AC 2010-971: ENTREPRENEURIAL EXPERIENCES AND INTELLECTUAL PROPERTY: A STUDENT PERSPECTIVE

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Dr. Sabah Abro is an internationally educated math professor and program Director at Lawrence Technological University. He graduated with a Bachelor degree from the University of Baghdad, pursued a post graduate diploma in planning from the United Nations institute in the middle east, Went to Wales in the United kingdom to get his Masters degree and then to Belgium for his Ph.D. He has also international work experience; he served as Faculty at Al Mustansiria University in Baghdad, a regional consultant at the Arab Institute for Statistics, a position that enabled him to lecture in a number Arab countries. In Jordan he served as the Chairman of the Math and Computer Science department at Al-Isra University. In The United States he worked as an adjunct faculty at Wayne State University, University of Detroit Mercy and Oakland Community College. He held a position of the Math program leader at Focus: HOPE for several years. Sabah has been involved in engineering education paradigms since 1996, he coordinated work with university partners to develop new curriculum in engineering education with a support of NSF grant. Dr. Abro has work as a consultant in six sigma training and certification where he was exposed to manufacturing facilities and their practices. He has many publications related to education and statistics. He is a member of several professional organizations like the American Mathematical Society.

Entrepreneurial Experiences and Intellectual Property:
A Student Perspective

Abstract

This paper analyzes engineering student experiences in an interdisciplinary entrepreneurial senior project course. The paper will study and discuss how the outcome of the search for intellectual property is utilized to develop and enhance the fostering and building of the entrepreneurial mindset and experience.

This Academic Model allows each student to participate in a process that embraces the importance of documenting and validating product ideas using real world techniques and tools. The student's entrepreneurial learning experience is well grounded and always begins with a patent search using the United States Patent and Trademark Office. This paper will demonstrate the value of understanding this process and a body of applied engineering knowledge that is available in the quest to obtain a patent. Students' experiences and outcomes are documented through individual interviews and assessment tools. The constraints and challenges of developing a product, engineering it and preparing it to be marketed will be presented in this paper. Real world entrepreneurial experiences are valuable lesson and an integral part of the entrepreneurial mindset learning experience. Real world entrepreneurial learning experiences are linked to each student E-Team as they move their product idea through the validation process. The patent search might lead to discovered work that is so close, overlap or even is a replica of the team preliminary product idea. In these cases, they cannot continue with their preliminary product idea and must become innovative. This practice illustrates a valuable lesson which integrates with other components of the entrepreneurial learning experience. Learning on how to manage failure is a key ingredient of building the entrepreneurial mindset. Students from five entrepreneurial senior project teams have been interviewed and their individual learning experiences will be used in this paper. The student perspective and their assessment will provide the documentation of the value of understanding and using intellectual property in delivering the entrepreneurial engineering education curriculum.

This paper is a serious attempt to study an educational model through analyzing the feedback from students who lived the experience. The paper consists of three parts.

1. Paper Objective: The paper is an attempt to study the effect of "pattern search" on the entrepreneurial mindset.
   The study will analyze the academic model that we believe is a successful avenue to help students in engineering programs. The pattern search process is practiced through this academic model. We will investigate different variables of the academic model used to create the entrepreneurial mindset.
2. Academic Model: The academic model is innovative in engineering education; it combines many educational and learning input variables such as theory, practice, creativity, business experiences, manufacturing processes, marketing and team work to create engineering graduates with entrepreneurial mindset.

Model Delivery Method

The class management style truly motivates engineering students. It combines methods used in business and engineering schools to create a real world environment as part of the entrepreneurial journey.

The model is built around a course called "senior project". It is a standard practice that almost all engineering programs will include a course of this nature. There are many differences between the classical senior project classes and this model. Most of the senior projects depend on the theme of applying the theory learned in manufacturing or building a product. The product does not have to be unique or innovative. The process in this model is completely different and is based on the real life practice on how to start the process of thinking, researching, building and marketing a product. The key player needed to make this model work is the designer and the leader required to apply this model. In order to make this model applicable and successful, it needed a leader that is an experienced and enthusiastic entrepreneur. The professional that was chosen to develop and coach (not only teach) the students through the course had all the qualifications mentioned earlier. The chosen coach has many years of experience in engineering, management, marketing, sales, and entrepreneurial thinking. He is an experienced entrepreneur and corporate entrepreneur with 30 patents. This intellectual property represents many industrial segments from medicine to machine tools to electronic display systems. Based on this experience and know-how, the instructor is well prepared to foster an awareness and understanding of the importance of intellectual property and entrepreneurial mindset.

