University - Industry Relationship

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Abstract

The paper discusses university-industry relationship. All presented examples are based on CCSU experience. There is a common tendency to focus on research and development projects. Although they are very important, contacts with industry should not be limited to R&D exclusively. The four-year programs are very often criticized for not providing graduates with absolutely up-to-date knowledge and skills. Nevertheless, universities should not sacrifice depth of knowledge for current technical skills. By maintaining intellectual integrity, universities make it easier for graduates to ensure a career in the long-term. Successful practices and experiences from CSSU illustrate the possible ways to better respond to industry needs.

I. Introduction

What can universities do to facilitate the increasing demand for Science, Engineering and Information Technology workers? Why has the gap between the number of graduates and the number of openings grown dramatically during the last several years? Although these basic questions are primarily directed to universities, the answers should come from all constituencies. Universities themselves are incapable of resolving this problem without strong support from industry and governments, if their mission, to reach prospective students and equip them with adequate knowledge and the desire for life-long learning, is to be successful.

There is evidently a need to coordinate curricula development to meet changing labor market demands. The "ivory tower" concept of universities derived from the paradigm that university-industry contact should be minimal has remained attractive, to many universities, for decades. The new paradigm is based on the very obvious observation that education does not and can not exist within a vacuum. This new trend resulted in a number of formal university-industry interactions over the past two decades. Usually, when considering university-industry relationships, there is a common tendency to focus on research and development projects. Research and development is a very important factor in developing industry-university relationship, however contacts should not be limited to R&D exclusively. There are many other potential areas for bringing faculty and academic programs closer to industry. The faculty can participate, contribute and also learn from their industrial counterparts through various approaches that might include the hiring of adjunct faculty, technology transfer projects, consulting work, graduate placement etc.

One of the most important concerns in the university-industry relationship is how responsive the universities must and should be. There are two aspects of this problem - the scope of offered programs and program curricula. The four-year programs are very often criticized for not providing graduates with absolutely up-to-date knowledge and skills. First of all, universities are unable to keep pace with every narrow and (frequently) ephemeral need. Furthermore, people with narrow technical skills can be in tremendous demand by industry for a time, but these skills usually become quickly outdated. Thus the workers must be retrained or replaced. Therefore universities must be very careful in order not to sacrifice depth of knowledge for current technical skills. By maintaining intellectual integrity, universities make it easier for graduates to ensure a career in the long-term. According to the National Academy of Science, there is a real need for graduates who can continuously "adapt, adjust and re-educate themselves to remain productive in a changing environment" [1]. Besides fluency in current technical issues, there are a large number of other attributes graduates can possess which are in high demand by industry: problem solving skills, critical thinking, analytical reasoning, effective communication skills, collaborative capabilities, desire to upgrade their knowledge etc. It leads to the conclusion that, although universities must be very protective of their academic values, they should still seek optimal compromise for the purpose of better recognizing and responding more effectively to industrial needs in both above mentioned attributes, academic program offerings and program curricula [2].

The third factor affecting the university/industry relationship, is how big the actual market for highly qualified (possessing academic degrees) workers is, and what the openings forecast is for university graduates in the future. The CT Department of Labor has classified occupations into 11 categories related to occupation's education and training requirements [4,5]. It reflects the real expectations of industry for an educated workforce. Based on these statistics (for 1998 and 2008) four-category subdivision charts were developed based on duration of education or the training required for occupations. Six-year (and more) university degrees are required for only slightly more than 4% of positions, and this is expected to reach almost 4.5% by 2008. A four-year university education is already required by more than 20% of occupations and will rise to 21.5% of jobs by 2008. There is no surprise that the remaining quarter of the pie comprises occupations requiring at least one-year of training - but not a university degree. At the moment 51.81% of occupations require either work experience or short-term training (weeks to months). By 2008, it is predicted to fall below 50%. Such general analysis leads towards some conclusions. First of all, some three-quarters of total jobs will not require a university degree, thus indicating how the interest of industry is distributed. On the other hand, the leading workforce, those who decide about ultimate company success, are well-educated managers, technologists and engineers. Secondly, there will be a slight but significant increase in demand for highly educated or well-trained employees (increase by 1.75%).

