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Collaboration of Industry and Academia Render Business-Ready Graduates

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Abstract

Both industry and academia face the challenge of attracting and developing tomorrow's engineers. This challenge is becoming more complicated because of the aggressive, complex and competitive nature of the global electronics marketplace, which demands constant change and innovation for companies to remain on top.

Both industry and universities have solutions to parts of this puzzle. By recognizing their mutual need to address this challenge, and the complimentary nature of their approaches, industry and universities are positioned to develop coordinated channels that result in programs to better prepare students with business-ready skills.

Introduction

Higher education's traditional axiom that today's students lead tomorrow's workforce¹ calls for higher levels of collaboration between industry and academic institutions to prepare students to transform this vision into reality. In the June 2006 issue of BusinessWeek magazine, Bill Gates said that education, "has led to a country that's been very innovative and created lots of jobs. Yet, when you look at it, you think the broad excellence we need and the changes we need aren't necessarily going to happen without intervention from the private sector²." Based upon the above quotes, it is apparent that educational institutions should unite with the private sector to produce business-ready graduates.

The electronics industry is fast-paced. It requires a steady stream of engineers with both education in the theoretical aspects of their chosen discipline and practical application experience. A business-ready graduate must extend his or her educational experience beyond their field of study to include subjects relevant to the business cycle, such as sales, marketing, finance and procurement. Christopher Bartlett of Harvard Business School said, "In a world that's moving in nanoseconds, empowerment is driving strategic decisions down to people who are closest to the customers, competitors and technology changes."³

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Graduating students who have this experience contribute to the success of their organization in a shorter timeframe, and can add more value than those who lack that experience. Universities are competing to attract and enroll the best overall students. One

mechanism to achieve enrollment of top students is to demonstrate how curriculum will prepare them for the job market.

Academia-Curriculum Approach to Preparing Business-Ready Graduates

To build a successful technology enterprise, it is vital to have a knowledge-based workforce with skills in science and engineering. That is, knowledgeable workers who also have the appropriate practical skills help to enhance the nation's health, security and prosperity. According to the US Bureau of Labor, the portion of the U.S. labor force with science and engineering skills is growing at nearly 5 percent per year, compared to 1 percent growth in the rest of the labor force.⁴ At the same time that global competition for science and engineering workers is increasing, other countries are making larger investments in science and education and the workforce than is the United States. For example, NAFSA: Association of International Educators argues, "The United States has always depended upon the inventiveness of its people in order to compete in the world marketplace. Now, preparation of the science and engineering workforce is a vital arena for national competitiveness."¹

Managing rapid and complex technology-driven change is daunting, as this type of change is a disruptive force on today's markets, business, economics and society. According to James Canton, as the innovations fostered by convergent technologies emerge faster, disruptions are expected to increase.⁵ Additionally, in order to support rapid technological change, many other things must change—such as educational curricula, workforce skill sets and business models. This situation is rapidly becoming the norm in today's electronic industry. Solutions exist in the form of new, sophisticated and savvy thinking about the real potential of the emerging technologies of the next decade, so that higher-education institutions can prepare graduates to face the challenges associated with these emerging technologies.

The Electronics Systems Department (ESD) at Arizona State University (ASU) Polytechnic campus (Mesa, AZ), with help of the Industry Advisory Board (IAB), has created a strategy map, as shown in Figure 1. This map was designed to provide strategic direction to the University for preparing business-ready graduates. Additionally, it helped to craft new directions in curriculum and enabled the University to offer programs that yield employable graduates in new and emerging technological disciplines.

ESD Strategy

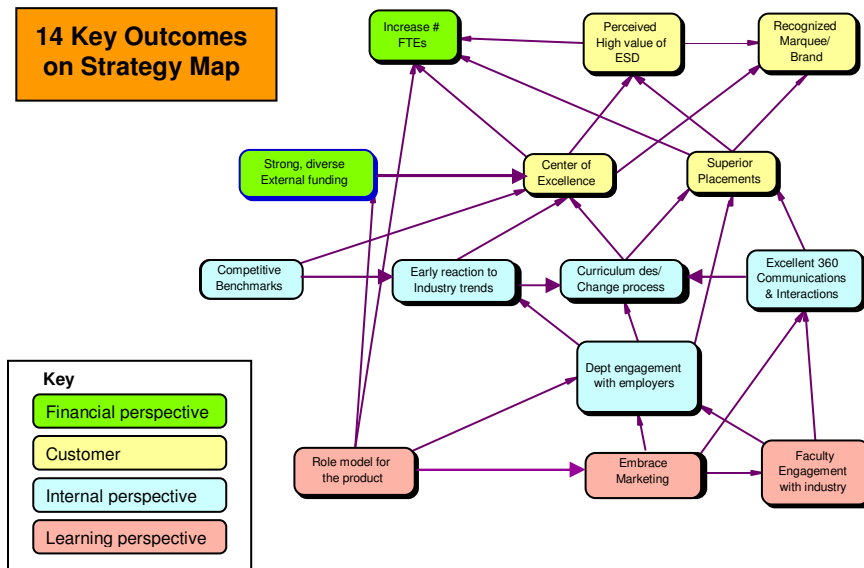


Figure 1: Strategy map used by ASU Polytechnic’s ESD for strategic direction on preparing business-ready graduates.