One of the key concepts introduced through this model is: Failure is a tool for learning and entrepreneurs should have enough confidence to believe they can make a major difference of their ventures."[1] The delivery style is "hands-on" and very real. Students are directly involved in a process that brings them into the world of entrepreneurship. Entrepreneurs should have an intense commitment and perseverance to work very hard and that is a key objective that the model emphasises on. Just like in real life, students in this course are encouraged to be optimists and strive for integrity and burn with a competitive desire to excel."[2]

The interaction in this class exceeds by far all similar experiences. The interaction time is very open and not bounded by the scheduled class times. It is so engaging that it drives most to the process of product development and ownership. This style is demonstrated by a sincere delivery with all of the passion and many years of practical experience. This class management method demonstrates self satisfaction, sharing of entrepreneurial experiences, and reaching out to the students with a strong desire to mentor the entrepreneurial spirit.

The model objectives, outcomes and learning experiences include the following:

- Create and develop an awareness and understanding of entrepreneurship and the entrepreneurial mindset. This includes the creative mindset, value creation, business opportunity, risk management, analysis of failure.
- Practice the entrepreneurial development process from an idea to a product. This involves conceptualization to completion.

- Conduct a patent search using intellectual property (IP) as a tool in the entrepreneurial journey.
- Develop a market survey, production analysis and business plan with a 15% Return on Investment target.

To achieve these objectives, the model introduces three main processes. These processes are:

Identifying and selecting the product

This course incorporates an "open style" of idea generation. It focuses on generating ideas using student experiences, hobbies, family interactions, work experiences (not specific to their employer) or suggestions based on their ideas. In some instances, ideas come from outside sources including businesses and universities. A "brainstorming" approach is used in all idea activities. This process is driven by functionality, application and the ability to solve a problem through the delivery of a product. As the idea generation process moves forward, the instructor becomes a facilitator and captures the ideas on the white board.

Once the ideas have been documented and thoroughly discussed, the facilitator directs each student to further investigate the uniqueness of the idea. The students use any and all resources available to investigate the idea. As a result of the investigation, some product ideas are eliminated.

The remaining ideas will be voted upon by the students. The voting process is not an easy one. It is open and verbal with the entire class involved in the process. Experience has shown that the best approach on voting for the product selection is accomplished with the "heart and head."

Creating the Entrepreneurial Team (E-team)

With the selection of the product, E-Teams are created. Over years, the instructor has found that each E-Team should have 2 to 4 members, 3 being the optimum. The creating of the E-Team is a very important step in achieving the objectives of the course. The makeup of the E-Team, as in any business venture, can make the difference between success and failure. By voting, each student creates their E-Team. Each team member must be able to recognize the importance of communication, team work, leadership and product ownership. Launching a new business venture is not easy. In creating E-Teams, students begin to learn the value of team work and leadership skills. "It is important to cultivate the individual skills necessary for an entrepreneurial engineer whether those skills are exercised in a startup, as freelance, or as a member of a large organization."[3] They work together to produce an effective business plan by the end of the product delivery date. The E-Team's mission of product development involves the initial step – the IP search process. According to the intellectual property law firm of Brinks, Hoffer, Gilson & Lione, "Intellectual property" refers to the creative product of a person's mind, which the law treats as a property right.[3]

The IP Search Process

One of the key learning experiences in this course requires each E-Team member to conduct a patent search on their product idea. This process involves the utilization of the United States Patent and Trademark Office (USPTO).[4] For many students, this is their first exposure to the USPTO. The USPTO is an online service that requires some education prior to its use; therefore, prior to the search, it is necessary to guide each student through this valuable resource and how to use it.

In order to communicate the value of the patent search, the instructor has developed a Power Point presentation which explains the organization of the patent structure. This enables the student to understand and use the patent search process.

The patent search process is used in this class to evaluate the uniqueness of their concept and design. This process further stimulates the student to generate improvement to features and functionality of their product idea. On the one hand, students may discover that their concept has been patented. This could mean that the product is in the public domain and can be used and manufactured; however, the E-Team cannot obtain a patent on this IP. If this prior art is active and enforced, they may have to change, redesign, or abandon their product idea.

