Meeting the Needs of Employers and Students: Implications of Global Business Trends and Changing Student Characteristics for Engineering and Engineering Technology Programs

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Abstract
In this paper we discuss work in progress where we are studying issues of timing and motivation for pursuing academic credentials and certification, along with implications for institutions providing academic credentials. Economic factors have altered the face of industry and methodology for conducting business. Outsourcing, downsizing, and other factors have led many individuals to consider academic options to restructure their careers. Demographic diversity among first year students continues to grow. As a result, the traditional "look" of the freshman class has changed. Engineering and engineering technology departments have tremendous opportunities for marketing their programs to new target audiences. We provide a framework for understanding these factors and discuss opportunities for future research.

Introduction. The decision to seek academic credentials is complex, especially when faced by individuals already in the workforce or those who are first generation university attendees. Demographic diversity among first year students continues to grow. As a result, the traditional "look" of the freshman class has changed. Economic factors have altered the face of industry and methodology for conducting business. Outsourcing, downsizing, and other factors have led many individuals to consider academic options to restructure their careers. This work in progress will explore these factors and discuss potential implications and research directions.

Education is the key to fulfilling goals for advancement in most professional fields. It is becoming more difficult for an individual without a college degree to rise through the corporate ranks or command a high salary. In general, formal education is required for professional success. In addition, formal education, particularly the completion of a degree, shows trainability. Sometimes a degree is referred to as the union card that gives job seekers a chance in the market. In today's business environment, an undergraduate degree is often just a basic requirement.

The student's choice of major is often determined by a combination of factors, including self-efficacy, mentoring, socioeconomic background, career stage, etc. Engineering technology and engineering hybrid programs are especially well positioned to capitalize on current trends. These programs offer a multidisciplinary approach that compliments current business methodology.

Current Business Trends. Today's marketplace is increasingly competitive and global. New strategies are essential in meeting the challenges of the modern business environment. There are a number of explanations for the recent explosion of global marketing relationships. Such relationships provide key inroads to global markets and increased market efficiency. In general, they:

- Generate access to new markets
- Enhance market position in existing markets
- Augment existing product lines with partner products
- Allow entry into new domains by giving partners access to existing product lines
- Accelerate the rate of international expansion
- Lower costs to gain/maintain competitive advantage.[13]

The new global workplace is unrestrained by time, distance, and organizational or cultural boundaries. Capitalizing on the quantum change in business innovation requires a quantum change with respect to workgroups as well. Virtual teams are vital components of global management systems. Created in response to increasing global competition, coupled with advances in information and communications technology, virtual teams allow multiple levels of interaction and eliminate barriers to the marketplace. Moreover, they are a method of outsourcing organizational functions to create a leaner, more competitive landscape.

Many organizations are turning to outsourcing to meet organizational needs from a maximum cost-benefit perspective. Contracting certain tasks garners the skills the organization needs without long-term cash outlay.

The move from traditional, face-to-face teams to virtual teams is driven by five major factors:

- The increasing prevalence of flat or horizontal organizational structures
- The emergence of environments that require inter-organizational cooperation and competition
- Changes in worker expectations of organizational participation
- A continued shift from production to service/knowledge work environments
- The increasing globalization of trade and corporate activity.[14]

Countries such as India are prime locales for outsourcing. They boast a plentiful supply of technical expertise willing to work at much reduced wages when compared to permanent employees in the United States. In 2000 alone, 27,121 jobs in computer and mathematical specialties moved off U.S. shores. These numbers are expected to rise to almost 110,000 by 2005; 277,000 by 2010; and 473,000 by 2015. Areas most at risk for outsourcing are those that are not tied to the firm's core competencies or needed to facilitate strategic planning.[8]

The shift to a flat or horizontal structure is primarily a response to global competition. Flattening the organizational structure streamlines management functions and shifts decision-making authority to lower levels. Synergy between former competitors is increasing as vertical integration becomes less beneficial in modern economic structures. In the past, firms controlled the entire production process from raw materials to marketing. However, diversification has made specialization on core areas, along with outsourcing a greater mechanism of efficiency.