Likewise, the curriculum change process shown in Figure 2 emphasizes industry involvement in shaping curriculum to meet the target objective—business-ready graduates.

The most successful companies increasingly make investment and location decisions based upon the proposed investment’s or location’s potential to employ a highly-skilled workforce that can teach the company what it needs to know to succeed. Bartlett went on to say “Today, global managers need to see the world not just as a collection of marketplaces, but also as a source of scarce information, knowledge, and expertise—the key resources required in the development and diffusion of innovation worldwide.”³

The Microelectronics Teaching Factory (MTF) that resides within the ESD at ASU Polytechnic is a successful exemplar that demonstrates how effectively both academia and industry can work together to achieve common goals that advance both organizations.⁶ The course-development philosophy that is currently being used promotes industry involvement from the beginning, as shown in Figure 2.

Additionally, faculty members are encouraged to individually develop professional relationships with industry, to keep pace with the current technological advancements. This may include inviting them to speak to a class, and to promote their professional growth on an ongoing basis. Course content is developed based upon the following essential rubrics:

- The course-design approach is competency-/outcome-based
- Classroom instruction is for clarification
- The laboratory is to expand on classroom instruction
- A final capstone project course integrates all the components

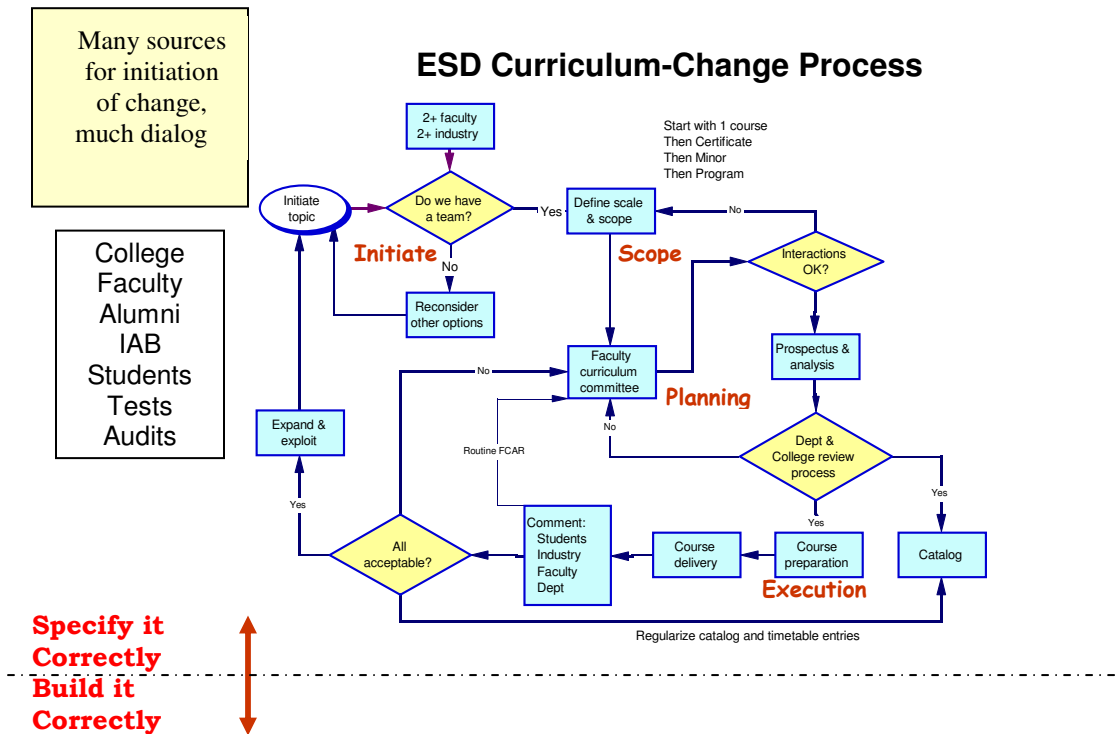


Figure 2: ESD at ASU Polytechnic’s course-development philosophy promotes industry involvement from the beginning.