3. Assessment: A serious and ongoing attempt to assess the outcome of this academic model has been a driver for adjustment and improvement of the model. We are going to use a cohesive method of analyses to assess and examine the model and connect to the objective of the paper. As this model is different from all other classes, it needed a different course evaluation form. A special questionnaire was developed for the students to evaluate their experience throughout the course. The questionnaire includes two parts. Part One, which includes nine questions, aims to have feedback from students about lessons learned through the model. Part Two targets the skills acquired by students through answering seven questions. The questionnaires are in the Appendix 3. The compiled answers of 50 students are in two tables representing Part One and Part Two of the questionnaire.

Table 1: Responses of 50 students on Part One Questions Distributed by Rank

			Rank				
Quest.	Topic	Wght Avg	1	2	3	4	5
1	Experience rate	3.84	2	6	10	12	20
2	Developing Solution	3.96	1	6	9	12	22
3	Fulfilling Needs	4.18	1	2	6	19	22
4	Raise awareness of potential Risk	3.98	1	6	8	13	22
5	Influence on the design	3.94	2	5	7	16	20
6	Caused the revision of concept	3.48	2	13	7	15	13
7	Encouraging	3.78		4	14	21	11
8	Effectiveness of defining uncertainty	3.96		2	14	18	16
9	Increased successful development of idea	3.86		3	14	20	13
	Ranking weights		9	47	89	146	159

Table 1 illustrates strong evidence that the students do appreciate the lessons they have learned though the model. The minimum average weighted rank was just under 3.5 out of scale of 5.0 being the maximum. The concept revision scored relatively lower than others. Other more important outcomes, such as fulfilling needs and raise risk awareness, were ranked higher by the students. The general experience from the model was also ranked high, close to 4.0.

Chart 1 from the data of Table 1 represents the weighted average for each of the nine questions.

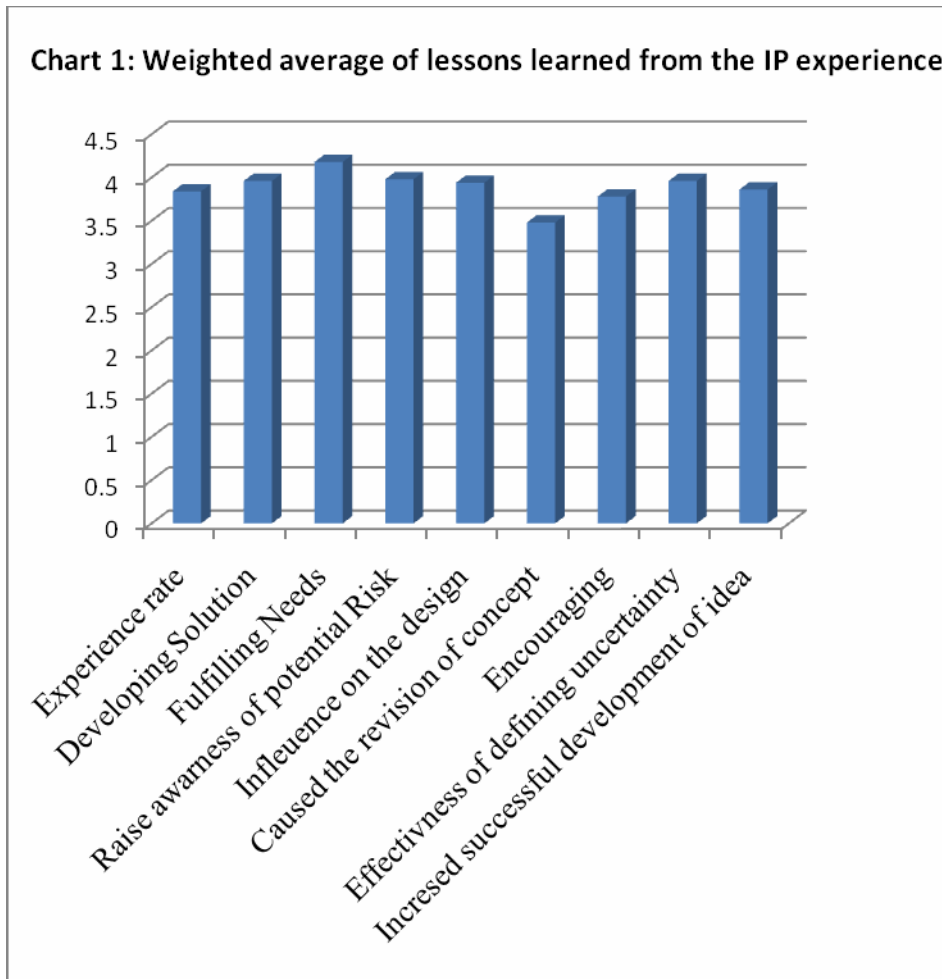Chart 1: Weighted average of lessons learned from the IP experience

