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## **AC 2011-19: RELATIONSHIP BETWEEN STUDENT COMPETITIVE ACTIVITIES AND THE ENTREPRENEURIAL MINDSET**

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# Relationship between Student Competitive Activities and the Entrepreneurial Mindset

## Abstract

This paper analyzes the effect of student competitive projects as part of their curricular activities. The goal of the analysis is to examine the relationship between these activities and the building of entrepreneurial mindset in engineering education. Student competitive projects have been and continue to be an integral part the engineering curriculum. Cross disciplinary and inter disciplinary teams are formed to compete in various competitions in our engineering programs. These projects include: Aero Design Competition, Bridge Building, SAE Formula, Element One, Baja Team, etc. These are examples of student competitive events that are held on local, national and international levels. Competitions have great impact in team building skills, self confidence, and technological knowledge, linking theory and practice and building school pride.

Our study involves surveys and interviews from team members of those competitions. These surveys enable us to validate the relationship between student competitive events and the entrepreneurial mindset within the engineering discipline. Our hypothesis is “Students competitive activities help entrepreneur mindset.” This paper will demonstrate how the competitive activities contribute to the development of the entrepreneur mindset. This does not mean that the students will become entrepreneurs after participating in these activities; however, they would have potential to become entrepreneurs. We will present the results of our study, our conclusions and the recommendations. This study may provide evidence of the importance of the utilization of student competitive activities as an experiential learning tool.

## Introduction

This paper analyzes engineering student experiences in senior competitive projects. The paper will study and discuss the relationship between student participation in senior project teams and the entrepreneurial mindset. The study will explore if engineering students’ participation in competitive teams directly contribute to their development of an entrepreneurial mindset. Furthermore, the paper seeks to determine if this activity, by its direct and indirect variables, will create entrepreneurial learning experiences for the engineering students.

The Academic Model embraces engineering education awareness of the importance of documenting and validating product ideas using real world techniques and tools. Some student competitive projects offer an opportunity to develop innovative solutions to vehicle design and engineering. As a result of this, students have developed new technologies leading to vehicle enhancement. This has lead to product development that may require protection by the United States Patent and Trademark Office. The student’s entrepreneurial learning experience in competitive project may include a patent search using the online service of United States Patent Office. In a paper delivered at the 2010 ASEEE Annual Conference in Louisville, KY, the value of understanding the patent search process and the entrepreneurial mindset was presented<sup>1</sup>. It was focused on senior capstone projects and the creation of entrepreneurial teams. Student experiences and outcomes were documented through individual interviews and assessment tools. The constraints and challenges of developing a product, engineering it and preparing it for market were presented. Real world entrepreneurial learning experiences are linked to each

student team as they move their senior project through product design and engineering. The patent search might lead to discover work that is so close, overlap or even is replica of the team preliminary product idea. The intellectual property search process is a valuable lesson which integrates with other components of the entrepreneurial learning experience.

### Entrepreneurial Mindset: Our Approach

The Entrepreneurial Mindset goes beyond creating a business venture. The foundational elements of entrepreneurship include creating an awareness of the importance of managing risk, experiencing failure and ambiguity. Entrepreneurial thinking is important for individuals who may create a business as well as for those who will work in larger organizations such as “Corporate Entrepreneurs” or “Intrapreneurs.” According to Morris et al., “Corporate Entrepreneurship” is a term used to describe entrepreneurial behavior inside established mid-sized and large organizations<sup>2</sup>. The term “Intrapreneur” was first introduced by Pinchot in 1985 as any dreamers who take hands-on responsibility for creating innovation of any kind within an organization<sup>3</sup>. The entrepreneurial mind creates inventive solutions to complex problems. It also recognizes the importance of identifying entrepreneurial opportunities.