The important question remains: should institutions of higher education concentrate only on the relatively small number of people requiring a degree or cooperate with industry in meeting its needs in the area of different types of training for the latter larger percentage (75%) of employees? Apparently the answer is the latter, despite the fact that it doesn't fall within the primary mission of a university. Such cooperation develops necessary alliances with industry, helps universities in identifying and understanding industrial needs and technological trends. Ultimately, through academic program modification, universities can better serve their students and respond to real expectations and needs of regional industry.

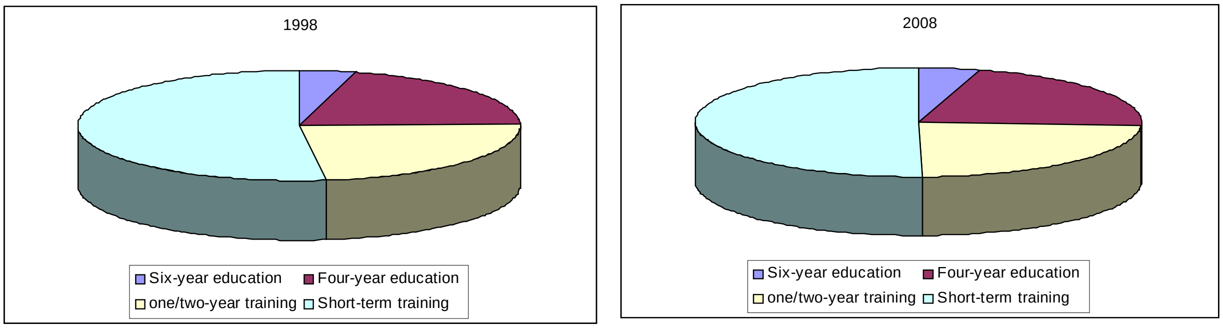

Fig.1. Type of education (or training) required for occupations in Connecticut in 1998 and 2008

II. Industry-university interaction - CCSU practices

Besides R&D projects, there are many educational initiatives, which can be considered equally important, and helpful in fulfilling universities' basic mission, i.e. produce highly qualified industry leaders possessing academic degrees. Successful practices and experiences from CSSU may provide some ideas regarding possible ways to better respond to industry needs:

- Serving both traditional and non-traditional students
- Offering non-credit and for-credit certification programs
- Application oriented programs
- Co-op programs for students
- Industrial Advisory Boards
- Transfer program (pathway) from community colleges (2+2 education)
- Continuous quality improvement- accreditation based on program assessment plan
- Demand driven educational offers

II.1. Non-traditional students (School of Technology at CCSU)

CCSU and the School of Technology serve both traditional and non-traditional students. I will use examples from the School of Technology, because that is what I know best. Examples exist from other schools as well. The population of part-time students is very significant at CCSU, although slightly declining during recent years. The entire university population of part time students over the last five years decreased from 37.86% to 33% in 1999. During the same time, the School of Technology's percentage of part time students was between 45.27% and 38.58% - averaging 42.29% over the last five years. This may indicate that educational interest among employees in improving certain skills and developing their knowledge is very high, and it must be considered as a promising trend.

II.2. Non-credit and for-credit certification programs

In 1993 CCSU established the Institute for Industrial and Engineering Technology (IIET). The Institute is an outreach function dedicated to building the Connecticut economy by providing competitive advantages to clients through training and education, technology transfer and business services. The Technical Training Center (TTC) within IIET provides affordable, current and advanced technology based skill development to business, manufacturers and industry in Connecticut. Training periods are flexible, either held on site or at the Institute. The offers are customized to meet the needs of Connecticut organizations and its employees. Hundreds of certification programs and different types of training have been organized and delivered since 1993.

