

# BRIDGING THE SUPPLY AND DEMAND GAP IN IT: STRATEGIES FOR THE RECRUITMENT AND RETENTION OF WOMEN AND MINORITIES

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## Abstract

Research eliminates any doubt that women are as prepared and capable of succeeding in IT as men. To meet our future technology work force demands, we must attract more students into the field of technology, both male and female. Statistical projections suggest that if equal representation could be achieved, our critical IT shortage problem would be significantly relieved; therefore study must continue until equality of representation exists. Two major focus points exist in achieving equal representation: (1) the recruitment of females to major in technology disciplines; and (2) the retention of females in the technology disciplines, once the initial choice is made. This paper will present the efforts of two universities toward these goals of recruiting and retention.

**Keywords:** women, minorities, recruitment, retention, internship

## 1. INTRODUCTION

A report by the American Association of University Women found “that girls are scarce in computer classes and in high-paying technology jobs, and it isn’t because machines make girls nervous or because they aren’t good at math.” (Reimer 2000) The findings of a teacher-student survey, *The American Teacher 1997: Examining Gender Issues in Public Schools* were contrary to some early research efforts which indicated females have distinct disadvantages during their pre-college education in math and science. The survey of 1,306 students and 1,035 teachers in grades 7 through 12 revealed that “girls appear to have an advantage over boys in terms of their future plans, teachers’ expectations, everyday experiences at school and interactions in the classroom.” (Sommers 2000)

A Search Institute survey evaluated the attainment of forty critical development assets of over 99,000 students in grades 6 - 12. These assets-- half internal, such as motivation, half external, such as family support --are referred to as “building blocks for healthy development”. (Sommers 2000) The survey reported that girls rated higher than boys in thirty-seven of the forty assets. By almost every measure of well being, girls out-ranked the boys: Females felt closer to their

families, had higher aspirations, stronger connections to school and were more assertive.

The Horatio Alger Association’s 1998 survey examined two groups of American students, the “highly successful” and the “disillusioned”. The successful students are characterized as hard workers, choose challenging classes, place high priority on school work, earn good grades, participate in extra-curricular activities and feel in control of their surroundings. The disillusioned students are characterized as being demoralized--pessimistic about their future, with low grades and little contact with teachers. Of the successful group, approximately 18% of all students, 63% were female and 37% male. Of the disillusioned group, approximately 15% of all students, 70% were male and 30% female. (Sommers 2000)

Studies indicate that girls have the ability and confidence to succeed in science and math based careers, so why don’t they?

## 2. WHY NOT?

“In 1971 females made up only 9% of computer systems analysts and other specialists. By 1990, this proportion jumped to 35%. But 1993 noted a decline in

representation to only 30% (U.S. Bureau of Statistics). A similar trend was found in the women's share of computer and information science bachelors degrees." (Parzinger, Lemon 1999)

Several reasons are given to explain why women leave the IT careers: (Parzinger, Lemon 1999)

- 1) Educational aspects
- 2) Corporate culture
- 3) Psychological traits
- 4) Family characteristics

If a student does not identify his career choice as math and science based in junior high school, the subsequent inappropriate high-school course selections may make it very difficult, or impossible to succeed in a technical field in college. A report of the National Science Foundation (NSF96-311) concluded that women take fewer high-level math and science courses in high school. (Wolff 1999) Many of the University's students drop out of the freshman programming classes because they were inadequately prepared. The prolonging of the time to complete degree requirements in order to take additional, non-credit, prerequisite courses presents, for most students, insurmountable problems in the areas of finance, ego and family/peer expectations.