Lawrence Tech has a strong commitment of fostering the entrepreneurial mindset. The College of Engineering has taken a leadership position in implementing the University’s vision of developing students with a global view and an entrepreneurial spirit. The curriculum includes eight courses with entrepreneurial content<sup>4</sup> (*Lawrence Tech 2007 Strategic Plan*). The College of Engineering offers a Certificate in Entrepreneurial Studies. In addition, Lawrence Tech is part of the Kern Entrepreneurial Education Network (KEEN) which is funded by the Kern Family Foundation. The primary focus of KEEN is engineering entrepreneurial education and the development of the entrepreneurial mindset. This includes a focus on entrepreneurship and intrapreneurship.

As a result of the Kern Family Foundation grant, Lawrence Tech is modifying 30 courses in the College of Engineering and the College of Arts and Science over the next 5 years. We have established the Kern Implementation Team which consists of selected faculty who are developing and teaching the modified courses focusing on problem based learning, active collaborative learning and entrepreneurial learning. The Kern Grant has also brought the new Entrepreneurial Studio to Lawrence Tech. This unique facility provides space for our Entrepreneurial Teams to create their product ideas and build prototypes. Our students have an opportunity to hear from entrepreneurial alumni. Their personal entrepreneurial journey is featured in the monthly Entrepreneurial Lecture Series. Our students have access to our entrepreneurial alumni through The Legends, an organization of entrepreneurial alumni. Lawrence Tech has an active chapter of the Collegiate Entrepreneurs’ Organization where they experience the entrepreneurial mindset. The EIP component of the Kern grant allows Lawrence Tech the opportunity to develop an entrepreneurial internship program that gives students exposure to entrepreneurs and the businesses they have created.

### Entrepreneurial Mindset: Our Experience

Entrepreneurial curriculums now include experiential learning as an integral part of exposing the student to the entrepreneurial mindset. At Lawrence Tech, we have created an entrepreneurial

curriculum that integrates experiential learning in our senior projects, community outreach programs, plant tours, E-Teams and laboratory environments. Our students participate in activities that provide experiential learning. We are now working on integrating entrepreneurial content into 30 existing courses. This includes the opportunity to link “theory and practice” through the integration of experiential learning into our engineering and arts and science curricula.

Students who participate in experiential learning are better prepared to enter the world of the entrepreneur. The new entrepreneurial internship and co-op programs provide an opportunity for our students to work directly with entrepreneurs in their companies. The Legends of Lawrence Tech, our alumni entrepreneurial organization, is participating in this program.

### Engineering Senior Competitive Projects

Senior competitive projects have been an integral part of engineering education at Lawrence Tech for many years. Students have participated in competitive projects that link theory and practice. Most of these projects have been created and driven by the Society of Automotive Engineers (SAE). This organization created competitive projects which included designing, building and testing of miniature vehicles or airplanes. SAE provides the specifications and coordinates the national and international competition among colleges and universities. These competitive events include: SAE Aero, SAE Baja, SAE Formula Hybrid and Formula SAE. In addition, the American Society of Civil Engineers created two other competitive projects: Bridge and Cement Canoe Design, Building and Testing. These competitions also engage students and provide an opportunity to compete with other colleges and universities. Lawrence Tech has and continues to compete in both SAE and ASCE sponsored events.

Each academic year senior and junior students from colleges and universities across the country begin the process of their senior project in the engineering discipline. At Lawrence Tech, this experience is part of the capstone course and has been created to bring together the body of knowledge from the core engineering curriculum. This experience provides the student with the opportunity to apply the knowledge necessary to solve technical problems. According to our associate dean of the College of Engineering, “Lawrence Tech has had a very close relationship with the automotive industry and our participation in SAE is a direct extension of that relationship.”

The learning experiences gained from the students’ participation in SAE and ASCE senior project teams go far beyond the traditional engineering discipline. This analysis and study seeks to document some of the entrepreneurial experiences gained by students as a result of their participation in competitive project teams. The entrepreneurial elements of SAE and ASCE projects have often not been recognized by students and faculty advisors alike.

### History

Lawrence Tech has a long history with SAE competitive projects. The College of Engineering at Lawrence Tech and the automotive industry in the Detroit area are closely related. Our

engineering alumni are well represented in the automobile manufacturing industry. Our faculty has extensive experience in all aspects of automobile engineering and manufacturing.