In addition to technical skills, the majority of the courses offered by the ESD at ASU Polytechnic emphasize personnel skills, communication skills and business skills to ensure that the curriculum creates business-ready graduates.

To meet this objective, the ESD took specific actions. They recruited personnel with a long history of business experience and an interest in developing business-ready graduates. They then added a set of courses that focus on business issues in ways that are highly relevant to engineering and engineering-technology students. The first course in this set, “Business Agility for Technology Enterprises,” is an upper-division/graduate-level course with several objectives. First, it aims to introduce students to “soft skills” (business development, marketing, etc.) and show the value of these skills in an engineering environment.

Secondly, the course aims to establish not only the value of teamwork, but also the careful selection of team members and the assignment of roles based upon individual strengths. Next, the course helps the students to build a basic vocabulary of business terms and concepts. It also presents various methods for solving technology-related business problems to the students. Finally, the course requires the students to discriminate between various methods that can be used to solve a systemic problem in a business.

The course uses material and concepts drawn heavily from contemporary business literature that should be more easily understood and absorbed by engineering and engineering technology students. Some topics were:

- Strengths-based Management^{7,8}
- Emotional Intelligence⁹
- Theory of Constraints^{10,11}
- Lean Thinking¹²
- Strategy Maps¹³

Students operate in teams and prepare papers on each topic covered. They are required to have a presentation ready for each topic, and may be called upon to deliver it at any time. To the degree possible, the class simulates business situations that students may likely to encounter on the job. It appears that the course meets its objectives, as demonstrated by some of the following student comments:

1. One student indicated that he had not seen the value of soft skills prior to the course but, after four weeks, concluded that they are as important and, in some circumstances, more important than engineering skills.
2. Two other students, both of whom have MBAs, indicated that they learned ideas and concepts that they never saw in their MBA programs, and that they could take these to back to their jobs.
3. Finally, one student used the knowledge gained in the course to obtain a significant promotion and a healthy salary increase.

This paper will explore this idea further, by providing an academia-industry collaboration example—that between Microchip Technology Inc. and the ESD at ASU's Polytechnic campus. This collaboration has been further enhanced via the creation of a new technology-emphasis area—embedded microcontrollers—in existing BS and MS degree programs, to foster these organizations' efforts to prepare business-ready graduates. Examples of some joint efforts are outlined below.

Industry-Curriculum Approach to Preparing Business-Ready Graduates

Companies are faced with constant challenges to remaining competitive not only in their specific technological arena, but in the business environment, as well. This is reflected in the idea from Steve Sanghi's book *Driving Excellence*, where he states, "various factors are forcing companies to increase their rate of improvement: the technology revolution,

increased globalization of the marketplace and competitors, investors' demands for impressive financial performance, and the purchasing habits and expectations of consumers"¹⁴ (Sanghi & Jones, 2006, p. 20). The result is that these "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"⁷. This constant change requires industry to take an active role in developing the skills of employees, both before and after they arrive at the company.

Industry, therefore, must communicate to the academic world what skills graduating students need to be successful. It must also assist in the development of programs to support those skills through collaborative efforts, such as those identified below:

- Microchip employees participating as curriculum advisors;
- Sharing of the latest industry technology trends into the classroom;
- Co-development of class material;
- Continuing education programs at the university that address advanced topics;
- Recruitment/Internship programs; and
- Seminar and workshop programs held at the university.

The importance of continuous training to a company can be highlighted by the idea that, "the employee development system increases employee job satisfaction and retention. Today's employees want to feel that they have a career path and that they are regularly enhancing their abilities. They are keenly aware that, in today's market, real job security and increasing compensation come from one's expertise and ability to perform. Hence, people are very focused on improving their skills, and expect companies to offer training and educational services."¹⁵

Much the same can be said for students and universities. While employees expect companies to provide ongoing training that will lead to advancement and increased compensation, students also expect universities to provide an education and degree program that will lead to well-paying jobs.

By collaborating to build systems that identify and deliver on their educational needs, companies and universities will be better positioned to meet the common goal of attracting, developing and retaining valuable students and employees. As we stated earlier, Microchip Technology and ASU at the Polytechnic campus are developing several initiatives to achieve these goals. These initiatives provide a coordinated foundation for long-term collaboration. Let us take a closer look.

Transferring the Latest Industry Trends Into the Classroom

The rapid pace of technological innovation can result in significant latency between adoption in the marketplace and instruction in the classroom. While universities are often at the forefront of technological development, the current status of the industry may not be as apparent, due to technological changes. Therefore, this status may not be readily adopted in the instructional arena.

