

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

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ABSTRACT

The 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 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. The UTCEI, as it ends its fourth year, has reached a point where tangible results have been achieved and can be evaluated. The program has increased both in size and in impact; and the retention component of the program is now in full operation. The UTCEI has achieved such great success that there are plans to incorporate it into the College wide recruitment and retention structure. In addition, it is regarded as a model program for possible incorporation into *The Learning Corridor*, a local Higher Education/State/Industrial Partnership that is being designed to provide a unique learning experience for inner city children (K – 12).

BACKGROUND

To assure success in this age of technology and global expansion, a continued supply of broadly educated engineering professionals is essential. The lack of such individuals is a lament that has frequently been expressed over the past few years. The expectation is that this trend will continue, with more engineering positions to fill, and less qualified engineering professionals to fill them. "New jobs that require a highly trained, technically competent work force are being created at the same time that the engineering and science work force is aging."¹ Indeed, by the year 2000, 60% of all U.S. jobs will require technical training.² At the same time that there are more engineers needed, "...there is diminishing interest in science and engineering among the traditional talent pool"¹. The decline has occurred for a variety of reasons and the need for engineering professionals is now urgent.

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Among other concerns, this decline in engineering and science graduates could lead to fewer innovations in today's many technological arenas.

One reservoir for engineering professionals that has yet to be tapped sufficiently is that of women and people of color. Demographic studies 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 years³. Thus, to assure economic prosperity future engineers must be recruited from traditionally under-represented groups and they must be educated in supportive environments that enhance their chances for success.

Four years ago the Engineering Department at Trinity College and United Technologies Corporation (UTC) responded to this challenge with the establishment of the United Technologies/Trinity College Engineering Initiative (UTCEI). The UTCEI is a comprehensive five-year program designed to encourage motivated, capable young women and students of color to study engineering and science⁴. Studies have shown that hands-on, supportive educational programs that begin before college, and continue through college, result in enhanced recruitment and retention for students traditionally under-represented in engineering and science^{1,2}. With this information in mind, the UTCEI was carefully devised to include both recruitment and retention components in an effort to address two main objectives: increased enrollment of talented women and persons of color in engineering and science programs and increased numbers of these students successfully earning engineering and science degrees.

PROGRAM DESCRIPTION

Introduction

The UTCEI is based on a unique tiered/mentorship model providing research, career and professional development experiences to high school and college students⁵. As part of the program, selected high school juniors from local Hartford area high schools join research teams specifically designed to cover topics from a variety of different engineering and science disciplines. Each team includes high school students, Trinity engineering and science students, industry professionals, and Trinity faculty members. Both the high school and college students benefit from this tiered mentorship approach and from working together with experts from industry and academia to solve real-world engineering problems. High school students are also exposed to a variety of professional development workshops with such topics as technical report writing, financial aid, networking, and power point. The UTCEI Program Coordinator provides support to all students involved in the program, aiding not only in recruitment, but also in retention. The Coordinator is a valuable resource to all students in the sciences providing such services as career guidance, tutoring and advising.

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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 the few 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 to be 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.

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, 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%). A minimum of two women and/or students of color are selected from each of the participating schools with total enrollment not to exceed 27 students. The UTCEI Coordinator works with the high school faculty to advertise the program and to establish contacts. Student selection is based on reviews of transcripts, two letters of recommendation, and an essay. The selection committee is made up of college and high school faculty. Student ability, in math and science, and motivation to explore engineering are both considered in the selection process, with motivation being a heavily weighted quality for selection.

Components of the Program

Trinity College Resources: The UTCEI provides Trinity College 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 program are also eligible to apply for a UTCEI fellowship, which

supports a summer research experience. The fellowship is undertaken with the supervision of either a TC faculty member, or an engineer or scientist from UTC.

Research Experience: The research experience is one of the most unique and essential components of the UTCEI. The experience is based on a tiered network of mentor/consultants that work together in the study of an engineering/science topic of common interest. Research teams (called *interest groups*) are comprised of participating high school students (called *scholars*), industry volunteers (called *team professionals*), Trinity faculty (called *faculty advisors*), Trinity engineering students (called *team leaders*, generally juniors and seniors), and other Trinity students (called *co-leaders*, generally first and second years who are either contemplating, or who have already declared engineering as their major). Team leaders serve as role models while functioning much like teachers and industry project leaders. Team leaders design research activities for their interest groups under the supervision of their faculty advisors. The co-leaders have much the same role as the scholars, to explore different topics in engineering. They also serve as role models for the scholars and receive mentoring from the other members of their interest group. In addition, they develop leadership skills while being responsible for logging participation, scheduling meetings, and documenting team activities. Each interest group is required to create a poster that summarizes their team's accomplishments.