In the early 1980s Lawrence Tech was approached by the Society of Automotive Engineers to become involved in their Formula competitions. This was a great fit for Lawrence Tech and its students. What a great opportunity for our students to become part of a “hands-on” learning experience that would link theory and practice!

Professor Lewis Frasc, Associate Dean of the College of Engineering, stated that, “Lawrence Tech became involved in SAE competitive projects because of what we are – an engineering college.” These competitions were the ideal fit for faculty and student alike and became an integral part of the capstone experience in the College of Engineering.

One of the early Formula competitive events was held on the Lawrence Tech campus in Southfield in 1984. This was a milestone event in that it presented an opportunity for Lawrence Tech students and faculty to demonstrate their understanding and ability to effectively apply engineering skills. Over the years the Lawrence Tech College of Engineering continued to expand student involvement in other SAE competitive events – Baja, Hybrid and Aero.

### Project Goals

Project objectives have been identified by faculty advisors who have participated in the competitive senior project experience. The feedback from faculty advisors has been summarized. According to Dr. Andrew Gerhart, Faculty Advisor for the Aero Team, one of the objectives of competitive projects is to give students an opportunity to implement what they have learned in the classroom. Dr. Gerhart stated that students who participate in the Aero Team are exposed to almost every aspect of the entrepreneurial mindset including: managing risk, experiencing failure, team building, uncertainty, budgeting and financial issues, raising capital, developing and executing strategy, creative problem solving and innovation. Business planning skills and leadership are also incorporated into the Aero Team experience.

Project goals include the designing, building and testing of a vehicle. According to Dr. Robert Fletcher, Faculty Advisor of the Hybrid Team, the senior competitive project provides a sound foundation for gaining implementation of the elements of the entrepreneurial mindset. The ability to apply sound engineering principals as well as having entrepreneurial skills is an important factor in global competitiveness.

According to Dr. Giscard Kfoury, Faculty Advisory for the SAE Formula Team, the student must understand that the team is charged with the task of designing and building a vehicle for a specific targeted market segment. The team must test the vehicle and make sure that it meets and/or exceeds the customers’ expectations. The team must recognize that it should provide features and value at a price the customer is willing to pay.

## Methods of Delivery

Senior competitive projects in the College of Engineering are delivered using interactive teams. Most teams are cross disciplinary and represent a broad spectrum of engineering disciplines. The team, as a unit, develops a business plan and strategy for implementation. Each member of the team is assigned specific tasks and a timeline for completion. The process of delivering involves a strong commitment for each team member. In a sense, it is much like operating a business. The success or failure of the team depends on how well the team functions collectively.

## Competitive Projects and the Entrepreneurial Mindset

### Student Surveys

The Entrepreneurial Mindset goes beyond creating a business venture. The foundational elements of entrepreneurship include creating an awareness of the importance of managing risk, experiencing failure and ambiguity. Entrepreneurial thinking is important for individuals who may create a business as well as for those who will work in larger organization such as “Corporate Entrepreneurs” or “Intrapreneurs.” The entrepreneurial mind is set to solve problems using creativity and inventive approaches.

In a recent survey of student experiences in competitive activities, they were asked about their understanding and awareness of the “Entrepreneurial Mindset.” The students completed a questionnaire to help us determine if their participation contributed to their understanding of entrepreneurship. In order to assess their experience in competitive activities, a questionnaire was developed which collected their responses. The following ten questions were used for the survey:

1. How did your experience in this competitive activity relate to enhancing your leadership skills?
2. As a result of your experience, to what extent did you have an opportunity to improve your solving problem skills?
3. How much did your experience contribute to improving your team building skills?
4. To what extent did your experience in your competitive team provide an opportunity to sell your ideas to others?
5. What was the extent of your experience in preparing a business plan in your competitive team?
6. As a result of your experience in the competition, how much innovation was utilized?
7. To what extent did you experience uncertainty as part of your participation in the competitive team?
8. As a result of your competitive team participation, to what extent were you involved in developing a budget and/or financing the project?
9. Did you consider your participation in the competitive team to be entrepreneurial?
10. To what degree did you or members of your team experience risk?

