A Profile of the 21st Century Engineering Technology Graduate: An Industry Perspective

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Introduction

By any reasonable standard, Engineering Technology (ET) is a young profession as well as a relatively new university program, It has only been thirty-one years since the ASEE published the basis for the criteria used to accredit four year Engineering Technology Bachelor degree programs in the "McCallick Report." Industry saw the first four-year accredited ET programs at Purdue, Brigham Young University and University of Houston in 1967.* However today, according to the 1992 TAC/ABET 60th Annual Report, there are 303 accredited Bachelor of Science/Engineering Technology programs at 116 colleges and universities. It is evident that the number of ET programs has exploded over the past 25 years.[2]

However, the next 25 years is not likely to repeat itself. ET graduates and programs must thoroughly understand the rapid changes that face the industrial world and must adapt their curricula to produce graduates that have the basic technical skills to succeed in such a highly competitive environment. Graduates must understand what is expected of them by employers that consider every hiring decision very carefully in an era of shrinking financial and personnel resources. University programs facing the same downsizing pressures as many industries must be creative in understanding what motivates industry and what technical and business skills industry requires of their employees. Colleges and universities must also carefully consider how to invest their limited resources to produce the best graduates.

The purpose of this paper is to summarize the authors' view as an engineering manager for a Fortune 500 company which employs both engineers and engineering technologists and a Technology educator at University of Houston. These suggestions also come from one who also spent a number of years as an Engineering Technology faculty member at a major university and well understands the challenges of quickly adapting educational programs to meet the needs of industry.

Background

It has been said that Science-Engineering-Technology is a spectrum or perhaps a continuum. On one end are the scientists working to understand the fundamental building blocks of nature or the development of basic sciences through research and study. Engineers are typically characterized as those that apply the results of the scientists basic research into products beneficial to society. Engineering Technology is only a half step removed from Engineering where Technologists are typically thought of as those who apply state-of-the-art technology to solve problems of interest to industry using established design methodology and procedures. Application versus analysis or quantitative versus analytical are other viewpoints. Others define the differences as the quantity and level of math required but that definition is much too simplistic.

If we were to stereotype engineers we would say they tend to gravitate to positions in product development, complex- analysis and design and perhaps applied research. Our stereotypical Engineering Technologist would be in a problem solving position such as manufacturing, facilities, production, quality and the like. There area variety of positions that are attractive to both groups including technical sales, application engineering and technical support services to name' a few.

If we accept these generic career categories we observe the ET is typically closely associated with design, manufacturing and production related fields. The typical Engineering Technologist finds today's reality as a free market economy that is fast paced and highly competitive on an international scale. It is not unusual to find domestic companies having offshore manufacturing affiliates marketing products world-wide. He finds himself working for manufacturers preoccupied with "right-sizing" and struggling to find stability in a world where trade barriers are being reduced and competition has never been so keen. For most companies the watch-word is adapt or disappear.

The post-industrial revolution has seen an explosive growth in the applied sciences and technology. Technology impacts us individually and collectively in how we behave, communicate, travel, obtain/exchange goods and services and health care. However, with each new challenge comes a new opportunity. Those that understand the rules of the "game" will evolve into new "market-driven" companies that understand and can apply technology as a competitive tool. That is where the properly trained and equipped Engineering Technologist can make significant contributions.[3,4]

The following sections present eight suggestions to guide the Engineering Technology graduates to properly prepare themselves to meet the industrial world upon graduation. These suggestions are pragmatic rather than dogmatic. Each graduate is an individual with unique professional needs and talents. However, the theme remains constant; a college education extends well beyond the classroom both in time and domain.

A like number of suggestions for faculty to direct the development of their curriculum and programs are also presented. These are really more than suggestions--they are imperatives. Faculty must also remember that they are in fierce competition. Industry will recruit those students that can make a positive impact on their company productivity and efficiency. Most companies assume that if a program is properly accredited then a general understanding of the math/science fundamentals has been achieved by the graduate. Areas that will differentiate an average program from one that will attract employers back time and time again are discussed. After all, the real measure of success of a program is how successful their graduates are in not just getting that first job but how well prepared they are to successfully manage continuous progress in their careers.

Engineering Technology Graduates Must:

The following eight suggestions are meant to guide the ET student to develop some understanding of the importance of issues of interest to industry beyond merely competencies in applied science. For example;

1) *Understand quality and it's impact on the enterprise.* Quality is now designed into the product rather inspected for after manufacturing. Not only does quality reflect on the whole organization but it has also been shown to ultimately produce the lowest product cost. Also witness the purchasers of goods and services that now require an 1S09000 certification to even be on the qualified suppliers list.

2) *Have excellent verbal and written communication skills.* *The* best academic skills will do the ET no good if he/she can't w-rite or verbally present ideas in a coherent and persuasive manner. Such skills need to be developed at every opportunity while in college. Technical communication courses, while not popular with

students, are extremely important. In many companies, technical expertise is not enough. The Engineering Technologists must-also interact with customers and make persuasive presentations.

3) *Work as a team member without **close** supervision under pressure in a culturally diverse environment.* Virtually all design work is done by a diverse team from all parts of the corporation. The successful Engineering Technologist will be able to deal with this diverse group to achieve success for the organization. The individual contributor has given way to concurrent engineering teams that can design and bring products to market faster than the competition.[5] Interpersonal and leadership skills are in great demands Take the initiative to develop those skills through work experience, technical societies or Capstone Project teams.