The NSF96-311 report also states that women earn over \$13,000 less per year than their male counterpart. Theories suggest that women do poorly in male-dominated organizations because they are few in number. Wright's research found that as the proportion of women in IT increased, the segregation within the occupation declined and the earnings gap narrowed. (Parzinger, Lemon 1999) Another theory, Jacob's "social control", suggests that "women receive lifelong social control messages about male-dominated occupations--They do not belong and should not be in them." (Parzinger, Lemon 1999) Another outcome of the social control theory is that men are taught to believe that women do not belong and react accordingly toward them in the workplace. As a result, "women decline to

enter male-dominated majors and occupations and choose to leave male-dominated majors and occupations." (Parzinger, Lemon 1999)

### 3. WHAT CAN BE DONE?

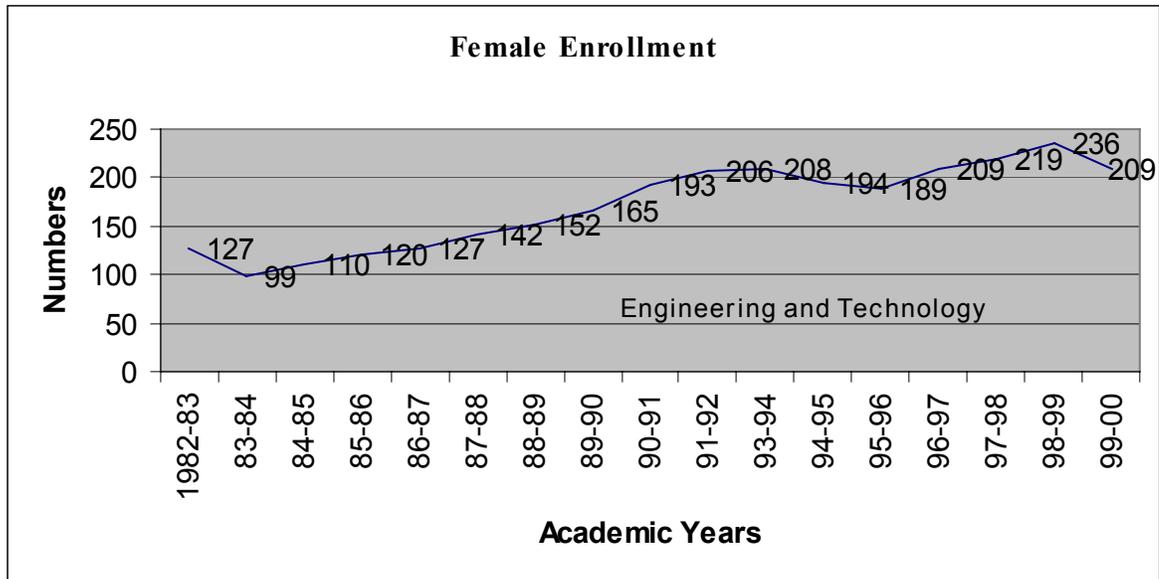
Programs at Ohio University and the University of South Alabama have been developed to attract and retain more female and minority students into the technical disciplines. Ohio University's Pre-Engineering Program for Minorities (PEP) and two-week summer program, "Women in Engineering and Technology" (WENT) are designed for recruitment. The Computer and Information Sciences Intern Program at the University of South Alabama has been modified to improve retention. This paper presents the description and current status of these program at both institutions.

### 4. RECRUITMENT

Ohio University, situated in the rural setting of Southeastern Ohio in Athens, has a student population of close to 20,000 students on the main campus and about the same number of town residents. Although Ohio University has an outstanding Engineering College, the problems are similar to those at other institutions of higher education.

The interests in certain disciplines change with the decades, but women are traditionally a minority in technology-based programs. The total enrollment at Ohio University has always included more women than men. However, even with many Engineering department options and Research Institutes and Centers, the percentage of women in any Engineering field has never exceeded 15 %.

Figure 1 shows the female enrollment in the College of Engineering and Technology from 1982 to the present.



**Figure 1**

In response to the lack of minorities in the Engineering program, the Russ College of Engineering and Computer Science at Ohio University has designed several programs to provide a bridge between high school and college for minority students pursuing a degree in engineering and technology. The Engineering College information about Pre-Engineering programs can be found at the web site: <http://www.ent.ohiou.edu/college/pre/html>.