The respondent has the option of answering each question with a one to five scale. One means none, least involvement, least significant, least relevant or least applicable. Five means maximum, most involvement, most significant, most relevant or most applicable. There is also

an option to provide some comment for each question. This survey was conducted electronically and manually.

### Review and Analysis of Data

In order to assess the relationship between the entrepreneurial mindset and the student’s competitive activities, a questionnaire was developed. This questionnaire is included in the appendix of this paper. It was given to 45 students who were members of the competitive teams. The analysis of the data collected provides the foundation for this paper. The feedback from the questionnaire supports the idea that the competitive activities approach used in these projects has resulted in learning experiences that foster entrepreneurial thinking. “An opportunity with no or very low potential can be an enormously big opportunity.”<sup>5</sup>

The data processed from questions about skills acquired is displayed in Figure 1 below using a weighted average calculation. In addition, a ranking relative frequency has been used to explore the weight of different ranks given by the student to the questions. The use of these tools demonstrates the student perspective of the learning experiences through the competitive projects. Figure 2 shows the relative ranking of the frequency of the responses. More than 50% of the respondents provided significant responses.

Table1: Responses of 45 students on entrepreneurial skills acquired by ranks

No.	Skills	Weighted Average	Rank					Total Response
			1	2	3	4	5	
1	Leadership Experience	4.3	0	2	6	13	24	45
2	Problem solving	4.6	0	1	2	11	31	45
3	Marketing Ides	3.9	3	6	4	11	21	45
4	Creativity and Innovation	4.6	0	0	4	9	32	45
5	Evaluation of Uncertainty	3.9	3	1	9	17	15	45
6	Entrepreneurial Experience	3.4	6	7	10	9	13	45
7	Achieving Goals	4.6	0	0	3	12	29	45
	Total =	4.2	12	17	39	82	165	315

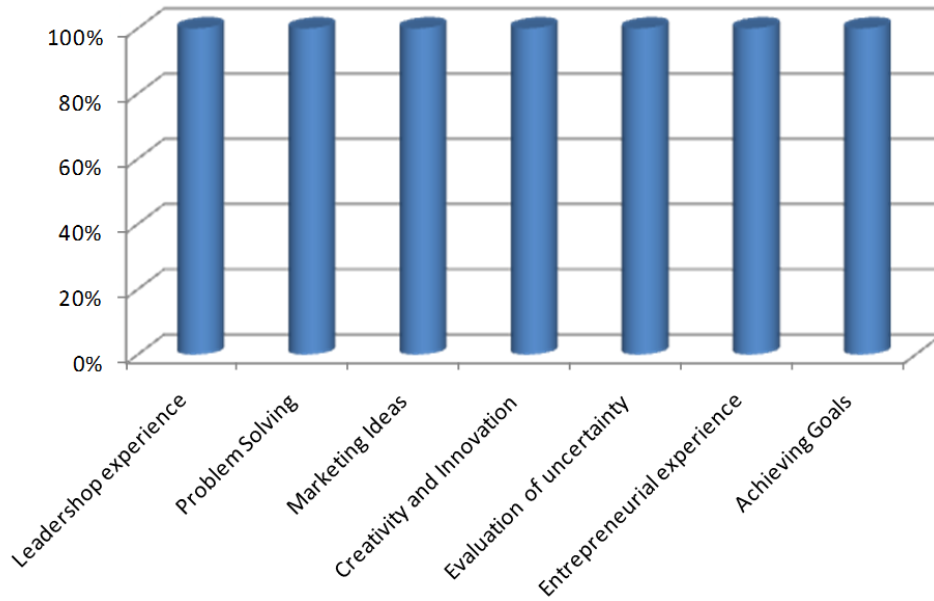


Figure 1: Responses of 45 students on entrepreneurial skills acquired distributed by rank