II.3. Application oriented programs

Academic programs offered in the School of Technology are carefully designed to maintain balance between theory and application. Programs are designed for students who love computers and are eager for hands-on experience with the latest technologies. Technical courses include an extensive practical component where the students learn about application of theory. The School strives to provide students with the latest software and computer systems and equip our laboratories with state-of-the-art machines and equipment used by major corporations [3, 6].

Academic programs are focused on applied engineering (engineering technology), technology management and technology education. Engineering Technology programs differ from engineering programs even though both are accredited by the same accreditation board (ABET). While traditional engineering programs are research based, focussed on complex analysis and design, and are more mathematically oriented, engineering technology programs require applied calculus, and integrate mathematics and science with technology by applying engineering principles to routine design, testing, evaluation and manufacturing problems. Course work involves the solving of technical and engineering problems and includes computer applications for design and engineering analysis.

II.4. Co-op programs for students

Cooperative Education is an academic program that integrates classroom study with career-related work experiences. Co-op work experiences are paid, full-time, six-month positions related to academic and career interests. Co-op is an optional and, in most cases, non-credit program. The CCSU program, the largest in Connecticut and one of the largest in New England, combines five months of on-campus study with six months of paid Co-op employment. Our students gain the opportunity to apply textbook learning to on-the-job training. Through participation in the Co-op program, students can graduate with up to two years of career-related work experience and, possibly, with a job offer. Many Co-op students are offered permanent positions with their Co-op employers upon graduation.

The data describing our successful partnership with United Technologies Corporation is an excellent example of Co-op program efficiency. The general estimation is that over 16 years of cooperation more than one thousand students from CCSU completed six-month assignments at UTC. The detailed breakdown of CCSU Co-op and placement data are as follows: during 1998 and 1999 the total number of CCSU Co-op students at UTC was 270. From that group 72 students were permanently hired (more than 25%). The School of Technology's 135 Co-op students constituted the largest population and 35 of them were offered permanent positions. It clearly illustrates that Co-op programs can be very successful in engineering and technology. Nationwide, graduates of Co-op programs are hired at higher salaries and promoted faster than other employees. For students unsure of a career, Co-op is a no-risk way to test job options. Co-op provides a direct route from campus to career.

II.5. Industrial Advisory Boards

For engineering and technology programs, an Industrial Advisory Board is an important component of the program assessment and quality assurance process [7,8,10]. An Industrial Advisory Board contributes significantly to program development by providing expertise in current technologies and creating alliances with regional industries. The Board assists faculty and administration in: (1) Evaluating and modifying existing programs and courses through identifying strengths and weaknesses, (2) Analysis of needs and development of new courses and programs and (3) Adjunct and student recruitment efforts. Each academic program in the School of Technology either has or is currently establishing an Industrial Advisory Board composed of appropriate to discipline industrial representatives.

II.6. Transfer program (pathway) from Community Colleges (2+2 education)

The CCSU articulation agreement with the state's Community Colleges makes it easy for graduates to transfer to the University and retain their earned credits. Since 1993 the School of Technology has successfully participated in the "College of Technology" project. This project had been developed between state universities and Community Colleges and offers a Pathway to Engineering programs at UCONN, and Engineering Technology and Technology programs at CCSU. This project promotes a very efficient 2+2 educational model leading to the Bachelor of Science degree in technical disciplines. It allows a student to begin technology or engineering study at any of twelve Community Colleges with the ultimate goal of achieving a four-year degree. The School of Technology has recently developed a special pathway to the engineering technology program at CCSU, in addition to existing Technology and Technology Education pathways. These programs offer students who continue their studies at the four-year level automatic junior status upon transfer, without any loss of credit.

II.7. Continuous quality improvement- accreditation based on program assessment plan

During the last two years, new accreditation policies has been adopted by all major, nationally and internationally recognized American accreditation boards/councils [7,8,9,10]. Accreditation has become an evaluation of the dynamic process of quality assurance in education.