**5. BACKGROUND**

In 1982, the College began the “Pre-Engineering Program for Minorities” (PEP). The program is still very active and includes (1) programming, (2) basic skills in pre-calculus and public speaking, (3) 12 credit hours in courses from engineering orientation, study skills, pre-calculus and recreation, (4) enrichment workshops, (5) a plant tour, and (6) minority panel discussion participation. Students in Ohio University and members of the National Society of Black Engineers (NSBE) participated and acted as mentors.

In 1989 the College recognized that 6<sup>th</sup> and 8<sup>th</sup> graders needed early encouragement in taking the math and science tracks as early as possible. The PIPELINE project was developed to provide programs such as MATHCOUNTS, for 7<sup>th</sup> and 8<sup>th</sup> graders, and TEAMS for high school students. State-wide programs have continued and OhioU has served as the state coordinator for many years.

In 1994 the College created a new position, "Special Assistant for Minority and Women’s Programs." The

Special Assistant is responsible for recruiting women and minority students and for developing and implementing the pre-engineering programs for these two groups.

In 1994, the "Women in Engineering and Technology" (WENT) program was established to provide junior and senior high school women an opportunity to explore the fields of science and engineering prior to entering college. For two weeks the women reside on campus and participate in various academic and social activities designed to increase their awareness and interest in technology- and science-based careers. The goal is career exploration through computer application, design, laboratory experiments, and panel discussions. The following year an identical program for minority males was established – Minority Males in Engineering and Technology (MENT).

**6. WOMEN IN ENGINEERING AND TECHNOLOGY (WENT) RECRUITING PROGRAM**

WENT has taken the best of other programs in the region and developed its unique combination of ‘work and play’ for a stimulating two-week experience. To be accepted, students must fill out an application, present a high school transcript that shows high math and science scores, write a one page essay – “Why I want to attend the WENT program”, and include a letter of recommendation. Tuition for room, board and incidentals for the two-week session is only \$200. The remaining cost of the program is funded by sponsors

that include Ohio University, DuPont, the American Society of Civil Engineers and additional foundations. The women live in the dorms with Engineering student-counselors. Upon completion, graduates receive four college credits and a \$1,000 scholarship to Ohio University, if accepted into an Engineering discipline.

The week's schedule includes a variety of formal classes with Engineering faculty, an engineering project and recreational activities. Classes run from 8:30 to 4:30 each day and include Introduction to Engineering, Chemical Engineering, Computer-Aided Manufacturing, Circuits, Computer Literacy, Automatic Identification, Manufacturing Systems, Civil Engineering, Robotics, Power Transmission and Engineering Physics. Students demonstrate their skills by creating a "bobcat" vehicle from Legos. The process integrates track surveying on a brick runway, vehicle analysis, vehicle construction and vehicle testing. Career encounters incorporate rap sessions, a plant tour, a Women's panel of Engineering professionals, and mentoring. Recreational activities, such as volleyball, games, pool party, pizza and movies, are planned for each evening, with an additional all-day trip to an amusement park. Parents are invited to the program's culminating activities of team bobcat demonstrations and a graduation ceremony.

The WENT program uses an effective set of evaluations to monitor its success and provide relevant feedback. In questions, such as "What did you expect out of the WENT program? In what ways did you get or not get what you expected?" the students have an opportunity to express themselves. The table in the appendix lists the criteria examined.

## **7. IMPACT OF MINORITY RECRUITMENT**

Since the start of PEP, program enrollment of minority students in the college has more than doubled. The total minority student enrollment is currently 6.39%, nearly twice the university-wide percentage. In 1998, of seventeen students enrolled in the program, all but one returned to Ohio University to resume study during the fall quarter. In 1999, of twelve students enrolled, all returned. Assistance continues throughout the academic year with advising, study tables, free tutoring for math, science, and peer counseling. The PEP program has provided a helpful transition for minority students to get a head start and the support they need to succeed in their academic careers. Statistics are now being compiled for the WENT program. Of the women who took part in WENT and who graduated from high school, 100% went on to college and a significant number chose engineering or science disciplines.

