

THE UNITED TECHNOLOGIES/TRINITY COLLEGE ENGINEERING INITIATIVE (UTCEI): A MODEL FOR THE PARTNERSHIP OF THE FUTURE

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ABSTRACT

The United Technologies/Trinity College Engineering Initiative (UTCEI) is a joint effort by the United Technologies Corporation and the Trinity College Department of Engineering designed to stimulate and maintain the interest of under-represented students in engineering and science. The five-year UTCEI began in the Fall of 1995 with an integrated recruitment and retention program based on a unique research/career experience involving both high school and college students. Both groups of students benefit from the experience of working together with experts from industry and academia in a mutual effort toward solving real-world engineering problems. The UTCEI also strives to strengthen professional, social, and academic programs for under-represented students at Trinity by supporting student run organizations; monitoring academic performance of these students; and by providing and seeking internship and work study opportunities in local industry and on the Trinity College campus.

INTRODUCTION

An educational pipeline, beginning on the elementary level, extending through the middle school years, and culminating in undergraduate and graduate education, produces our nation's scientists and engineers. Demographic studies of this pipeline indicate that the number of prospective engineering students to be drawn from traditional backgrounds will decrease in the years ahead. "Just to maintain present numbers, enrollment levels and distribution rates of ethnic minorities and women must rise from today's combined total of somewhat less than 25% to 75% in just 40 years."¹ To respond to this challenge, future engineers must be recruited from traditionally under-represented groups and they must be educated in supportive environments which enhance their chances for success.

IMPACTING CHANGE THROUGH COLLABORATION
1997 WEPAN/NAMEPA CONFERENCE

The Engineering Department at Trinity College is proud of its record of attracting and retaining students from under-represented groups. Our average enrollment rate of 30% for these groups over the past five years compares favorably with the quoted national average of 25%¹. The Trinity engineering faculty, and the College administration do recognize, however, that they must use the widest range of human, financial, and technical resources available to build on this record. Because United Technologies shares Trinity's commitment to science and engineering, to women and persons of color in the field, and to young scholars in the Greater Hartford area, the UTCEI is a natural partnership.

PROGRAM DESCRIPTION

Participants

Trinity College and Engineering: Founded in Hartford in 1823, Trinity College (TC) is a highly selective, non-sectarian, and coeducational college with an enrollment of approximately 1,800 students. Trinity is one of a handful of liberal arts institutions of national stature with an ABET-accredited engineering program. The aim of the College's engineering degree program is to train engineers at the forefront of the profession, men and women capable of making significant contributions to their profession and to the community. Their ability to do so is greatly increased by the development of skills, knowledge, and intellectual curiosity that extend beyond the traditional boundaries of technical training. In recent years, Trinity's engineering program has also placed high priority on the recruitment and training of a larger number of majors who are women and/or from minority backgrounds. This commitment includes the encouragement of promising students in secondary schools.

United Technologies Corporation (UTC): United Technologies is a \$23 billion corporation that provides a broad range of high-technology products and support services to customers in the aerospace, building and automotive industries worldwide. UTC's best-known products include Pratt & Whitney aircraft engines, Otis elevators and escalators, Carrier heating and air conditioning systems, Sikorsky helicopters, Hamilton Standard aerospace systems and UT Automotive components and systems. The Corporation also supplies equipment and services to the U.S. space program. UTC supports the UTCEI program with a five-year-\$300,000 grant, volunteers from many of the UTC divisions and other Corporation sponsored activities.

Hartford Area High Schools: The participating high schools are Hartford Public, Bulkeley, Weaver, East Hartford, Bloomfield, Northwest Catholic, Kingswood-Oxford School and Miss Porter's. The schools listed include both public and private institutions, most with a large representation of students of color (average over 50%). For participation in the UTCEI, two women and/or students of color are selected from each of the participating schools. The UTCEI coordinator works with high school faculty contacts to advertise the

program and to establish contacts. Student selection is based on transcripts, a student essay and several letters of recommendation received in December of the junior year. The selection committee is made up of both college and high school faculty. Student ability and motivation are both considered in the selection process, with motivation being an important and essential quality for selection.