Formerly, accreditation principles were based on detailed accreditation standards that included periodic monitoring and control. These standards were well designed, fixed, and definitive of most academic program criteria. The evident shortcoming of that model was its "static" character. The dynamically changing technology and "environment" both had very limited influence on program and graduate's competencies.

A new accreditation philosophy consists of a two-fold approach comprising minimum accreditation standards and continuous improvement process through self-evaluation and quality improvement, illustrated in Fig.2.

This continuous improvement process (also called continuous quality improvement or CQI), demonstrates many similarities with the ISO 9000 family of international standards for quality assurance. General academic standards were limited to the most important minimum requirements. On the other hand, the CQI process is based on program objectives, which are reflected in measurable outcomes. The outcomes must be continuously measured, analyzed and corrective actions implemented. The approach is evidently "dynamic" and results in ongoing evaluations and corrections as a response to changes in industry, technology trends etc.

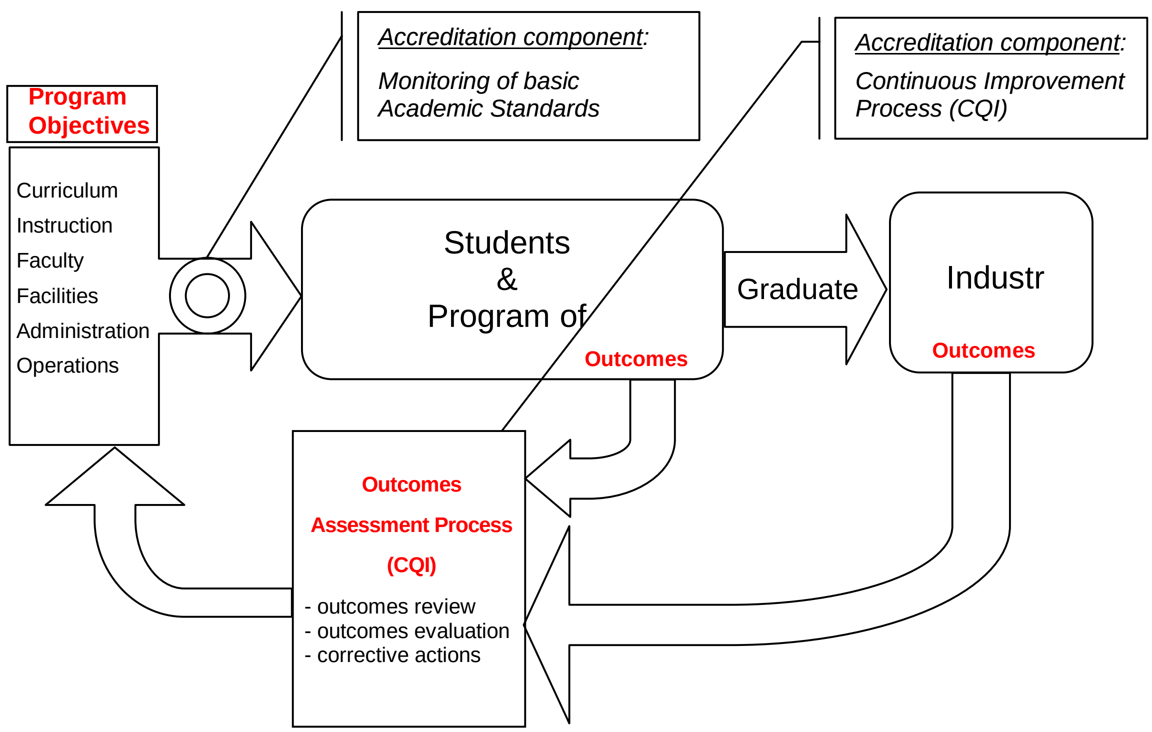

Fig. 2. New "Dynamic" Accreditation Model (Input Monitoring and Continuous Outcomes Assessment Process)

II. 8. Demand driven academic programs

The report produced by the CT Department of Labor reflecting industry/occupational projections for the period 1998-2008 predicts 101.5% growth in openings for computer engineers, 80.7% for systems analysts, 65.7% for computer support specialists, and some 15% for all other engineering disciplines. This is a tremendous opportunity for present and future students in those disciplines [3,4,5].