Employee expectations are changing as well. Those who have grown up in a system of technology expect greater organizational flexibility. This includes distance-working relationships using information and communications technology. Virtual teams provide a platform for exceeding worker expectations. Shifts from production to service or knowledge-based industries have also changed the design requirements for business architectures. Production facilities require greater levels of structure. Service and knowledge-based industries operate with a higher level of flexibility. Virtual teams compliment this system requirement by creating an interface that is dynamic in both team membership and task structure.[14]

Global management structures cover greater geographical distances than traditional business organizations. A corresponding increase in cultural distances follows. In today's complex business world, the communications system reflects the intended command and control of the organization. The choice between organizational structure may well depend on which set of drawbacks the management can handle best.[11]

Academic Credentials: Organizational Value. Training can be considered formal education within many organizations. Organizations are hesitant to provide training that can easily be used elsewhere. Specialized training that is more organization or process specific is deemed more valuable.

Organizations funding credentialing of employees might find that it is more beneficial to the organization to encourage those pursuing advanced degrees in their initial discipline. Human resource managers should explore ties between job satisfaction and employee loyalty with types and levels of continuing education.

Motivations: Career Changers. An undergraduate degree is often a prerequisite for professional success in technology-based firms. For most, that means a degree in engineering or the sciences. However, in today's business environment some argue that it is important that engineers know how to make and market their product. As a result, the years from 1997-2000 saw a 26% increase in the number of engineers taking the GMAT, the standardized test required for business school applications.[6]

Part of that growth can also be attributed to economic downturns in high tech industries and outsourcing of services. Displaced workers often turn to credentialing opportunities such as postgraduate degrees or certificate programs in hopes of strengthening their resumes or retraining in order to find that next job.

For those fortunate enough to be with a stable firm, there can be advantages for those pursuing academic credentials if the organization places value on the degree program selected. It can also have value for those who wish to change careers.

Engineering management and financial engineering are hybrid programs that combine elements of engineering with management courses as parts of the total curriculum. Credentials in these areas open career opportunities in finance, risk management, information technology and other areas requiring sophisticated understanding of quantitative methods. These programs

frequently attract individuals who already possess a degree in other areas. Interestingly, these individuals are not limited to strict engineering backgrounds. In addition to engineers wanting to break through to management, these programs appeal to accountants, economists, and others interested in moving into a more technical area.[10]

Motivations and Demand in Engineering Enrollment. Recent enrollment numbers reveal a decline in the majority of engineering disciplines. Other than computer and aerospace engineering, which had a 4% and 13% increase, respectively, engineering departments witnessed an average decrease of 5%.[1]

Student recruitment and retention is of primary concern for academic institutions. Examination of diversity issues may provide insight for institutions seeking to counter the decrease in engineering enrollment numbers. Understanding factors affecting decision-making can provide vital information as well.

The stereotypical view of engineering students is white and male. However, the face of the beginning engineering student is changing. Academic institutions can positively impact their enrollment figures by recognizing this change and marketing to minority student groups including women, those with varying ethnic backgrounds, and mid-career changers. In the decade from 1986 to 1996, the percentage of engineering students that were both white and male declined by an average of 6%. Examining total enrollments in the late 1990s, a significant minority (approximately 25%) falls into various ethnic categories, are women or are older than twenty-five. Interestingly, completion rates for female students and offers insight into student retention issues.[12] These insights may prove applicable to retention issues with all minority enrollees.

Research suggests that it is not enough to raise awareness of engineering programs; rather, it is essential that requirements of engineering curriculum be stressed and deficiencies overcome prior to student enrollment. Partnering with area secondary schools is an effective means of addressing this problem. Common problems observed with those who fail to meet entry requirements include poor preparation in mathematics, perceptions of engineering as male-oriented, and lack of understanding of potential career paths after graduation.

