

RECRUITMENT AND RETENTION OF WOMEN IN ENGINEERING: A SMALL COLLEGE PERSPECTIVE

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Introduction

This paper is based, in part, on the author's seven years' experience as Dean of the small exclusively undergraduate College of Engineering at Valparaiso University (VU). From the small college perspective, several topics relevant to the recruitment and retention of women in engineering education are discussed in this paper. These are the quantity versus quality of engineering graduates, the profile of future engineers and the special contributions of women, and strategies and tactics for recruiting and retaining women engineering students.

The Numbers Game: Too Much of a Good Thing?

There must be some approximate minimum number of engineering graduates needed to keep our industries competitive, maintain our infrastructure, and protect our environment. However, we can't seem to define the number as evidenced by the most recent round of forecasts and misunderstandings. A 1986 NSF study warned the nation that a "short-fall" of about 700,000 engineers would occur between 1988 and 2006. An almost crisis atmosphere developed, fed largely on the widespread communication of the forecasted shortfall. Now we learn that the 1986 study was not based on supply and demand analyses and that shortfall did not mean unsatisfied demand--even though most people thought the latter and acted or reacted accordingly.^{5,6}

Common sense supply and demand considerations suggest that there has not been and is not an unsatisfied demand for engineering talent in the United States. When adjusted for inflation, engineering starting salaries have remained essentially constant since at least 1960!⁷ As of spring 1992, unemployment of engineers in the U.S. was at an all-time high of 4.2%.³ Engineering colleges experienced marked downturns in placement of bachelors degree graduates in academic years 1990-91 and 1991-92. The report⁴ on a 1991 conference sponsored by the Engineering Manpower Commission states: "Most of the conference participants...seemed to be more concerned with the possibility of current surpluses of engineers, reflecting rises in 1991 in unemployment rates for the profession and poor placement conditions for recent candidates, both conditions being related to the current economic recession." The apparently widespread under-utilization of young engineers employed by

the private and public sector also suggests that there is no significant shortage. Young engineers should be groomed to be the managers of technology--not the doers.¹⁴

One thing we can be sure of is that numbers are needed for survival of small engineering programs and colleges, particularly tuition-driven independent schools. But is survival of engineering schools a valid reason to encourage young people to study engineering? I don't think so. Some engineering schools and programs have closed in recent years. Perhaps more of "us" should do so.

Accordingly, the first observation I want to make is that I am very skeptical of the claims that we need more engineers. Shortage claims seem contrary to common experience and may be more self-serving than societal-serving.

If Not Numbers -- What?

Because of its historic, present, and future impact on society and the environment, engineering is one of the most important professions. Hardy Cross,² using very direct, plain words, writes: "It is not very important whether engineering is called a craft, a profession, or an art; under any name this study of man's (human?) needs and of God's gifts that they may be brought together is broad enough for a lifetime."

Instead of thinking about the quantity of engineering graduates perhaps we should be concerned with the quality of those graduates. And we should be contemplating the definition of that quality in light of the needs of our ever-changing world. What is needed for the future?

Robert Reich,¹¹ in his book The Work of Nations, urges Americans to prepare for the global society with emphasis on the global market. He defines a special category of worker called the symbolic analyst. They combine an ever-expanding knowledge base with communication ability in the broadest sense. Their strength is not knowledge per se, but their ability to quickly and creatively use the knowledge. Symbolic analysts have four basic skills: abstraction, system thinking, experimentation, collaboration.

If one accepts Reich's general thesis about a growing global economy and his specification of the symbolic analyst as the individual who will thrive in that economy, then engineering seems to have a promising future. For one thing, engineering has traditionally emphasized the use of knowledge to solve problems. Reich is saying that this problem-solving ability will become increasingly valued. The skills he identifies--abstraction, system thinking, experimentation and collaboration--are the "stuff" that engineering is made of. Another view of the future, and one that is even more engineering-specific, is provided by Arango.¹ He argues that an invigorated and improved engineering profession is crucial to maintaining a leadership position in the global economy.

Mendelson¹⁰ succinctly describes tomorrow's engineers when he writes "What is needed for the engineer of the future is a new definition--one that includes the art and skill of problem-solving in broader socio-technologic issues and, as a need that will be with us forever, the art and skill of change management. In this context, no other career--with

the possible exception of medicine--offers so much potential for personal reward, self esteem, and enduring value to mankind."

Therefore, my second observation is that engineering is very well positioned to be an increasingly important profession though we must pay close attention to the quality of the engineering graduate in light of changing needs. That quality is defined by the characteristics of students we recruit into engineering and by the nature of the engineering programs.

Women Critical to the Future of Engineering?

If we focus on quality characteristics of potential engineering students--rather than on numbers--I believe that we will find that women, as a group, inherently have more to offer than men, or at least something different and important to offer. Experience and limited data suggest that women students, as a group, tend to have more altruistic aspirations, tend to offer higher academic ability, and tend to have other attributes more in keeping with the future of engineering needs of society than do men.

For example, a fall 1990 survey¹² at VU of 93 incoming freshman engineering students, about one-fifth of whom were women, revealed that the women had much higher advanced degree aspirations than men and were much more likely to want to make contributions to society. Furthermore, the women, vis-a-vis the men, had a much stronger desire to obtain recognition from colleagues, to influence political structure, to help others out of difficult situations, to make theoretical contributions to science, to be involved in environmental clean-up, and to keep up to date with politics.

With respect to academic performance, women in our college consistently do better than men. For at least the past six years, the average cumulative grade point average of women engineering students has exceeded that of men engineering students by 0.2 or more. Women are also more involved than men in extra-curricular activities in our college and have a stronger sense of community.