Currently, the CT Department of Labor is also reporting a dramatic shortage of graduates in the critical IT disciplines. Fig.3 illustrates the shortage of graduates in selected IT and engineering programs.

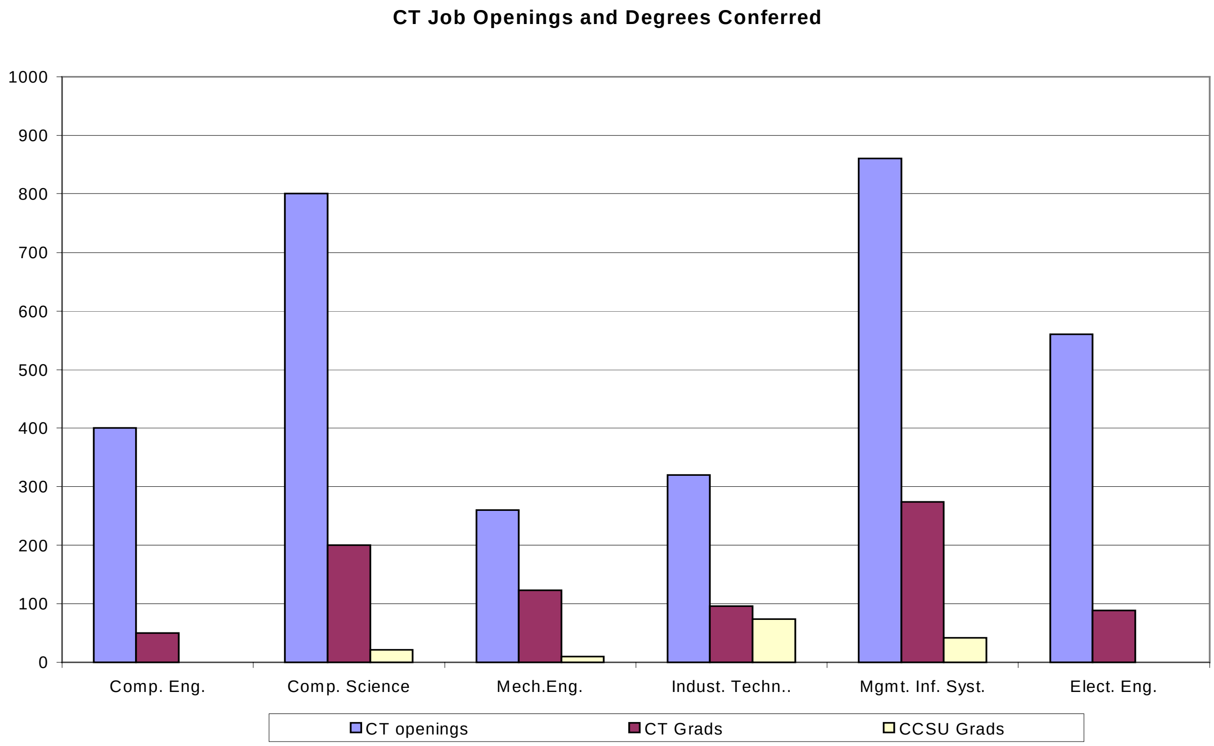

Fig. 3. Job openings and degrees conferred (1998-1999)

At CCSU we offer a number of programs, which perfectly match the critical disciplines [3], reported by the Department of Labor and specifically illustrated in Fig.3. The statistics in Fig. 4 present the total enrollment in chosen IT, Engineering Technology and Technology programs offered at CCSU. This leads to an optimistic conclusion. If the new program responds directly to the identified and growing demand for new educated workers, there will be employment opportunities. One hopes that the enrollment will also grow steadily. In extreme cases, universities and schools cannot simply accept more students because the available resources are limited (qualified faculty, laboratories, equipment, dormitories etc.).