4) *Have a strong sense of work ethic with a natural curiosity.* There is no place to hide in today's industrial environment. Each person has a particular job to accomplish and any one person without a "sense of urgency", as one manufacturing manager put it, can cause the whole team to fail Corporate technical managers want goal oriented individuals that will put the little extra time and effort to get the job done.

5) *Be adaptable when changes in industry and technological advances in a world-wide enterprise occur.* Gone are the days when a person could graduate with a specific set of technical skills and expect to get a job doing the same thing for his whole career. Industries and market places change rapidly and the student needs to understand where he fits within his company and where his company fits within it's industry. Understanding that global market changes will cause changes in his company that the ET must expect and plan.' There is no place for "we've always done it that way."

6) *Have a **clear skill** set that meets the needs **of industry.*** A curriculum that covers the fundamentals is expected of all programs. However, the best program of study for the ET to meet the needs of industry will include computer applications such as CIM or CAD/CAM, automated manufacturing processes, advanced materials and applications, system integration, project management and other cross discipline applications.

7) *Understand that [earning is a **life-long process** that only begins in **college.*** Recorded knowledge through 1975 doubled by 1995 and will redouble by 2015. This means that typical graduate will be exposed in college to only about 1/6 of the knowledge required during his career.

8) *Success **is a function** of (Skills, Effort& Attitude).* A successful ET graduate must have much more than a very high grade point average. The GPA may get a student through the first interview but will not help him keep a job. Success in the workplace is more a fiction of basic skills earned in college multiplied several times by an attitude that the ET will make whatever effort is required to succeed at whatever task is assigned.

Engineering Technology Programs Must:

Faculty and administrators have a responsibility to gain a thorough understanding of what industry's needs are today and into the next century. Industry experience by faculty members twenty years ago have no comparison with today. Every program must develop a general depth of knowledge that meets the demands of tomorrow's corporations, provide a foundation to obtain employment for it's graduates and provide a framework for the student to improve his knowledge and understanding in the future.

1) Develop sound decision-making skills. A well-rounded program gives the student the opportunity to apply his newly developed technical skills in a supportive environment that promotes developing decision making skills. For example, Capstone Design classes must require the student to make a series of technical judgments based on a sound technical understanding of the fundamentals. Design tradeoffs must be carefully considered including economics of alternatives, materials selection, labor costs, schedules and priorities. An experienced engineer once said that all technical decisions are based on either doing the job "fast", "cheap" or "good". Now pick any two you want.

2) *Teach/develop strong technical fundaments.* Faculty must set high standards for their students and maintain them. Design skills are especially in demand and must be cultivated in core courses for all students[8].

3) Present an opportunity to develop breadth and depth of skills and experience necessary for students to obtain employment. Programs should emphasize long-term student projects, individualized student-faculty projects and part-time industrial employment. Today's industry offers a number of COOP student positions who invariably are offered full-time employment upon graduation. Industry much prefers students that have demonstrated their ability to take on a real-world project and drive it to completion.

4) *Develop the ability to upgrade skills over a life time.* The college experience should be targeted at developing a specific set of skills and abilities. However, there is seldom any thought given to providing the student guidance on how this body of knowledge he has collected fits together. Students need guidance on how to structure their knowledge and gain an understanding of where his strengths and weaknesses are, and what to do to fill in the gaps.

5) *Have a close relationship with industry, professional associations and government.* Faculty within each program should cultivate long-term relationships with their ultimate "customers," those that hire their graduates. In addition, keeping close contact should provide continuous feedback so that programs can be adjusted to meet the needs of industry and government employers.

6) *Have flexibility to accommodate special needs of students.* Programs of study must not be so rigid as to preclude a highly motivated and capable student the opportunity to "customize" his/her course of study (within the confines of ABET recommendations and required course competencies) to reach a particular personal or career goals. It is the authors experience that Engineering Technology programs have a large number of re-entry students with a number of years of work experience, or students currently employed in industry. These students are typically much more motivated but also require more customization of their programs of study since they already have a clear sense of direction for the careers.

7) *Have cross-discipline courses.* ET programs should allow students to take courses in other programs such as business, economics, etc. Such courses taken by graduates illustrate a greater breadth of understanding of the business enterprise.[9] Other courses that emphasize the integration of design, manufacturing and concurrent engineering should also be encouraged. [10]

8) *Have a business component to introduce areas that impact the entire business enterprise.* The best ET graduates will have good ability to solve technical problems with an understanding of the impact on the human, business and financial resources of the company on an international basis.[11] All students need to understand the importance of the client/customer relationships.

Conclusions

Students are graduating into a business and technical world where basic design and interpersonal skills, creative thinking, adaptability and basic business skills are highly prized. The ET graduate also faces a series of challenges unlike ever before with global competition and corporate "re-engineering." These natural forces require graduates to have a much wider skills set beyond just the basic technical competencies expected of all graduates. Engineering Technology programs need to recognize the forces on industry today and mold and shape their programs to reflect these needs and stay in close communication with their industrial "customers". This will require programs which continuously rework their curriculum at the same pace industry is changing to ensure that graduates are prepared to compete well into the next century.

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