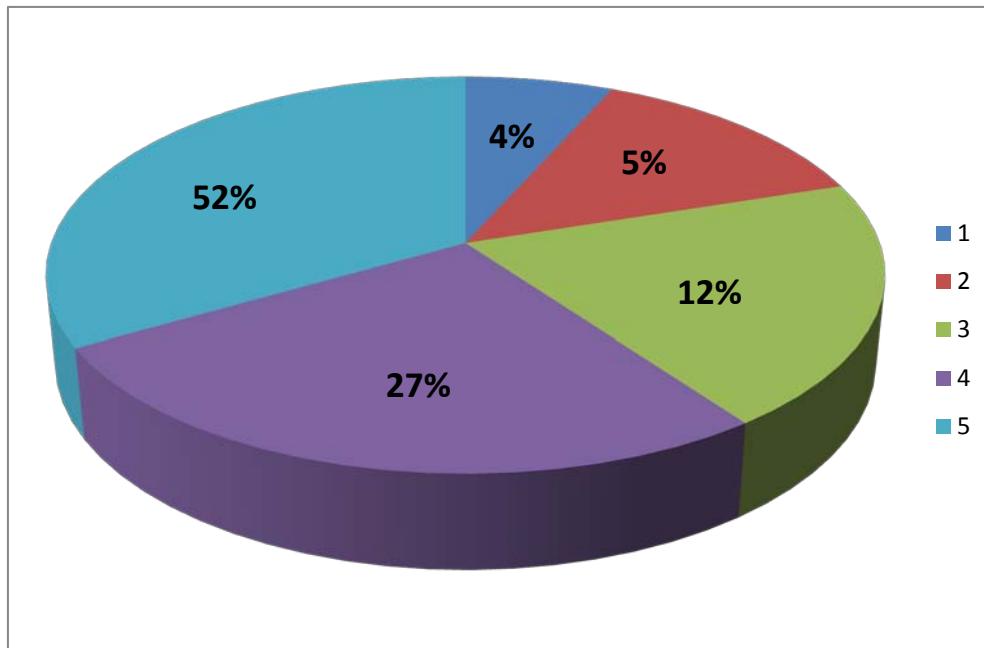


Figure 2: The relative ranking of the frequency of the responses

Figure 3 represents survey responses for leadership skills. It illustrates more than 50% received significant experience in leadership for their competitive projects. Figure 4 illustrates the responses for innovation. More than 75% mentioned that they received opportunities for innovative activities. Involvement of the entrepreneurial activities is somewhat indecisive. Figure 5 illustrates that students view their involvement as entrepreneurial. However, when we discussed this with the team, they stated that their involvement had more entrepreneurial content



because they initially did not understand the meaning of entrepreneurial. Figure 6 illustrates the involvement of risk. Figure 7 illustrates the responses related to improving team building skills, ambiguity, and capital formation.

