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Universities and Industry Create Engineer Entrepreneurs to Fuel Innovation

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Abstract

Entrepreneurship is a driving force in creating new products and new companies. Both these activities create job opportunities for our students upon graduation. According to Kauffman Foundation research, 41% of children ages 9-12 say they would like to start their own business. Furthermore, about 70% of the net job creation in the nation was attributed to businesses in existence less than five years. Based upon this data, it is evident that universities and industry need to join hands to promote the integration of entrepreneurial skills into classrooms to motivate and provide guidance to the nation's future innovators. Today's engineering students must not only be technically educated, but they must also be aware of what it takes to bring their ideas to market. This includes skills in marketing, production, budgeting, innovation and business analysis. It is the collaboration between industry and academia that will teach our students to shape their ideas to fill real-world needs.

Engineering entrepreneurship requires that engineers acquire a number of skills that are not normally present, particularly in new graduates. These include a number of general business skills related to accounting, marketing, finance, and others where engineering graduates typically have minimal skills and, in many cases, little interest. Additionally, the broad area of soft skills can be difficult for engineering students to grasp and they openly question its value. Yet, when presented in a graduate course in business agility for engineers, one of us (JS) has seen students recognize the value of these skills and begin to develop and utilize them within 4 weeks of the start of the course. One student's comment typified the reaction: "When I started this course I saw no value in soft skills. Now I can see that they can be more valuable than technical skills."

Companies such as Microchip Technology are well positioned to mentor university students. Companies can provide guidance with regard to creating business plans, marketing and promoting their designs, while guiding students to turn their innovative ideas into a successful enterprise. Arizona State University's (ASU's) Polytechnic campus is uniquely situated to encourage students to participate in

entrepreneurial activities, as an integral part of their degree program. Many of the students are already in industry. They have gathered some of the skills mentioned above, are interested in entrepreneurship, and are encouraged by many of their employers to be innovative and entrepreneurial. This is combined with a unique mission, the creation of business-ready graduates as an integrated component of the entire educational program in our department. This refers to students who not only understand the industry they are entering, but also many of the business and business skill issues needed by industry. The synergy that is brought forth by both organizations—Microchip and ASU at the Polytechnic campus—leads to a successful model that couples the entrepreneurship programs at Microchip with the business-ready model at ASU and encourages students to pursue innovative paths, via guidance provided by both the Company and the University.

This paper will discuss several ideas for potential ways in which universities and industry can collaborate to create engineering entrepreneurs. One idea involves holding a design contest for students to create a working prototype of a product; then develop business and marketing plans for the product, while gaining an understanding of the patent process. All of these activities are part of a capstone project that is already included in the curriculum at ASU's Polytechnic campus, Department of Electronic Systems.

Introduction

ASU defines entrepreneurship as “the spirit and process of creative risk taking and innovation that leverages university knowledge to spur social development and economic competitiveness.”¹

Additionally, in a contributed article to *Mechanical Engineering Magazine*, Ephraim Suhir, President and CEO of ERS/Siloptix Co. in Los Altos, CA, wrote that “a technological professional with entrepreneurial skills has a better chance than a business administrator of moving innovations from research into manufacturing and the marketplace.”² This suggests that there is real business value when engineers can apply entrepreneurial skills to their technical knowledge. Today's engineering students must take their ideas from theory to the marketplace, and universities must collaborate with industry to provide the real-world exposure that will educate these future entrepreneurs to think creatively and innovatively. Industry skills, including business planning and analysis, marketing, presentation and communication skills are necessary to bring engineers' innovations to the consumer.



Figure 1:
In addition to technical skills, engineers must have communication skills, business-sense and marketing savvy in order to succeed in entrepreneurial environments.

Equally important is the recognition that “soft skills” (such as business planning, marketing and communication skills) are crucial to successful entrepreneurship. Engineering students are frequently preoccupied with “hard skills” (technical knowledge) and might not immediately recognize this. Interaction with representatives from industry demonstrates the practical value of these skills, so that students can easily understand them. Engineering entrepreneurship is a vehicle that pulls these diverse aspects together in ways that are meaningful and useful to both students and industry.

