modifications in future work we hope to more clearly validate our hypothesis that the LLP methodology will result in better overall concepts than the traditional approach. The lessons learned in this study will serve as a valuable data points in future integrations of LLP into engineering courses at OU or at other universities. By continuing to foster the collaboration between the engineering and business colleges at OU, an increasing number of students are gaining valuable cross-disciplinary knowledge and experience that will be beneficial to them in their careers.

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