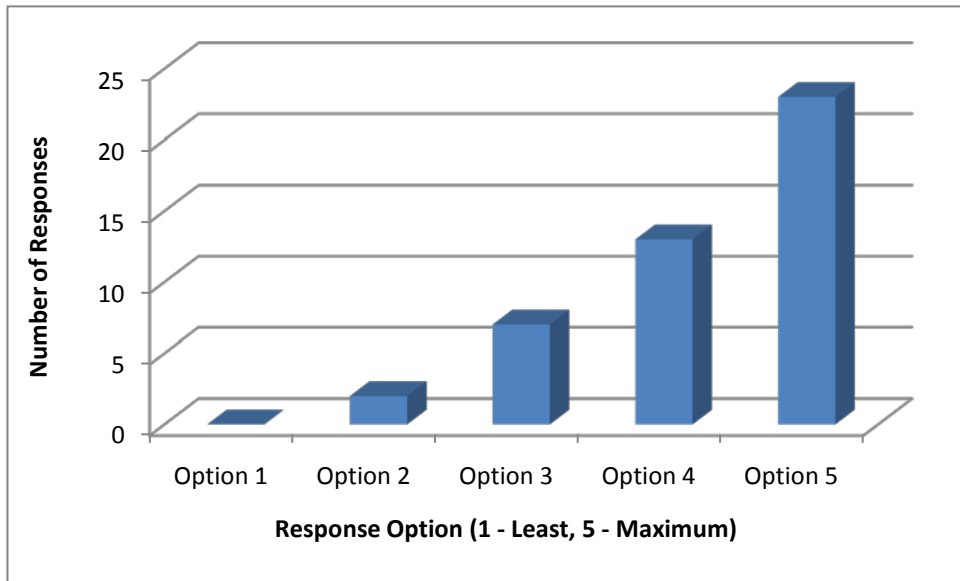


Figure 3: Survey responses for leadership skills in competitive activities

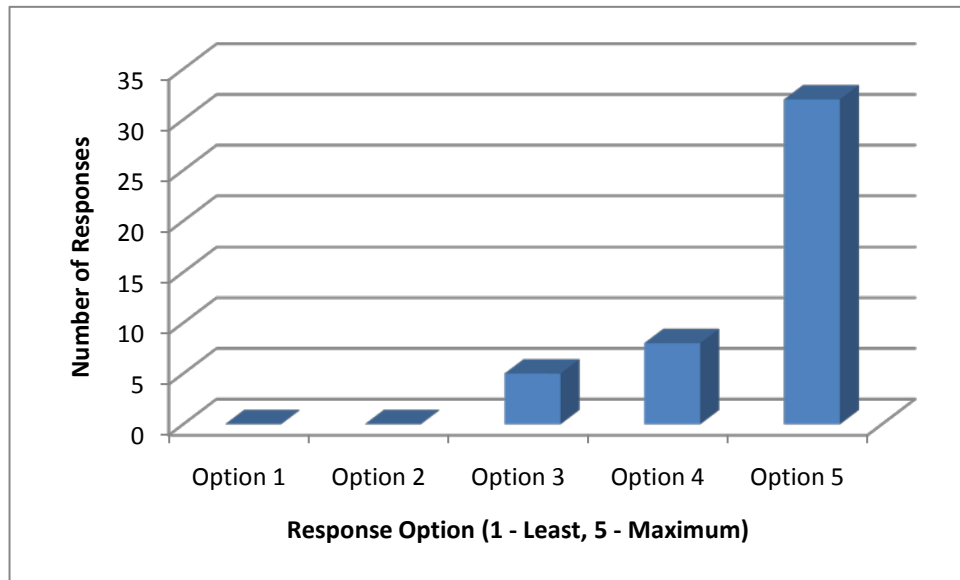


Figure 4: Survey response about innovation in the competition projects

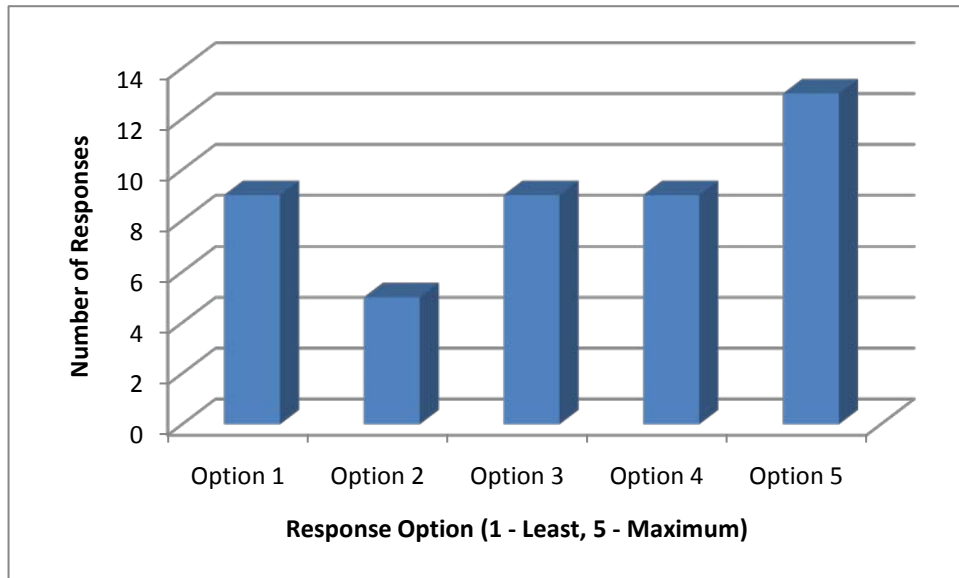