## **8. LONG RANGE PLANNING**

The goal of Ohio University's College of Engineering and Technology is to expand its pre-engineering programs for minorities and women. A secure base of financial underwriting is necessary to allow the program not only to grow but also to improve. Some of those improvements and growth plans are based on needs that include recruiting and retaining students for Engineering, and providing long-time professional support. Future plans of Ohio University are to create and develop:

1. An Alumni and Corporate Network for mentorship, career counseling and externships, and eventual employment.
2. Mentor-Match Program to invite minority and female alumni to campus as role models through presentations and guest lectures, and to sponsor students through scholarships.
3. Industry Program to provide sponsorship through scholarships, co-ops, and summer intern programs. Mentors and speakers to visit campus and meet with students.
4. Increase minority and female faculty recruitment.
5. Post-Entrance Bridging Program to assist female and minority students to make the transition from high school to college-level academics.
6. Individual Counseling and Advising on time management, outside employment, stress factors, and other factors instrumental to academic success.

## **9. RETENTION**

As previously noted, there are several significant influences on females' decision not to major in technology related disciplines. One influence is the lack of appropriate role models for girls at the critical decision-making time beginning around grade 5 and extending into high school. Noted also is that girls view the technology work environment as sterile with little or no opportunities for nurturing and human interaction. The narrow view of the world of work in technology as presented to students in middle school is not appealing to the vision most girls have of desirable careers. Surveys indicate that careers in technology are viewed as contradictory to the traditional female family roles of wife and mother.

Attracting females to technology disciplines is critical. At the college level, available resources often limit focus to the retention of females who present themselves to us in our courses. Loss of numbers of female students has been attributed to a lack of peers in the classroom, a lack of representative faculty, ergonomics of laboratories ill-designed for comfort of the female population, and overall non-existence of support for non-male population. Over the last four

years, several efforts have been made to improve the retention of students, some specifically for women, others for students in general, in computer science at the University of South Alabama. A “Women in Computing” support group was started, lab hours have been extended with free tutors available, semester “cook-outs” are held to encourage communication among students and among students and faculty, and scholarships and awards are presented every Spring at the annual student chapter of the ACM Awards Banquet. Our female faculty representation has increased from 2 to 5 of 17, and the retention issue for all students, including females and minorities, has reached a general awareness level among our faculty and student body. Encouragement to develop policies, procedures and culture to improve retention has also become a top priority at the University level due to two successive years of decreased enrollment. All academic units within the university are being required to develop a strategic plan for the retention of all students. It should be noted that studies have indicated that efforts employed to retain students, in general, are as effective for female students as for male students. Indeed, surveys conducted with the Women in Computing support group revealed women’s needs and expectations to be very similar to their male counterparts.

#### **10. RETENTION STRATEGY: USE INDUSTRY RESOURCES TO PROVIDE ROLE MODEL SUPPORT**

To address the role model shortage for female computer science students, speakers were invited to campus to discuss relevant issues in the discipline. The speaker program was well received, but insufficient to significantly affect the retention rate of females. In addition to the general strategies to improve the retention rate in computer science, our school has a unique program that has been modified to promote the retention of women and minority students—the Internship Program. Briefly, the intern program is different from traditional co-op and internship programs. The major differences are:

- Student interns are paid while in the program.
- Student interns receive one semester credit for each semester in the program.
- The university receives overhead money for housing the program.
- The School of CIS receives overhead money for managing the program.
- A faculty member receives release time to manage program.
- Coordinated policies and procedures exist to promote interns to positions of increased responsibility with wage increases.

The four-year-old program has had 173 participants, and has grown from one to five partners with additional partners pending. The total of 173 interns consists of 134 males and 39 females. Currently, there are 42 interns in the program, 12 are female, 30 male. Of the 131 former interns, 87 have graduated, 12 females and 75 males.