Chart 1 indicates that the model was highly appreciated by students. It also provides a general conclusion that although different lessons were ranked differently, the overall lessons learned were ranked high and close to each other.

The other interesting result from Table 1 is the percentage of ranks provided by students through the questionare. In general , the highest ranks of five given by students for the nine questions related to lessons learned was 35% and 32% went to rank four. In general only 13% of the scores were two or less versus 87% for rank three or more.

Chart 2 explores these percentages.

Chart 2: Percentages of answers distributed by the rank given to lessons learned
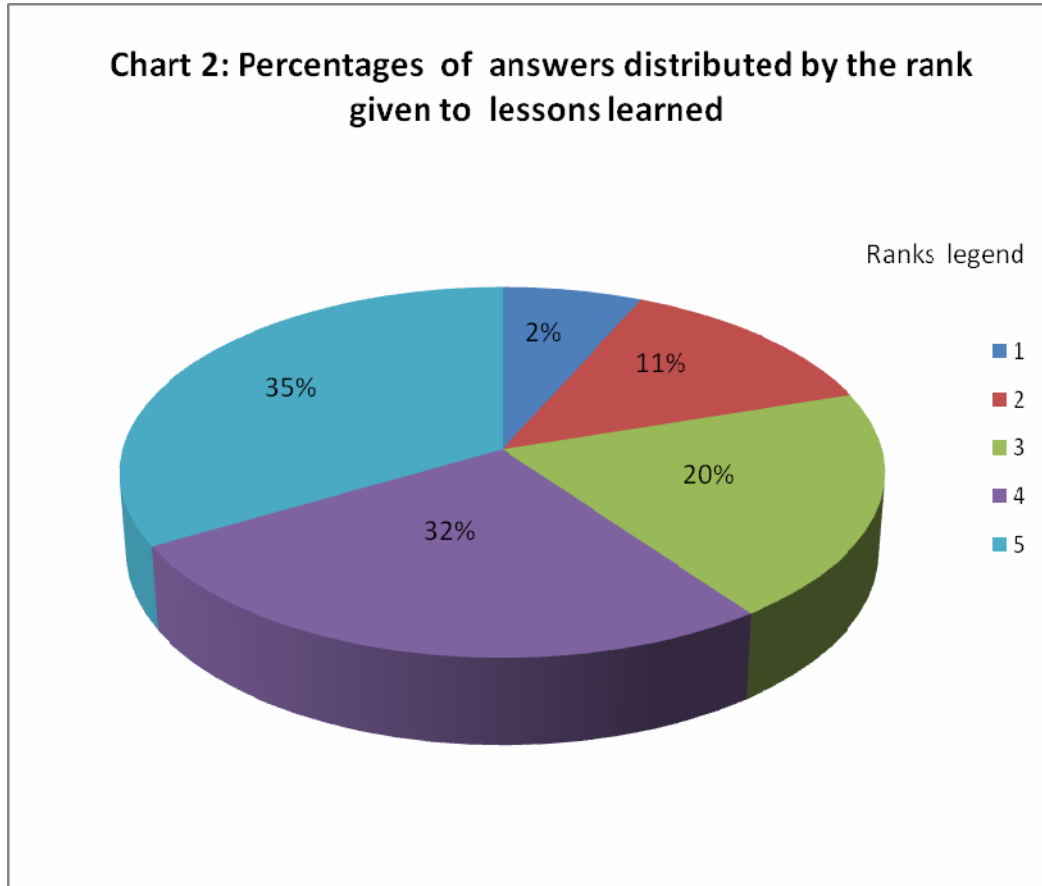
Table 2: Ranks given by fifty students to different skills aquired