Components

Research Experience: The design and success of the UTCEI rests heavily on the active participation of people from the three institutions: UTC, TC Department of Engineering, and the eight area high schools. At the core of this program is a commitment to the promotion, retention, and graduation of women and students of color pursuing degrees in engineering. Through an early awareness component, the UTCEI seeks to stimulate interest in engineering and science on the high school level by offering talented students opportunities to conduct engineering research in state-of-the-art laboratories at TC. In future years of the program, these research projects will also take place in UTC labs. The UTCEI provides TC computing resources to each of the participating high schools along with an e-mail account, and a TC library card for each of the selected students. Students are encouraged to utilize these resources and to “network” with other members in the program. Trinity engineering students who participate in the early awareness component are also eligible to apply for a UTCEI fellowship supporting a summer research experience. This project is undertaken under the supervision of either a TC faculty member, or an engineer or scientist from UTC.

The research experience is one of the most unique and essential components of the UTCEI. This experience is based on a tiered network of mentor/consultants that work together in the study of an engineering topic of common interest. Research teams (called *interest groups*) are comprised of participating high school students (the *scholars*), UTC volunteers (the *team professionals*), Trinity Engineering students and faculty, and other students who are either contemplating, or who have already declared engineering as their major. Based on the recommendation of Trinity Engineering Faculty, engineering students with extensive laboratory experience are selected to lead these research teams. These students are designated *team leaders* and serve as role models while functioning much like teaching assistants. Team leaders design research activities for their teams under the supervision of engineering professors called *faculty advisors*. The other Trinity students involved in a UTCEI research team are called *team co-leaders*.

The structure of each UTCEI interest group encourages multiple interactions and fosters the formation of mentoring relationships between all members of the team. Several team professionals and team leaders are assigned to each team in an effort to optimize the exposure of each participant. E-mail addresses are exchanged by all members of the team and progress reports and other communications are encouraged via the Internet. Team professionals, many of whom are Trinity alumni(ae), are engineers from UTC that have volunteered to assist teams by providing technical and professional advisement. These

volunteers act as role models for team leaders, team co-leaders, and UTCEI scholars alike, however, the greatest emphasis is placed on the team leader--professional relationship. In a similar fashion, the relationship between the team leader--scholar is emphasized.

Professional Awareness Training: Throughout the year, the office of the UTCEI sponsors programs that encourage the retention of current engineering students. The UTCEI sponsors professional awareness workshops as well as social activities. UTCEI is also instrumental in the advisement of student run organizations in support of women and students of color (e.g., Society of Women Engineers (SWE) and National Society of Black Engineers (NSBE)). For example, during the Summer of 1996, UTCEI co-sponsored (along with NSBE) the Southern New England Association of Technical Professionals Second Annual Career Day Conference.

Professional awareness and recruitment activities are scheduled for scholars during the spring, summer and fall of the junior through senior year. Scheduled activities include workshops (e.g., project design and presentation), engineering career days and field trips. Scholars and their parents are also invited to attend several admissions and financial aid workshops. In addition to the activities mentioned above, scholars are provided with training in several essential skills (e.g., computing and library use). Team leaders and professionals are encouraged but, are not required, to attend all UTCEI events.

RESULTS AND DISCUSSION

Development of the Evaluation Model²

It is not realistic to assume that every student that participates in the UTCEI will complete an engineering degree. The development of this five-year initiative is, however, based on the expectation of several positive results:

- The attraction of women and students of color to the study of engineering
- The retention of these students as undergraduate engineering majors
- The assistance of these students in identifying postgraduate career paths

The chronological time required to achieve these results presents a significant challenge to the evaluation. The desired results for the first goal will not begin to be conclusive until the Fall, 1997 when the first UTCEI scholars have completed high school and are ready to enter their first year of college. Measuring the ability of UTCEI to retain these students through graduation will occur over four years, which is beyond the completion of the current project timeline. Identification of postgraduate career paths will be possible at the end of undergraduate study (1999-2001, for the junior and senior years of the first class of scholars). However, the employment options and selection for the first class will not be known until after graduation in May, 2001.