Based on the literature noting the shortage of role models for female students in the CIS discipline, a change was made to the prerequisite structure of the intern program. In an effort to increase retention of female students, the internship program was viewed as an additional role model resource. The prerequisites for the program were restructured to allow female students to enter the program earlier. An alternate minimum ACT score or equivalent of 23 was accepted in lieu of successful completion of the sophomore data structures course. This change allowed female students to enter the program as freshmen (Early entrance females), thus being exposed to additional role model support at a critical time in the degree program. Our program has proven to be like the majority of CIS programs that lose a significant number of majors during the first year in the CS1-CS2 course sequence.

The change was implemented in spring of 1998. Since that time, 13 females have become interns under the alternate prerequisite structure. Two left the program because of personal choice, three were non-renewed due to poor work performance and eight are still in the program.

#### **11. CURRENT STATUS**

Data is being collected on retention and academic performance of the females entering the CS program beginning Fall of 1999 to make comparisons between the females in the Intern Program and students not in the program. Thus far, the participation level and duration are insufficient to draw any conclusions. Several observations have been made at this point in respect to the selection and placement of the early-entrance female interns. Females, just like males, must have adequate preparation for success in the discipline. A minimum requirement should be a respectable score on the math ACT or equivalent and a 3.0 of 4.0 high school grade point average. Since resources are thin, careful screening of students for placement in special programs for retention and recruitment is fiscally prudent. In most cases, if a student lacks the prerequisite knowledge and problem-solving training, it will take much more than an internship to retain that student.

The placement of the early entrance females in the program is also critical. An intern position that is above the level of the intern’s technical training will

only have a negative affect on the student's confidence to remain in the discipline. The three females lost for poor performance in the program were attributed to inappropriate placement. The coordinator accepts the responsibility of allowing an industry manager to select an early-entrance female to a position that the coordinator felt the student was not prepared. The coordinator underestimated the support to be supplied to the intern in the industry environment. Position selection for early-entrance females is critical for program success. In reality, few appropriate positions actually materialize. Currently, there are several more early entrance qualified intern applicants than appropriate positions.

The plan for the program is to continue to integrate early entrance females into the internship program and track their progress relative to other students. It is the goal to produce the first statistical report after the first group, entered in Fall 1999, have had a sufficient time to graduate, Summer 2003.

## 12. SUMMARY

The problem of recruitment and retention of females and minorities is one of national economic concern. The retention problem potentially will directly effect enrollment and quality of technical programs.

In conclusion, organized efforts should be tested to determined effective ways to bridge the supply and demand gap for IT professionals. Two specific

programs currently being refined and tested are described here in an effort to encourage continued thought and sharing of ideas for strategies to address the under-representation problem.

## 13. REFERENCES

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## APPENDIX

Table of Criteria for Questions as of the WENT students when they had completed the two week program.

Event	Rank 10	7	5	3	0
	Terrific	Pretty Good	Okay	Needs Work	Scrap
Team Building					
Computer Literacy					
Engineering Physics					
Power Transmission					
Plant Tour					
Chemical Eng. Lab					
Automatic Identification					
Manufacturing Lab					
Haptics and Robotics					
Circuits					
Electric Bobcat					
Vehicle Project					
Civil Engineering					
Surveying					
Computer-Aided Manufacturing					
Residence Hall Life					
Recreational Activities					
Counselors					
Panel Discussion					

Two additional questions were asked:

- (1) On a continuum below, mark how certain you were about pursuing a career in engineering. Mark an "X" for before you started the program, and mark an "0" for how certain you are now.

No Chance								Definitely		
	1	2	3	4	5	6	7	8	9	10

- (2) On a continuum below mark how certain you were about attending Ohio University. Mark an "X" for before you started the program and mark an "0" for how certain you are now.

No Chance								Definitely		
	1	2	3	4	5	6	7	8	9	10