Convergence - Engineering and Business Education Enhancements

Lex A. Akers, Dean
Caterpillar College of Engineering and Technology
Bradley University

Darrell Radson, Dean
Foster College of Business Administration
Bradley University

I. Introduction

The academic process we refer to as Convergence is developing curricula, forming industrial partnerships, and focusing faculty scholarship to educate engineering and business students to identify, develop, and capitalize on high-potential business opportunities. This paper describes our plan at Bradley University to develop and implement our Convergence educational model. First, we differentiate Convergence from the many joint Business and Engineering academic programs, entrepreneurial programs, and the various Business and Engineering minors that currently exist at US universities. Next, the different knowledge and skills needed by the Business and Engineering students are described. Lastly, we describe the planned convergence curricula allowing Business and Engineering students multiple educational opportunities to experience Convergence.

II. Business and Engineering Academic Programs

There are number of excellent existing business and engineering joint academic programs. Although, we do not intend to review all of these programs in this section, we will discuss the four basic categories found among the many joint business and engineering undergraduate academic programs.

The first category is joint business and engineering degrees. An example of such a degree program is found at Drexel University[1]. Such degree programs contain broad-based business and engineering courses, enabling the graduates to work in technically orientated business fields. The students complete a set of fundamental business and engineering courses and may choose from fundamental courses in a number of engineering disciplines. A concern for these types of degree programs is the students do not receive an ABET accredited engineering degree.

The second category is the multi-course sequence. This is usually a two course sequence of business courses within engineering. An example is the Integrated Engineering and Business Practices curriculum at Notre Dame University[2]. This two course sequence teaches engineers a number of fundamental business skills. These courses are designed to help engineering students understand corporate operations and sensitize them to the need for such skills when they move into managerial leadership roles.

The third classification is joint business and engineering project directed course sequences. These course sequences are very common and many times referred to as providing an entrepreneurial experience. An example is a sequence of three courses between engineering and business at the University of Missouri[3]. Such a course sequence provides knowledge, practice and experience to the student in skills such as innovation management, developing marketable products, and in many cases the actual planning, pitching for venture capital, and launching of a startup business.

The fourth category can be described as either certificate or minor programs. There are a large numbers of options in this category. At Bradley University, there is a minor in Business Administration that engineering students may take that provides a relatively comprehensive exposure of business principles such as accounting, economics, quantitative finance, marketing, and managing organizations[4]. Additionally at Bradley University, there is a minor in Quality Engineering available to business students providing the knowledge and skills in the methodologies for designing, producing, and delivering quality products and services[5]. A relatively unique program is found at Auburn University and is referred to as the Business-Engineering-Technology program (BET)[6]. This 16 credit hour minor is a cohort driven educational experience for a select group of engineering and business students. This four semester program provides a very comprehensive business and engineering experience for the students. They are taught and practice in developing new products, business plans, market viability studies, and have a capstone product development experience. This sequence of courses and experiences does an exceptional job in educating engineering and business students to be able to work together as a productive team and develop the rapport and the language to effectively take technical ideas and produces high potential business opportunities.

All of the above mentioned categories provide valuable skills, knowledge, and practice for business and engineering students to help prepare them for the profit-based technical world. Our Convergence academic program has many similarities with the above programs. However, as will be described below, Convergence offers a variety of opportunities for the engineering and business students to engage in these studies to varying degrees depending on their current interest and academic accomplishments. A major characteristic of the Convergence academic program is to develop the knowledge and practice to transform the student into what is referred to as a "T-person"[7]. A "T" person, as the shape of the letter implies, has solid foundational knowledge in either engineering or business, the "I" of the "T". Additionally, the student learns and practices the ability to communicate, respect, develop rapport and function in a joint engineering business team. This is represented by the horizontal cap of the "T".

III. Points of View

Convergence education will require changes, not just in curricula but in the culture of how business and engineering students and faculty learn and interact. It goes beyond the classes, it's the experience, interaction, and the environment we are establishing. From the Foster College of Business Administration point of view, the goal is to weave into a solid business education the experience and understanding of technology-based businesses that will launch their graduates on a trajectory of business growth and development, entrepreneurship, and leadership. Business students will gain the knowledge, experience, and skills to:

- Identify, evaluate, and capitalize on high-potential business opportunities, particularly ones based on new technologies.

- Integrate the functional areas of business to effectively plan for the growth and development of technology-based businesses.

- Effectively communicate and work efficiently in teams with technical professionals to produce marketable results.