Skills Acquired from Senior project E team	Wght Avg	Rank				
		1	2	3	4	5
Management Risk	3.82		6	12	17	15
Uncertainty	3.76		3	15	23	9
Ambiguity	3.58	2	4	18	15	11
Innovation	4.28		3	4	19	24
Creativity	4.36		3	3	17	27
Problem Solving	4.4	1	1	3	17	28
Opportunity Recognition	4.24		2	7	18	23
Ranking weights		3	22	62	126	137

By studying Table 2 we can conclude that the students appreciate the skills they have aquired through the exercise of the model. Four of the skills that we thought should be aquired through

living and working through this model have been highly ranked. These skills that are essential to the skills needed for enterepenures and provide confidence for the graduates to pursue the path of enterperenurship.
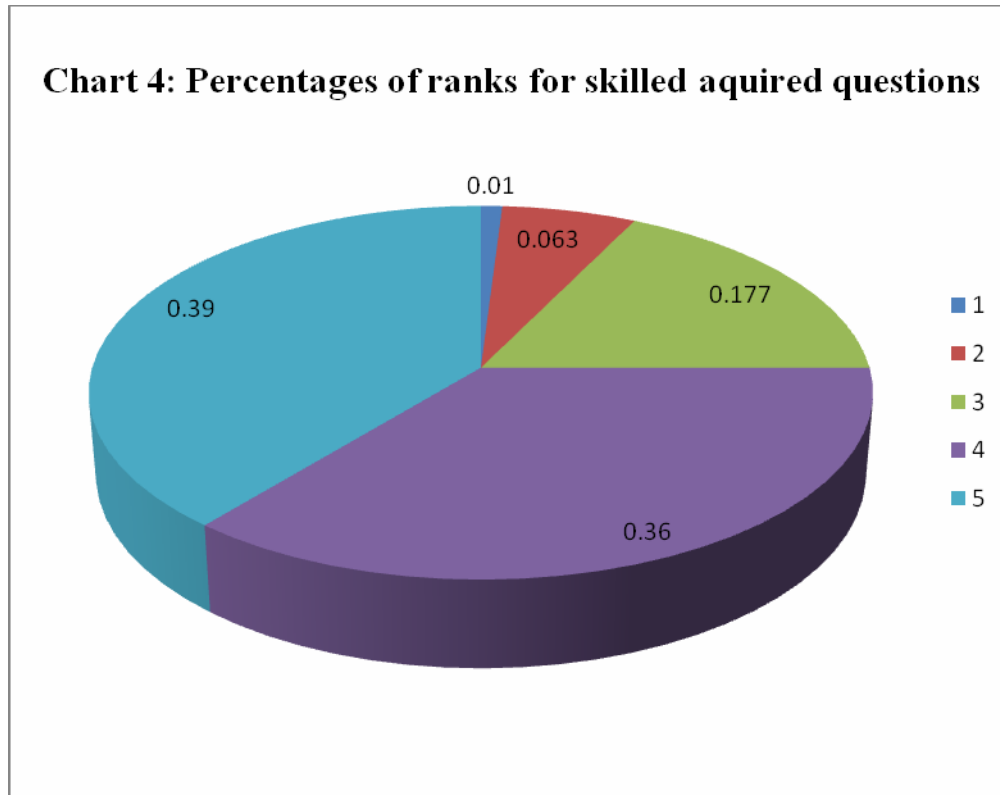
Opportunity recognition is one of the major skills that an enterepenure has to have. The students seem to believe that they are more familiar with this skill after the course. This fact is reflected by the weighted average of 4.24. Problem solving skills that are needed for all professionals, team leaders and enterperenures were provided to the students according to the questionnaire to the extent that they ranked it with 4.4 out of five . If we look at the bar chart below, we can tell that skills aquired by the students has been remarkebly recognized by the students.

Chart 3 supports the notion of positive skill building process in the model.