Mentoring: 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/coleaders are assigned to each team in an effort to optimize the exposure of each participant. All members of the team exchange e-mail addresses and progress reports and other communications are encouraged via the Internet. Team professionals, many of whom are Trinity alumni(ae), are engineers from industry that have volunteered to assist interest groups by providing technical and professional advisement. These volunteers act as role models for team leaders, co-leaders, and UTCEI scholars alike, however, the greatest emphasis is placed on the team leader—team professional relationship. In a similar fashion, the relationship between the team leader--scholar is emphasized.

Retention and Professional Awareness Programs: 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. The 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)). In addition, the Program Coordinator provides personal counseling, academic advising, and career counseling, as needed by students in the program. Thus, the UTCEI program fills "the academic void" for people of color and women studying engineering who may often feel left out of informal networks and mentoring. These organizations and mentoring/counseling relationships can "...do much toward creating a caring atmosphere on campus [and] the encouragement does much to help in recruitment, retention, and graduation⁶.

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RESULTS AND DISCUSSION

The UTCEI is now completing its forth year in operation. Table I represents a summary of the Y1-Y4 participants.

Table I: UTCEI Team Participants Year I-IV (Fall 1995- Spring 1999)

	Year I	Year II	Year III	Year IV
Team Leaders	7	6	8	9
Co-Leaders	8	8	9	9
Team Professionals	9	10	4	13
Scholars	16	17	18	19
Scholars African American	31 %	47%	11 %	21 %
Scholars Latino	25 %	24%	16%	21 %
Scholars White	25 %	18%	38%	36 %
Scholars Other	12.5 %	12%	35%	21 %
Scholars Male	12.5 %	24%	12%	36 %
Scholars Female	87.5 %	76%	88%	63 %

Team Leaders: Trinity College Juniors and Seniors
 Co-Leaders: Trinity College First and Second Years
 Scholars: Juniors in High School
 Team Professionals: Industry Volunteers

Upon the completion of each year of the program, the program has been evaluated using the evaluation model developed for the UTCEI by the Parisky Group⁷. Table II summarizes some of these results.

Table II: Summary of Results to Date

1. 40% of the members of the first year of the program enrolled in Trinity College and are now sophomores
2. 33% of the members of the second year of the program enrolled in Trinity College and are now freshmen.
3. 100% of all the UTCEI members, now of college age, are attending college.
4. 72% of the first year scholars (now sophomores in college) are majoring in engineering and/or science.
5. 66% of the second year scholars (now first years in college) are majoring in engineering and/or science.
6. The UTCEI program has been instrumental in helping Trinity students get internships and full-time jobs upon graduation (100% success rate for Trinity engineering students)
7. The UTCEI Program Coordinator advises and supports Trinity College students majoring in, or interested in, majoring in engineering and science. (e.g., fall of 1998, over 30 Trinity students had substantial contacts with the Program Coordinator).

EVALUATION DESIGN

A complete evaluation of the program, for Years 1-4, is currently underway. To access the ultimate impact of the UTCEI, a unique and comprehensive evaluation tool is necessary. This evaluation tool was designed and is currently being implemented by *Supportive Consulting Services, Inc*⁸.

The development of the UTCEI is based on the expectation of:

- 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 evaluation design was developed to measure the cumulative impact of the program, over its four years. To do this, the goals of the UTCEI were divided into the following "levels of impact". To measure the success of the program each impact level is to be evaluated as described below:

A. High School: Determine the yearly and cumulative effectiveness of the UTCEI in providing information and experiences to local high school women and students of color about engineering and related sciences training and opportunities -- so that they may make an *informed choice* about their own education and career direction.

B. College: Determine the yearly and cumulative effectiveness of the UTCEI in supporting and retaining Trinity College women and students of color into engineering and related majors and ultimately into engineering careers.

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C. Volunteer, Mentors and Cohorts: Determine the impacts and benefits upon the program, its volunteers and mentors, and its student cohort groups in a tiered-mentoring design. This includes students, faculty, and industry professionals.

D. UTC hiring and recruitment: Determine the effectiveness of UTCEI in increasing the number of qualified applicants and hires who are women and students of color.

E. Organization: Determine the relative effectiveness of UTCEI at different levels (A-D) as well as its ability to change and evolve over time.

The data from the complete evaluation will be presented in the fall of 1999.

CONCLUSION

The UTCEI was designed to encourage women and/or people of color to explore engineering and science. It has been very successful at achieving this goal. Many of the high school scholars that entered the program with little knowledge and/or interest in science and engineering are now choosing to pursue these degrees. For the many college-age UTCEI students, the unique tiered mentoring/research experience has imparted, among other things, strong communication, team building and leadership skills. Many have been impacted by the UTCEI with individuals from the Greater Hartford Community, the Trinity Community and United Technologies Corporation. Because of this great success, the UTCEI is now being considered a model for other programs. Ultimately the UTCEI's educational design has proven to be a beneficial learning experience for all students in engineering and the sciences.

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