- Develop business models and plans for new businesses, the development and expansion of current businesses, commercialization and technology transfer.

- Work successfully with the technical side of the product planning and development cycle

From the Caterpillar College of Engineering and Technology point of view, the goal is to weave into a solid engineering education the professional business skills and experiences that will firmly set our graduates on a path to industrial leadership positions. Through Convergence, we will equip our engineering students with the knowledge, experience, and skills to:

- Identify and capitalize on high-potential business opportunities.

- Effectively communicate, work efficiently in teams to produce marketable results, and develop rapport with business professionals.

- Understand the drivers of business success (i.e., profitability).

- Continuously learn and evaluate new technologies.

- Have the confidence gained through real-world experience to succeed in today's global and fast-paced business environment.

IV. Curricula - Multiple Points of Convergence

Our plan is to develop curricula and an associated culture where business and engineering students learn together to understand that business and market success result when a diversely educated group of professionals work together where everyone adds value to the end result. We will achieve this by developing *multiple points of convergence* between the two colleges thereby increasing the educational opportunities of our students. All business and engineering students will experience a change in their education by our convergence activities but the degree of their convergence experiences will not be the same for all students. Some students will choose particular opportunities and some will choose others. The degree of convergence will be different for different opportunities.

Figure 1 is a graph depicting the multiple points of Convergence. The sizes of the circles are proportional to the number of students who will participate in these opportunities. The colors

indicate the degree or depth of convergence for each opportunity. Each activity is briefly described below.

A. Awareness Seminars

Speakers in these seminars and lectures will be business leaders and successful entrepreneurs who work in industries where technology and engineering face business and market realities, challenges, and opportunities on a daily basis. Students will become aware that the

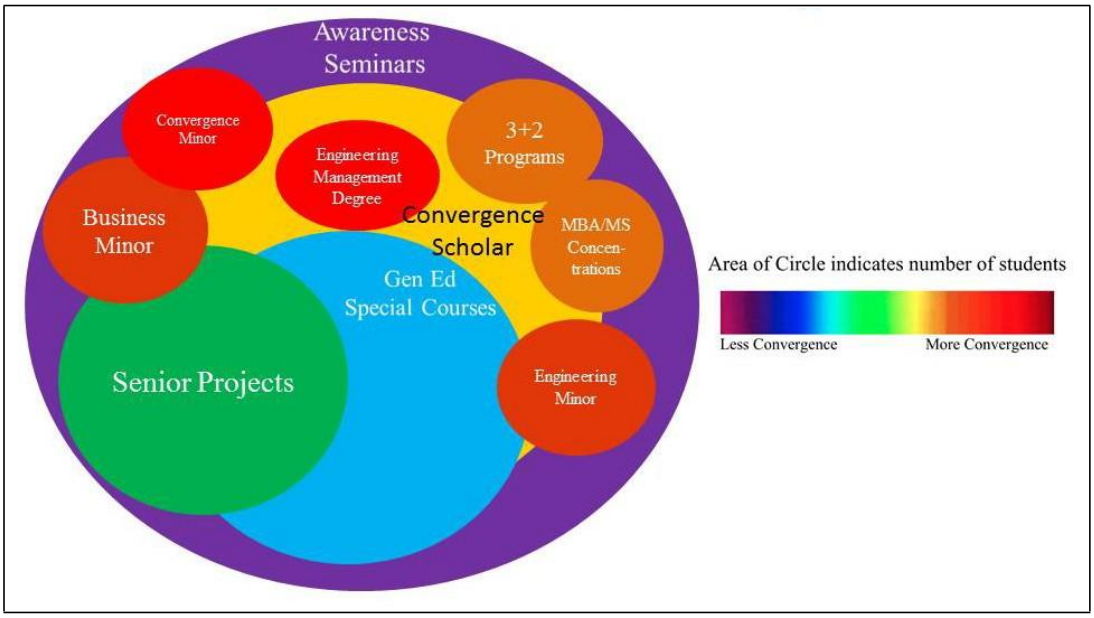

Figure 1: Multiple Points of Convergence

successful application and commercialization of technology is the result of effective business planning and execution.

By a constant flow of business leaders coming to campus emphasizing the importance of both the business implementation and technical innovations in their firms, our students will understand the importance of their expertise and how it fits into the larger business picture.

B. General Education and Special Courses

Courses will be developed that will be included in the University's General Education curriculum designed around convergence topics and themes. In addition, other courses will be developed to fit other convergence opportunities. An example is the following:

> ME/ECON Economics and Technology of Energy: This course combines engineering and business students on teams that investigate and do a business and technology analysis of a scenario for generating and delivering electricity.