There is something different about the way women go about studying engineering--greater excitement, stronger sense of community, higher aspirations and deeper confidence--that says "I'm going to do something worthwhile with my life. I have a plan, and I'm going to use this engineering education as a springboard."

I also believe that there are some fundamental differences in the way men and women tend to approach professional work after college. For example, my experience with women in the practice of engineering is that they tend, relative to men, to be more supportive of fellow workers, to be more aware of and expressive of feelings as they relate to accomplishing project objectives, and to be more willing to share ideas. These traits increase the effectiveness of engineering teams and enhance the quality of the product. Marcellino⁸ identifies and contrasts the management styles of men and women. His article suggests that a greater infusion of women and their characteristics will make engineers and the engineering profession better equipped for the challenges of tomorrow.

Accordingly, my third observation is that women as a group have much

to offer the engineering profession of the future.

Recruiting and Retaining Women in Engineering Studies

I would like to offer some thoughts on recruiting and retaining women in the study of engineering. First of all, let's not judge a college or university's commitment to recruitment and retention of women and other under-represented minorities by the number of its formal programs. There seems to be a tendency to do so.^{6,9} As one considers smaller and smaller engineering schools, one is likely to find fewer and fewer special programs, offices, and administrators for women and other engineering minorities. The absence of specially-named programs, offices and administrators does not mean that there is an absence of interest in or support for women and other under-represented minorities in engineering. In fact, such support might be stronger in small institutions because of their traditional high expectation-high support philosophy.

One challenge faced by the small engineering college might be called the low-recognition-by-the-person-on-the-street factor. One tactic for offsetting the low name recognition factor is to use third-party endorsements. Document ways in which people and organizations, that are obviously or apparently knowledgeable about engineering education and practice, "invest" in the small engineering school and its graduates. The VU College of Engineering uses a series of fact sheets as one way to demonstrate third party endorsements. Fact sheets are inexpensive, informative, and frequently updated means of providing information on investors. For example, a fact sheet titled "Known By The Companies We Keep" uses a simple matrix to show how various well-known engineering organizations invest in the VU College of Engineering by providing monetary grants and equipment gifts, serving as cooperative education partners, and hiring its graduates.

Gender-neutral or balanced language is an important part of a positive environment for recruiting and retaining women in an engineering college. The text, illustrations, and graphics used in the University catalog, general and program-specific information materials, and correspondence should be examined. Although very few male faculty members will be sexist, they have been educated and have worked in a largely male environment and may not realize that they use offensive terms and expressions (e.g., "girls").

Bright young women, in contrast with men, seem to be more interested in how various college education opportunities will enable them to make some significant contribution to society. They should be told that environmental problems, the challenges of global economic competition, and the dilemma of aging infrastructure all will be solved by engineering-led teams.

The SWE Chapter is an essential element of our College's recruitment and retention efforts. SWE recruitment efforts at VU in Academic Year 1991-92 included telephone calls to all admitted women students, helping the College host high school students and their families at all visit and other special days, hosting a Girl Scout troop, and having lunch with high school students who were on campus to take the National Engineering

Aptitude Search Test. Examples of retention contributions include the Shadow Program (links students with practitioners), technical paper presentation competition, panel discussion on engineering disciplines, presentations by role models, and sharing information about the accomplishments of women alumni. And these recruitment and retention activities are only incidental to the principal purpose and programs of the SWE Chapter.

Focused faculty phoning of prospective students can be an effective recruitment tactic. The brightest students are selected, with an intentional bias toward women, and are telephoned by selected faculty who offer to answer questions about engineering and, if there seems to be a "fit," are encouraged to apply to VU for admission to the College of Engineering.

Curriculum design and delivery are another important aspect of student recruitment and retention, particularly the latter. Engineering curricula tend to be very logical and systematic. For example, calculus leads to physics which leads to static mechanics which leads to mechanics of materials which leads to structural analysis which leads to structural design which leads to non-technical considerations which leads to project management and so on. Similarly, for a child, crawling should lead to walking which should lead to running which should lead to leaping and so on.

But logical and systematic doesn't necessarily mean engaging, exciting and empowering. Going directly from crawling to running can be exciting and empowering even if there are some bad falls and hard knocks along the way. Ironically, the traditional, logical and systematic approach to engineering curricula seems to take its greatest toll on the brightest students--the very students for which the programs are presumably designed.¹³ Accordingly, a few engineering schools are developing and experimenting with new curricula, especially in the first year or so of their programs. For example, VU is instituting changes in all four engineering programs with an important component being a new first-semester, freshman-year course titled Exploring Engineering.

Small, independent, exclusively or primarily undergraduate engineering colleges have an advantage in that they can make curricular improvements relatively quickly because, among other things, they do not need the approval of "the other campuses." Their internal review process should be relatively unencumbered. Finally, because of the close contact with and knowledge of their undergraduate students, these institutions can take proactive measures to minimize adverse transition impacts on students already in the programs.

Summary

Claims of actual and imminent engineer shortages seem ill-founded and more self-serving than societal-serving. Questions of shortages aside, engineering appears to be very well positioned to be an increasingly important profession in the global environment provided that the quality of the graduates changes to meet the changing needs of society. A greater infusion of women, and the special characteristics of women, will make engineers and the engineering profession better equipped for the challenges of tomorrow. Strategies and tactics used to

recruit and retain women in engineering education need to recognize the special aspirations and qualities that women tend to bring to the process.

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