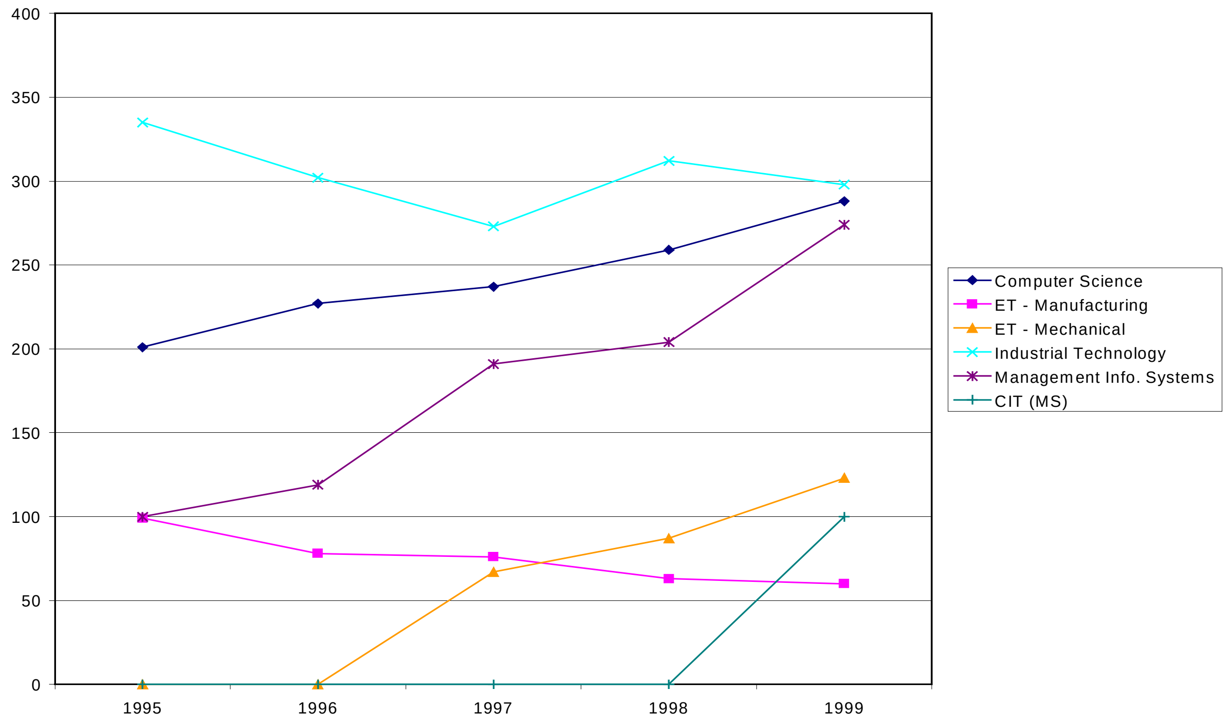

Fig. 4. Total enrollment in selected IT, Engineering Technology and Technology programs at CCSU

III. Conclusions

University - industry relationship should not be limited to R&D exclusively. There are many other prospective ways for developing excellent university-industry relationship. There is also necessary a common effort of governments, industry and universities to rebuild the awareness and attractiveness of science, technology and engineering in modern society. It must be re-established prestige and respect for these occupations, which require fluency in contemporary technology but also, unprecedented discipline in life-long learning. Today's unbelievable progress in technology and science causes the obtained academic knowledge to very quickly become obsolete, unless each graduate puts additional effort into up-dating personal knowledge, expertise and skills. Additionally, there remains bias from the recession of the Industrial Age/Industrial Society.

The coordinated long-term effort must be focused on re-building the confidence of society in engineering/technology disciplines, furthering awareness that engineering/technology education remains one of the best investments in the future of the next generation. This should be coupled with providing attractive programs in science and pre-engineering for K-12 education and for technology education.

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