In the semiconductor marketplace, innovation has resulted in products that are orders of magnitude more powerful and complex than in the past. Microchip competes in the semiconductor space, and its innovation has enabled microcontrollers with larger memories, more peripherals and more computing power to be brought to market, at lower prices than ever before. Accomplishing this, however, has required the development of increasingly sophisticated software, often necessitating teams of engineers, rather than just one.

Software language requirements also change as the C programming language becomes the preferred development platform (over assembly), which can harness the power and complexity of today's microcontrollers.

While universities provide instruction in C programming, this is often done from a theoretical or computer-based perspective, and does not address the unique requirements of the embedded-control market. Additionally, many microcontroller-based classes use only assembly language during instruction. These two factors can leave engineering graduates lacking an essential skill—knowledge of embedded C programming. By exchanging information like this, companies can help universities to stay ahead of emerging trends in industry and deliver coursework to the students that better prepares them for the job market.

Armed with a better understanding of the needs of industry, universities can develop degree and certificate programs that are far more relevant to students. To help accomplish this, we move into the second part of our strategy.

Microchip Employees Participating as Curriculum Advisors

While it is essential for companies to communicate their needs, it is also incumbent upon universities to seek out industry input, to ensure they are meeting the needs of students. By incorporating the needs of industry into curriculum, universities can better prepare students for the transition into the workplace.

Additionally, industry involvement lends more credibility to the story of the university, as shown through the recruiting partnership that ASU at the Polytechnic campus has established with Microchip. As part of this partnership, Microchip employees act as advisors for the development of new curricula and courses.

This provides the university with a clear picture of the emerging and unrecognized needs of the semiconductor industry. Microchip engineers have served on the Microelectronics Teaching Factory Industry Advisory board, and have helped to create curriculum and course content. Additionally, they have offered the space to provide onsite lectures for both Microchip employees and ASU students.

Co-Development of Class Material

A key limitation behind the development of new classes is resource availability. Class material generation is time consuming and expensive for universities. Anything that can be done to shorten the cycle will allow the university to better respond to changes in industry, and to provide a higher quality, more relevant educational experience in a timely manner.

During 2006, Microchip opened a series of Regional Training Centers (RTCs) around the world to provide continuing training opportunities for its customers. These centers were opened, based upon customer requests and the Company's observations, to provide short, intensive training in a wide range of product and application topics. Classes range from one half day to three days, and are intended to provide working engineers with a jump on acquiring new or enhanced knowledge to help make them more productive.

What Microchip is not equipped to do, however, is provide exhaustive, in-depth coverage of specific subject areas. Therefore, the material that Microchip has developed for its customer training classes is available for use by universities to incorporate into classes and curricula. This material includes presentation slides, instructor guides, application examples, demonstrations and hand-on exercises. While there is no expectation that this material is sufficient for an entire semester course, it can significantly reduce development time for a new class and provide real-world examples to enhance the theoretical discussions. Universities can adapt this material to meet the goals of their particular programs and be more responsive to students' needs.

Continuing-Education Programs at the University that Address Advanced Topics

Implementing an effective employee-training program is a crucial component of a company's long-term success. As previously noted, employees are attracted to organizations that can help them grow and increase their opportunities. Likewise, companies need their employees to continuously improve in order to meet competitive challenges.

This is referenced by the idea contained in the book *Driving Excellence*, which states "the employee development system is the vehicle used to improve the performance of employees. It instills and maintains the culture, while enhancing the abilities and expertise of the employees.... The system is a crucial piece in perpetuating a continuous-learning environment.

It allows the company to maintain an educated, ever-improving employee population” (Sanghi & Jones, 2006, pgs. 213-214). Effective training programs, however, can be a costly endeavor for any company. Additionally, companies may not have the necessary resources to provide adequate training in certain areas. Through a partnership with local universities, companies can leverage the resources and expertise available at the university to provide a richer, more diverse continuing-education program for employees.

Recruitment and Internship Programs

ASU’s career-services center is very active in bringing numerous employers to the campus to facilitate both internship and job opportunities. Microchip participates in these activities, along with other companies. Additionally, the Microchip career Web link is provided on ASU’s MTF Web site⁶ for our students.

Conclusion

By working together, industry and academia can develop programs to assist universities in attracting students, and ensure a pipeline of highly skilled, business-ready graduates to enter the workforce. These programs are not only expected to help academia and industry, but also to help students receive a superior education and improved employment prospects. Microchip Technology and ASU at the Polytechnic campus are working diligently through various collaborative efforts outlined in this paper. Both are committed to achieving the mutual goal of preparing business-ready graduates.

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