Chart 3: Weighted average for skills aquired
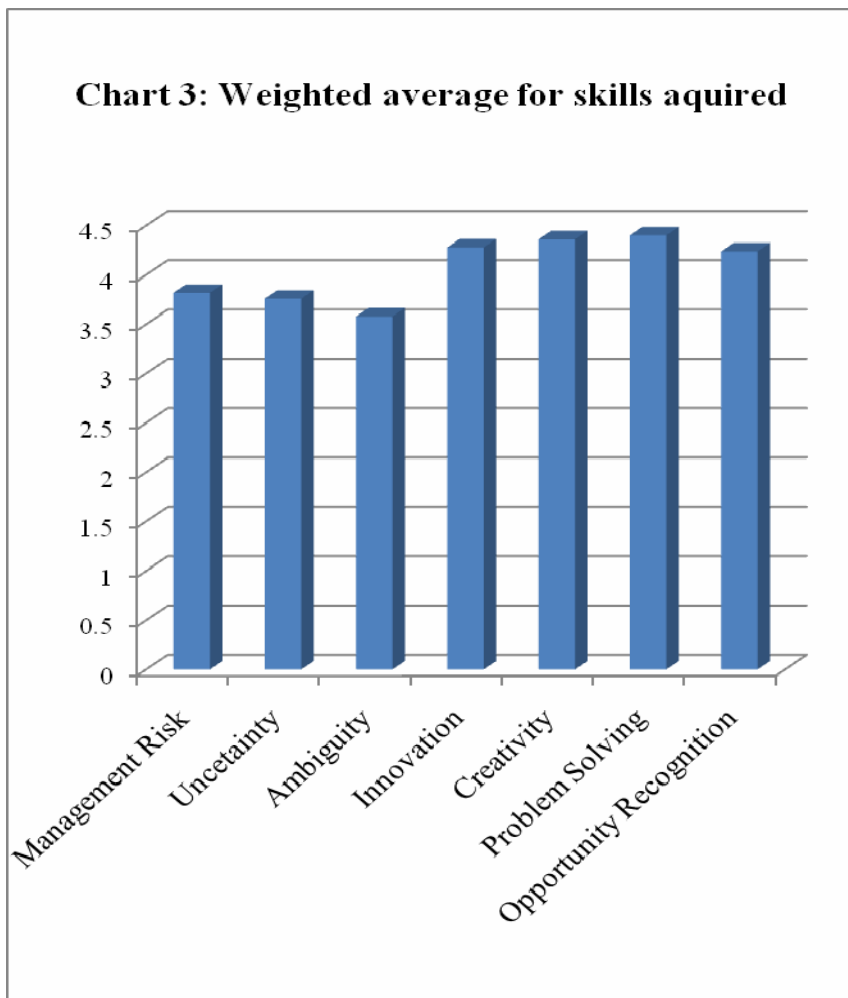
The overall percentage of high score ranking was 75% for ranks 4 and 5 and a total of 92.7% percent was the share of score 3 or more versus 7.3% votes for the rank of fewer than 3. Chart 4 highlights these percentages and supports the idea of a successful skills acquiring process through the model.

Chart 4: Percentages of ranks for skilled aquired questions

0.01

0.063

0.177

0.39

0.36

Legend:
- 1
- 2
- 3
- 4
- 5

Learning Outcomes

The value of participating in the IP patent search process directly pertains to developing and creating an understanding of the entrepreneurial mindset. LTU is a member of the Kern entrepreneurial education network that is supported by the Kern family foundation. The primary objective of this foundation is to foster the engineering entrepreneurial mindset. The following are some of the comments from students who participated in the IP search process:

- Experienced total failure and thereby had to abandon this product idea. As a result of the IP search, the E-Team found their product idea was completely encompassed by claims in prior art and technological solution around this problem.
- Learned that their product has been patented; as a result of this, the E-Team can create new features to improve the product. This experience directly relates to the entrepreneurial mindset, creativity and inventiveness. These improvements could lead the E-Team to a new patent.
- Found their product idea had been patented; however, the patent is no longer in force. Therefore, this reinforces their product idea without legal implications because it is in the public domain and can be manufactured and sold.
- The patent search process made the E-Team aware that they have an expanded customer market.
- The search process caused the E-Team not to revise their original product design.
- This patent search influenced their product design and caused them to redesign their product features.

- Prior artwork forced a redesign of the product, thus minimizing the risk of potential law suit.
- The search produced intellectual property that caused the original product design to be abandoned, thus experiencing failure.