Figure 5: Survey response participation in the competitive team to be entrepreneurial

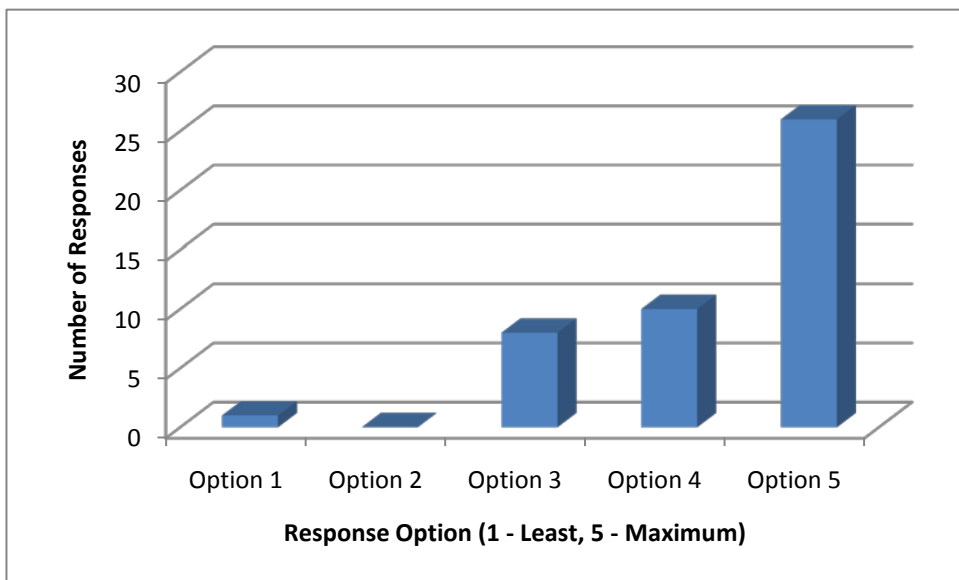


Figure 6: Survey response about risk experience in the competitive project

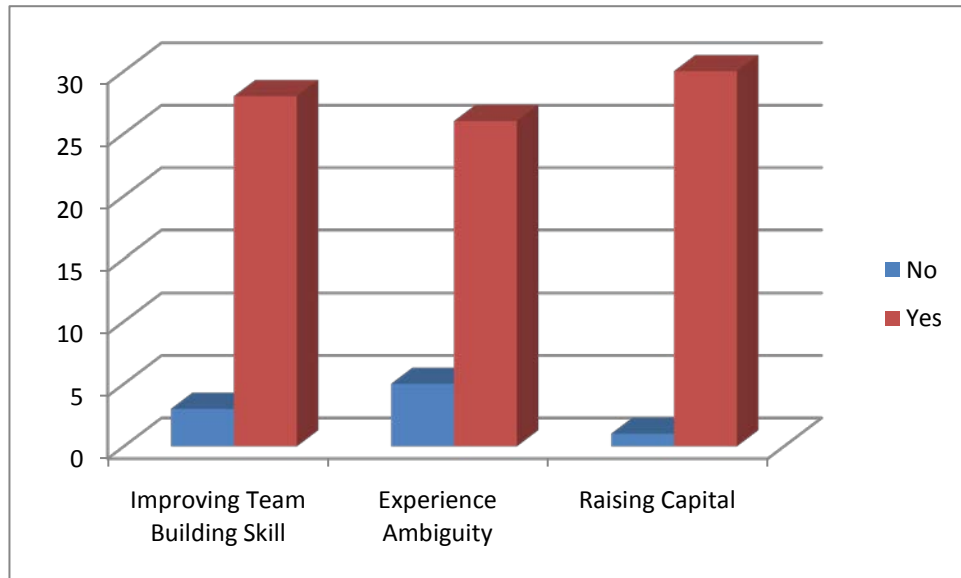


Figure 7: Responses on improving team building skill, ambiguity, and capital formation