C. Convergence Scholar

Students enrolled in the Foster College and the Caterpillar College will have an opportunity to earn the designation of Convergence Scholar in recognition of achievement in Convergence studies, seminars and projects. The Convergence Scholars designation may be earned in conjunction with any degree and major within the Foster College of Business Administration and Caterpillar College of Engineering and Technology. Requirements of the Convergence Scholars Program will not add to total credits necessary for graduation. This program will be modeled after Bradley's Global Scholars program and the Entrepreneurs Scholars program.

Coursework, seminars, and projects for the Convergence Scholars Program will be designed to broaden business and engineering student perspectives by providing enhanced preparation for careers in a global marketplace. Topics and issues taught will develop within students a capacity to identify and exploit high- potential business opportunities.

D. Senior Projects

Undergraduate Senior Projects provide an essential capstone to many of our convergence opportunities. Using the currently required Caterpillar College Senior Design projects and the Foster College Business Senior Consulting projects as a foundation, these two-semester senior projects bring business and engineering students together on one team. The team deliverables include the development of a new technology or technical enhancements to an existing technology together with a complete business plan or a commercialization plan. Each term has two advisors, one from each of the two colleges.

Three such projects were introduced this semester (Fall 2012) to serve as a prototype from which to further develop this new mode of instruction. In all three projects, business and engineering students are working, discussing, and presenting together as a team.

E. Convergence Minor

This minor will be considered a "platinum program" offered through our colleges. This program, similar to the Auburn University minor, will be a two-year minor offered to top-performing students in the Foster College and the Caterpillar College and delivered in a cohort fashion starting in a student's junior year. Students admitted to the program are competitively selected for their academic and other achievements. Courses are team taught by senior engineering and business faculty.

The program is similar to an honors program restricted to business and engineering students who must apply for admission and are selected to fill a fixed number of seats each year. Students learn and practice professional skills such as teamwork and leadership during the two-year program by working in multiple teams and practicing team leadership in convergence projects. For 2 years, these students will have continuous and active involvement with their cohort and develop the "T-person" skills and experiences needed to work in successful cross-functional teams.

V. Conclusion

We believe for the future of our economy and technology based companies, educating business and engineering students in the manner we envision is vital. Our economy and the firms in them need business and engineering to converge. Convergence education will require big changes, not just in curricula but in the culture of how business and engineering students and faculty learn and interact. It goes beyond the classes, it's the experience, interaction, the environment we are establishing. We will develop and deliver curricula, create and capitalize on industrial and university partnerships, and produce faculty scholarship to educate students who can identify, develop, and capitalize on high-potential business opportunities.

Although our convergence approach to education will have many added values, we believe an important one for technology-based businesses is the development of graduates who can develop real answers to real problems. Real answers are not solely technologically feasible but can be implemented with a realistic and credible business approach. Our students will gain this experience through project-based learning. Business and engineering students will learn together to understand that business and market success result when a diversely educated group of professionals work together where everyone adds value to the end result.

VI. References

1. "Business and Engineering", http://catalog.drexel.edu/undergraduate/collegeofbusiness/businessandengineering/
2. "Integrated Engineering and Business Practices Curriculum", http://engineering.nd.edu/academics/businesspracticesprogram
3. "Entrepreneurial Innovation Management", http://engineering.missouri.edu/imse/degree-programs/course-descriptions/
4. "Minor in Business Studies", http://www.bradley.edu/academic/colleges/fcba/education/minors/busstudies.dot
5. "Minor in Quality Engineering", http://www.bradley.edu/academic/undergradcat/20122013/egt-minors-imet.dot
6. "Business-Engineering-Technology Program", http://www.eng.auburn.edu/research/centers/twc/bet/index.html
7. "Becoming a T-Shape Person: The Engineer's Problem", https://sites.google.com/a/nd.edu/kwiromeo/archives/features/tshape-person-the-engineers-problem

Brief Biographical and contact information

Lex A. Akers is the Dean of the Caterpillar College of Engineering and Technology at Bradley University. He was previously the Associate Dean of Academic Programs at the University of Missouri.
lakers@bradley.edu

Darrell Radson is the Dean of the Foster College of Business Administration at Bradley University. He was previously the Dean of Business and Economics at Michigan Technological University and the Director of the BS in Business and Engineering degree program at Drexel University.
radson@ bradley.edu