Entrepreneurship Education at ASU’s Polytechnic Campus

The Electronic Systems Department (ESD) at ASU’s Polytechnic campus has as a major objective—the preparation of business-ready graduates. There is a requirement that technical proficiency cannot be sacrificed for the sake of acquiring business skills. Rather than have these business skills detract from technical proficiency, various business methods and tools are introduced to help teams function more effectively, reduce waste in technical areas, clarify thinking and problem solving, improve interpersonal communication and provide other methods to help students become more efficient.

Engineering entrepreneurship is a particularly attractive framework in which to introduce these ideas for two reasons. First, many students have a keen interest in entrepreneurship, which translates into active class participation. Secondly,

entrepreneurship is challenging and multifaceted. It gives students candid insights into how businesses actually operate and why they operate in those ways—particularly when there is industry involvement in the program. This is where ASU’s partnership with Microchip is particularly important.

Engineering entrepreneurship is a balanced combination of engineering, business knowledge, and soft skills training, but one that some students view in terms that are typically too simple. ASU at the Polytechnic campus approaches the issue of engineering entrepreneurship with Microchip in two steps. The first step involves an intermediate capstone course required for juniors that includes significant components related to project management and involves students in engineering tasks that require a myriad of skills they have developed through prior course work. In more basic terms, it integrates technical skills with project management in a business-like setting.

The fundamental outline of the course was prepared by ESD with some input from Microchip, which provided other specific resources. For example, they provided personnel to deliver 30- to 60-minute presentations in several classes. These presentations stressed both technology issues and the surrounding business issues that needed to be considered. They frequently included case studies. Additionally, the presentations introduced the idea of engineering entrepreneurship in steps that students could absorb and understand. These ideas are further reinforced in the course by illustrating the application in product development, incremental but significant improvements, and creative approaches by students for developing project ideas and acquiring the funds needed to develop those ideas to a deliverable product.

Microchip also provided a condensed, half-day seminar on entrepreneurship. This afforded an opportunity for students to see how entrepreneurship works at a major company, introduced issues such as business plans and intellectual property, and provided an opportunity to engage representatives from Microchip in open and candid conversations with students. Microchip also makes a number of its Web seminars available to students on an ongoing basis, which gives them access to current practices and information they can use in subsequent projects and classes.



Figure 2:
A student participates in one of Microchip’s hands-on engineering classes.

For the second step, ASU at the Polytechnic campus plans to expand this involvement into higher-level classes, including the upper-level capstone course. In these courses, many of the ideas and approaches brought forth in step one are to be discussed in greater detail. Business analysis, planning, and justification will be included, and the engineering projects will be more intricate. Microchip provides tools and materials to these classes.

Additionally, Microchip and ASU at the Polytechnic campus plan to jointly develop an Entrepreneur Workshop for Universities, which would be used at both Microchip and ASU. The seeds for these activities were planted in the work described earlier. Together, Microchip and ASU at the Polytechnic campus are exploring how students might conduct some of their work at Microchip or in cooperation with Microchip engineers.

Entrepreneurial Experience in Corporate Environments

Microchip Technology, like many other companies, is constantly challenged to remain successful. In their book entitled “Driving Excellence,” published by Wiley, Microchip President and CEO Steve Sanghi and Michael Jones, former Vice President (VP) of Microchip Human Resources, write the following:

“...various factors are forcing companies to increase their rate of improvement: the technology revolution, increased globalization of both the marketplace and competitors, investors’ demands for impressive financial performance, and the purchasing habits and expectations of consumers.”³

It is the integration of these skills in marketing, production, budgeting, innovation and business analysis that drive entrepreneurship and subsequent growth. The authors continue, “The forces have added a great deal of complexity to a company’s internal systems and processes. The sophistication of these systems and processes continues to increase with the advent of new technologies and the desire for improved execution, dramatically changing the composition of the workforce.”⁴

Given these factors, it is clear that Microchip has a vested interest in collaborating with universities to develop engineering students who understand and appreciate the scope of entrepreneurship in the corporate environment.