### Student's Feedback

Students have provided comments on their experience in competitive projects. The following are some of the comments received:

- They had free reign when it came to creativity and innovation. The only requirement was to build a canoe, the rest was up to us. All within reason. Creativity and innovation can be used wantonly and aimlessly when a clear goal outside of being new or cool is not defined. There should always be grounding element of reason coupled with one's imagination considering the problems associated with being radically cutting edge.
- The events provide many opportunities for creativity and innovation. It also teaches students, who are interested in the auto industry, the opportunity to be creative while adhering to requirements from 3rd parties.
- Absolutely, It was an opportunity to lead a team of creative and motivational leaders. We will deliver a race car because we believe in the program, understand the importance of selling our ideas, and believe in each other. It's about having high confidence in what we do, and if there are members who are not highly confident in what they are doing, the other team members encourage them and support them to become confident.
- I believe that in order to be entrepreneurial, you have to sell a product/service. Since we are not looking to make any profit off of the competition, I would not consider my participation to be entrepreneurial.
- Most of my ideas were creative and innovative, although the engineering ultimately proved that most of them were not worth the added effort of implementation. We had to think up the idea, fund it, and market it. That sounds entrepreneurial to me. As close as it gets. You try to shy away from risking your own money, but it happens anyway often enough, and the teams overall and subteam-wise are run like businesses.

Alot of innovation takes place in the program, we are constantly analyzing designs, methods, and performance to innovate less expensive, better performing, and better manufacture methods. This paper demonstrates that the competitive activities could develop entrepreneur mindset. It does not mean that the students will have entrepreneur after participating in these senior design competitive activities. However, there is a great potential that it would leverage them to be entrepreneur.

### Summary and Recommendations

The competitive senior project experience has proven that the value added to the students' professionalism as engineers is clearly obtained through the project experience. Furthermore, as a result of this, the entrepreneurial mindset is being created and fostered the process. The entrepreneurial skills are nurtured and developed during this exercise. Leadership quality is enhanced through the building of teams, budgetary structures and risk management processes.

According to Donald Kuratko, "Entrepreneurial Mindset can be developed in individuals<sup>5</sup>." This means that engineering students could acquire it if they are well prepared through education.

To evaluate and analyze the entrepreneurial preparation of the engineering students participating in the competitive senior projects, the authors interviewed several faculty who acted as advisors. The names and positions of these faculty advisors are included in the appendix. By integrating the feedback from the interviews, the analysis of the questionnaire statistics and student comments, we can recommend the following:

- Entrepreneurial thinking should be integrated into the leadership program within the university curriculum.
- Create an awareness and understanding of the importance of entrepreneurial thinking prior to the practice of competitive senior projects.
- Students should be encouraged to attend the Entrepreneurial Lecture Series sponsored by The Legends Entrepreneurial Alumni Organization.
- Explore more funding sources to expand the Entrepreneurial Internship Program from its current capacity of 10.
- Engage engineering students in entrepreneurial workshops prior to their senior competitive projects.
- Encourage engineering students to elect entrepreneurial courses to satisfy their tech elective courses.
- Encourage students to conduct intellectual property searches using the online United States Patent and Trademark Office as part of the entrepreneurial mindset learning experience. This encourages product innovation, patent filing and possible commercialization.

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## Appendix

The following staff and faculty advisors are extensively involved in student competitive projects. The authors would like to acknowledge their contribution to this paper.

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