Summary

This paper demonstrates that the integration of an IP search is a valuable tool in experiencing the entrepreneurial mindset in the process of developing a product. The students who participated in each E-Team shared their learning experience. The conclusions indicated that the IP search was beneficial. Each student experiences problem solving, uncertainty, creativity, recognizing the opportunity, ambiguity, uncertainty and the management of risk.

Bibliography

1. Donald F. Kuratko and Richard M. Hodgetts, Entrepreneurship: Theory, Process, Practice. Seventh Edition, 2007, page 116
2. Donald F. Kuratko and Richard M. Hodgetts, Entrepreneurship: Theory, Process, Practice. Seventh Edition, 2007, page 116
3. Brinks, Hoffer, Gilson & Lione, The Basic Principles of Intellectual Property Law, 2005, page 1.
4. United States Patent & Trademark Office website: www.uspto.gov /, January 4, 2010.
5. Jeffrey A. Timmons and Stephen Spinelli, New Venture Creation, Entrepreneurship for the 21th Century, Eight Edition, 2009, page 104.

Appendix 1: Course description of Senior Project course

The intent of this course is to foster and expand entrepreneurial concepts by utilizing all of the student's educational and professional experience. The product development cycle focuses on teamwork, effective problem solving, and leadership skills. First, the class brainstorms several product ideas and a selection process is used to determine which ideas will progress to products. Then working in student-selected teams, a patent search is done to see if the product idea is novel, and a market study is performed on the selected product idea. The team will then design, engineer, test, and construct a working product based on their market feedback information. This product is the cornerstone to starting a company that will have a realistic time-table and a target ROI. Several oral presentations and work outside of the classroom are required. Video recording of the final presentation and product demonstration is done and several industrial advisory board members may be present as a panel to assess the student presentation and product.

Appendix 2: Lawrence Tech – Background and Culture

Lawrence Technological University (LTU) was founded in 1932 as a result of Henry Ford and the educational community requesting part-time evening programs. At that time, there were no colleges or universities in the Detroit area offering evening courses. The Dean of Engineering at the University of Detroit (U of D), Russell Lawrence, was approached to create a night school program. He left U of D and started Lawrence Institute of Technology (LIT) to offer engineering

and technology programs that were open to part-time as well as full-time students. Mr. Lawrence had the entrepreneurial spirit to create LIT even in the depressed economy of 1932.

In 1986 the Bachelor of Science in Technology degree was initiated and the name was changed to the Bachelor of Science in Engineering Technology in 1990. As a foundation for this program, and since the LTU philosophy is "Theory and Practice," a capstone course needed to be developed. An important requirement for this Senior Project course was to have it taught by a professor who had an entrepreneurial mindset. Also, another was that Senior Project would use all of the skills that students learned from their previous course.

Appendix 3: The Questionnaire:

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ASEE Student Questionnaire

Legend
| 1 | 2 | 3 | 4 | 5 |

None   Maximum
Least   Most
Not significant   Most Significant
Not Relevant   Relevant
Not Applicable   Applicable

Part One: Please answer the following questions by ranking them
1. Rate your experience/exposure to the resources of the U. S. Patent and Trademark Office (USPTO) website.

   1   2   3   4   5
2. The product idea was based on developing a solution to a problem.

   1   2   3   4   5

3. The product idea was based on fulfilling a specific need.

    1   2   3   4   5

4. The patent search (PS) made the team more aware of the potential "risk" involved in product development.

   1   2   3   4   5
5. The PS had an influence on the design of the product.

   1   2   3   4   5
6. The PS caused the team to rethink or revise the original concept.

   1   2   3   4   5

7. The PS encouraged the team in its effort to design, engineer, and build a product.

    1   2   3   4   5

8. Rate the PS as an effective tool in defining the uncertainty faced by your entrepreneurial team (E-Team).

    1   2   3   4   5

9. The PS increased the successful development of the team's product idea.

    1   2   3   4   5

Part Two:

As an engineering student, what is the best evaluation of the skills acquired from this Senior Project – E Team experience?

1. Management Risk   1   2   3   4   5

2. Uncertainty   1   2   3   4   5

3. Ambiguity   1   2   3   4   5

4. Innovation   1   2   3   4   5

5. Creativity   1   2   3   4   5

6. Problem Solving   1   2   3   4   5

7. Opportunity Recognition   1   2   3   4   5