As a high technology, commercial enterprise that provides products and services to other technology-driven companies, Microchip’s interest is two-fold. First, it seeks to hire employees who are not only skilled in their chosen area of expertise, but who also understand the impact of other parts of the business on their individual role. The “Aggregate System” of management in use at Microchip and described in Mr. Sanghi and Mr. Jones’ book embodies, as several of its elements, the principles of inspiring leadership, a continuous-improvement culture, fully aligned strategies and the pursuit of excellence. These principals make Microchip’s a very entrepreneurial culture. The more well prepared graduating students are in these areas, the earlier they can make an impact on Microchip’s performance—fueling both the organization’s growth and their own. Secondly, if Microchip can help universities develop entrepreneurial students, and at the same time expose them to Its products and services, the students are more likely to select Microchip’s semiconductors for the products that they eventually develop and market.

To this end, Microchip has developed several initiatives through its Regional Training Centers (RTCs) that are aimed at partnering with universities and colleges to foster entrepreneurship. Microchip’s Technical Training Engineers (TTEs) travel to universities and provide workshop-based training on products and applications. Quite often, these participating students are involved in design competitions or are seeking guidance for student projects that is not available elsewhere within the university. These programs have been run at locations such as the DeVry Institute in Cleveland, and Ryerson University and Seneca College in Toronto. Additionally, Microchip makes courseware used in its RTCs for customer training sessions available to professors for incorporation into university classes. This provides a real-world construct for the teaching of theoretical concepts. The Company has also provided equipment and consultation to professors seeking grants to develop innovative technology training courses and workshops.

As mentioned earlier, the hard skills learned in technical training are not enough, by themselves, to fuel entrepreneurship. To meet these objectives, Microchip is developing programs in conjunction with ASU at the Polytechnic campus to provide leadership in developing the “soft skills” necessary for real-world success.

Preparing Future Engineer Entrepreneurs

Entrepreneurs have clear vision about their ideas. They are positive thinkers and prudent risk takers. Their drive and determination to transform their vision into reality is very high. However, entrepreneurs are frequently deficient in business processes that are required to bring their idea into marketplace successfully.^{5,6} The model presented in this paper illustrates the integration of entrepreneurship education and entrepreneurship experience in a corporate environment, to close engineering students’ knowledge gaps and prepare them to launch successful business enterprises based upon their vision and personal drive.

Entrepreneurship education typically resides in business colleges within higher education institutions. The mission of the Electronics Systems Department (ESD) at ASU’s Polytechnic campus is to produce business-ready graduates, so it is both valuable and appropriate for its students to be exposed to education in entrepreneurship, along with related and essential soft skills. Recently, the Kauffman Foundation awarded \$5M in funding given only to only two higher education institutions in the nation. ASU is one of these recipient institutions, and it anticipates additional support from the Kauffman Foundation in its endeavors to strengthen entrepreneurship education for students. Microchip’s involvement is a key component that provides valuable help to prepare future engineer entrepreneurs.

After acquiring sufficient education and soft skills in entrepreneurial areas, ASU Polytechnic students are required to participate in a capstone project to combine and use both hard and soft skills. The students are encouraged to compete with other students regionally and nationally to exhibit their skills in both areas. These goals are expected to be jointly achieved with collaboration between Microchip and the ESD at ASU’s Polytechnic campus.

Conclusion

Technology and industry are powerful forces that are responsible for tremendous transformations that are changing the daily lives of ordinary citizens. In order to sustain the USA’s competitive global economic position, technology and industry must continue to foster and grow entrepreneurial activities that support the country’s key strengths and innovation. Current outsourcing efforts demonstrate that many technical and engineering jobs functions can be outsourced to other nations at a lower price, but it is knowledge-based activities such as innovation and business skills that provide the strength of developed nations such as the USA.

To achieve this, it is essential that industry and academia nurture younger generations and teach them the entrepreneurial skills they will need to contribute new ideas and keep the country moving forward in technological enterprises. This paper outlined one approach to achieving this goal and, on a smaller scale, the details on how to implement these principles into university curriculum. Success in this area requires that educational institutions join hands with corporations to weld together the ideas of entrepreneurship and the methods of a successful corporation. This combination provides the setting necessary for developing the future engineer entrepreneurs that the USA's economy requires to retain its position on the world stage.

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