These problems may be reduced in scope by fostering an interest in science and math in K-12 education, facilitating interaction with successful women or minority practicing engineers, and showcasing the variety of career opportunities available.[4]

During the past two decades career choices and decision-making have been studied in increasingly greater detail. Societal expectations no longer support the view that individuals will select a career path and remain on that path for their entire career. Rather, individuals are expected to review and revise career decisions over their entire working life.

Many characteristics determine an individual's decisiveness with regard to career path. This level of commitment is also apparent in the choice of undergraduate major. Research suggests that self-efficacy, locus of control, and anxiety are personality traits that have the most significant effect on decisiveness. Self-efficacy relates to an individual's belief in his/her ability

to complete a set of tasks. Locus of control refers to an individual's level of internal vs. external motivation.[7, 3] Interestingly, the correlation between self-efficacy and career choice may be higher among women and minority groups than white males. Although this correlation with career commitment levels is only slightly higher for women, it appears significantly higher for African-American males.[2]

The global nature of many business environments has made the need for detailed career information crucial to effective decision-making. Students who do not possess the right level of information regarding a degree program may quickly lose interest in the major and become indecisive regarding their career plans. Institutions providing academic credentials can confound these problems by creating clear, informative career tracks within majors.[3]

Role of Distance and Continuing Education. Improvements in technology have made it possible to expand the traditional classroom beyond physical walls. Virtual classrooms are considered an effective means of bringing education to the working adult. Degree programs offered via distance education have increased significantly as academic institutions attempt to fill this perceived demand in the educational niche.

Global outsourcing and tight federal budgets continue to negatively impact employment prospects. Interdisciplinary training or cross-training in umbrella programs and using off-campus or life experiences have also been incorporated into some academic programs. Each of these is geared toward increasing the marketability of graduates in a tight economic arena. Moreover, with corporate downsizing, outsourcing, and other indicators of economic downturn, education is a frequent path of those who have been part of a lay-off. These types of programs have broad appeal for those who have broad interests from their life experiences.

Universities have emerged in response to this niche market and provide customized programs. Many question the value and integrity of these degrees and believe they have negative long-term ramifications for academic institutions. It is reasonable to consider the possibility that programs should actually focus on training students for specifically for careers in industry rather than promoting graduate programs leading to academia. Industrial organizations are increasingly global or tied to other geographic markets.[9, 5]

Discussion and Opportunities for Research. Enrollment numbers continue to shrink in most engineering programs. Finding means to increase market share in under-represented groups is essential to reversing this trend. A number of areas for action or future study are suggested in examining these possibilities.

Examining pre-college preparation in K-12 education and forming partnerships with area schools is one possibility for targeting under-represented groups and capitalizing on this enrollment market. Similar approaches can be followed with area business.

Global business partnerships, outsourcing, and the increasing use of virtual technology have resulted in new combinations of skill sets required of successful job seekers. Identification and analysis of these skill sets provide useful guidance for institutions providing academic credentials and certifications.

Institutions providing advanced credentialing are faced with intense competition in a new labor markets. Convenience and value are motivating factors for many interested in continuing education. Studying the needs of business organizations can provide insight into building required flexibility into programs without sacrificing academic integrity.

Conclusions. Academic institutions face a number of problems associated with the changing face of student enrollment. Decreased interest in engineering by traditional program participants (i.e., white males) may result in an undersupply of engineering graduates. Opportunities should be pursued to increase participation by first generation college attendees, those pursuing career change, and under-represented minority groups.

Partnerships with area K-12 education providers and area businesses are a means of securing additional enrollments. These partnerships should incorporate elements that will enhance the needs of current business trends. Flexibility and an interdisciplinary approach are considered important characteristics of training or credentialing programs in the face of globalization. These types of programs may gain the maximum benefit for those seeking to increase participation in engineering or engineering technology programs.

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