It is understood however that UTCEI may have additional positive effects on students beyond the basic goals listed above. To develop a design that would measure the true impact of the project, the evaluator worked with project designers and operators to develop measures by which they could track results *at each stage* of the process, including whether there were enough results in the early stages to allow for some attrition and modification of the activities. Note the premise, an evaluation plan conducted as part, and thus *during* the program, is most beneficial. One can then apply lessons learned at each of the later stages of the project.

Extensive discussions during the development stage of the evaluation resulted in the design of specific methods for quantifying levels of participation in various elements of the project. It is believed that the availability of in-depth information about events and activities would keep the focus of the evaluation on long term, regular measurement of project intensity. Project and measurement tools were proposed to develop a system for capturing in-depth information throughout the UTCEI, including the following²:

Product

Tool

Project support to high school student prospects and scholars from Trinity Students

Log re: Trinity students who assist with project: date, type of assistance, event, student name, year

Project support from Trinity faculty, staff

Log re: Trinity faculty/staff who assist with project: date, type of assistance, name, position

Tours, participation of UTC personnel

Dates: descriptions of UTC interactions with students

Events for high school students, scholars

Logs with attendance by students, parents etc.

Baseline information on current engineering student population

Demographic profile of engineering majors pre-post initiative

Results (1995-96)

Fifteen UTCEI scholars participated in the first year of the program (1995-96). The 1995-96 interest group projects covered topics in biomedical engineering, materials science, communications, robotics and process engineering. Scholars also attended regular Saturday workshops on professional and academic developmental topics and visited several industrial sites. In the Spring of 1996, teams met for fourteen weeks with research being conducted primarily in the Trinity College engineering laboratories. At the conclusion of the research

component, each team was required to deliver a formal presentation at the *Trinity College Annual Science Symposium*.

Attendance records indicate that **four** scholars participated 80% or more in events; and that participation ranged from: less than 30%: two scholars ; 43%: two; 71%: seven; 85%: four. **Four** scholars participated in eight or more hours work on projects. Participation in project work sessions ranged from two sessions or less: eight scholars; three-four work sessions: three; five-seven sessions: four. **Eight** team professionals and **fifteen** Trinity students participated in the program. The average number of contact hours (with member(s) of interest group) was **two per week** during the duration of the research component. **Three** Trinity faculty members participated and the number of contact hours could not be determined from the recorded information. The results of the scholar evaluations were, in general, very favorable. For example, **80%** of the scholars indicated the highest participation rating for team leaders while **54%** gave similar ratings for team professionals. **Seventy-three percent** of the scholars have applied to Trinity including two applicants that have already accepted admission by Early Decision. The other scholars await notification for regular admission. A Trinity graduate involved in the UTCEI was employed by UTC upon graduation and has continued his involvement with entering scholars in 1997.

RECOMMENDATIONS AND CONCLUSIONS

The first evaluation covers the start-up year during which the project established procedures and assembled a valuable array of experiences and contacts for high school scholars. Trinity students were affected and provided support to students as both mentors and project consultants. UTC provided real life views into the working world of engineering through scholar visits to facilities and contacts with UTC engineers. The actual number of contact hours for UTCEI participants was lower than anticipated, however, the results of the recruitment efforts were much more favorable than expected. To extend the duration of the research component, it is recommended that the program focus more on students in their junior year. The selection process should be shifted to the end of the sophomore year and students should be ready to start the program at the *beginning* of the junior year. Workshops introducing students to the research process should be conducted during the fall semester with actual research beginning in early January. UTC team professionals should be more actively involved in all activities. A system should also be established for rewarded students with high attendance and a minimum attendance requirement should be utilized.

1. Bickart, T., (1991). "Gateway to pluralism: Recruitment an retention." *Engineering Education*, 81(4), 419-424.
2. "UTCEI: The First Year", First Year Evaluation report submitted by *The Parisky Group*, Hartford, CT.