

WOMEN IN ENGINEERING: A PROMISE UNFULFILLED?

Driving the streets of southern California in the mid-1980s is a late model, small pickup truck. As is common in this part of the country, it displays a personalized license plate, which says to the world, "Here I am." The letters on the plate spell INJINER. Not surprising, here in the land of defense contractors and high tech. Engineers populate the area in large numbers, and are in high demand. Nor is it surprising that someone would be proud enough of being an engineer to display it in this way. With the growth of high tech industries in the past decade, engineering has achieved greater visibility in the occupational hierarchy. While engineers still do not enjoy the prestige of doctors and lawyers, America's crisis of competitiveness in the world economy has brought greater attention to the engineers who must develop the technologies of the future. The shortages of engineers projected for the next decade are decried by economists and political leaders. Not surprising, then, that an engineer might want to brag about his chosen profession.

What *is* surprising, however, is that the driver of this pickup is not a man, but a woman. We will call her Bonnie. Bonnie is no different than the thousands of young women who graduated from a major state university in the area in the early 1980s. A native of southern

California, she turned down a job in another state, reluctant to leave the sun and surf that her hometown offers. She is career-oriented and ambitious: she wants to make money, and to move up in the organization. She lives with her boyfriend, who she is planning to marry in a year or so, and wonders how she will be able to incorporate children into her life.

What is different about Bonnie is her choice of occupation. Engineering holds the dubious distinction of being the most male-dominated of all the professions. Even fields closely related to it are less male-dominated. In 1988, women constituted 33 percent of computer and mathematical scientists, 24 percent of natural scientists and chemists, but only 7.3 percent of engineers (Vetter and Babco 1989).

During the 1970s and early 1980s the percentage of women receiving engineering degrees grew dramatically, however, and it looked as though engineering would be catching up with these other fields. Between 1970 and 1980 women's share of bachelor's degrees in engineering rose from less than one percent to nearly ten percent, a larger percentage increase than for any other science-related field. This is particularly impressive, given the fact that the occupation itself was growing rapidly during this time (Vetter 1981).

Bonnie is part of that historic development, and she knows it is something to brag about. She enjoys the surprised responses she gets when people realize that *she* is the INJINER referred to on her license plate. There are a number of reasons why women like Bonnie were attracted to engineering in the 1970s and 80s, and which seemed to presage an ever-growing role for them there.

First, engineering as a profession has grown rapidly in the recent past, and will continue to do so in the future. Between 1975 and 1985 the number of graduates from engineering schools doubled (Ellis 1990). Despite this growth, the demand for engineers is projected to increase by another 25 percent between 1988 and 2000. The two specialties on which our study focuses will experience the greatest growth. Electrical engineering, already the largest specialty, will grow by 40 percent. Mechanical engineering, the second largest, will grow by 20 percent (American Assoc. of Engineering Societies 1989a). Serious shortages of engineers are projected over the next several decades, and women and minorities must be drawn upon in larger numbers if we are to meet the need (National Science Foundation 1986; Ivey 1987).

Engineering should be especially attractive to women, for not only does it yield higher salaries than the female-dominated profes-

sions, starting salaries for bachelor's degree recipients are higher than for *any* comparable field (College Placement Council 1990). In fact, engineering is one of the five best-paid occupations for women, along with law, medicine, computer science, and educational administration (U.S. Dept. of Labor 1988). Moreover, female engineering graduates receive slightly better starting salaries than men. In 1986, offers to women as a percentage of offers to men were 100.3 percent in electrical engineering, and 100.1 percent in mechanical engineering. Only in the allied health professions did women do as well relative to men (100.3%). They fared less well in all other fields, including computer science, physical science, and mathematics (98%), biology (97%), business administration (95%), economics (92%), and social sciences (85%) (College Placement Council 1986).

This combination of growth and reward makes engineering an attractive field for women. Long confined to "pink-collar ghettos," where jobs are characterized by low pay and few opportunities for advancement, women are responding eagerly today to careers that offer more.

In addition, the nature of the work involved in engineering has been changing, in ways that would appear to make it more attractive to women. Whereas its traditional image was of rugged, mechanical, outdoor work, engineering today has moved indoors, and involves analytical skill, small scale design, and computer work (Salembier 1971; Hacker 1983). No longer just building "bridges and machinery," engineers are doing work that involves them in a broad range of physical, environmental, and social sciences. In addition, because the newer fields of engineering have had less time to become male-identified, they are seen as more accepting of women (Boyce 1987).

Finally, the "paraengineering" occupations are growing as rapidly as engineering itself, which means that technicians and drafters now do much of the "hands-on" work of engineering, work that is most closely identified with the male gender role. This leaves the more abstract and creative work, along with administrative activities, for engineers (Hacker 1983; U.S. Dept. of Labor 1988).

For all these reasons it was expected that the rapid movement of women into engineering would continue into the 1990s and beyond. However, in the 1980s, the increase in women's share of bachelor's degrees slowed, and by 1989 it had leveled off at 15 percent (American Assoc. of Engineering Societies 1989b). Therefore, it may well be that the surge of women into engineering has peaked, and that the increases seen in the 1970s will not continue into the 1990s.

If that is true, then Bonnie and her female colleagues will constitute not the cutting edge of a new occupational trend, but the sum total of that trend. This means that not just Bonnie, but those who follow her, will remain “tokens” in a heavily male-dominated profession.

Like women in other male-dominated occupations, Bonnie has had to do more than master the intricacies of engineering. She has also had to deal with being one of the first women in that field. This has often meant scrutiny, skepticism, and sexism. Yet she has dealt with these problems and feels confident that she will be moving up soon—first to senior engineer, later to project engineer. One of the central questions in this book is whether she and others like her will actually be able to do that.

In the chapters that follow, we describe the experiences of women like Bonnie, and the men who were their classmates in college. First, however, we must provide some background. In chapter 2 we discuss the status of women in the work force, and in nontraditional occupations. We then examine the major theoretical perspectives that have been used to explain women’s occupational status. Finally, we discuss the nature of engineering as a profession, focusing in particular on what we call the “culture of engineering.” In chapters 3 through 7 we tell the story of women in engineering today, comparing them throughout to their male colleagues. In chapter 3 we begin with their childhood backgrounds, and the experiences that led them to choose engineering as a college major, and a profession. In chapter 4 we describe their college years, following them in chapters 5 and 6 into the workplace. We describe their experiences as working engineers, and as tokens in a male-dominated work environment. We assess their status in the workplace, and their ability to move up at the same pace as their male counterparts. In chapter 7 we describe the family relationships of married engineers, and the different ways in which work and family interact for women and men.

As we proceed through these chapters we develop a theoretical model to explain the problems and opportunities women find in engineering. We conclude our discussion in chapter 8 by reviewing our model, and considering its implications for theory and public policy.

The findings reported here are based on a study of women and men in engineering, conducted in 1986. We gathered data in the form of questionnaires and in-depth interviews from a random sample of engineering graduates (1976–1985) from two major public universities in southern California. We refer to these schools hereafter as Califor-

nia Elite University (CEU) and Public State University (PSU). We oversampled women, given their small share of this population. We asked our respondents a wide range of questions, dealing with their backgrounds, college experiences, work experiences, work-related values and attitudes, and family relationships. We explored their experiences and attitudes regarding the entry of women into the profession. (See Appendix A.)

What we found was a complex picture that allows for no easy explanations. Women are doing well in engineering, but not as well as men. Like women in other male-dominated professions, they often find themselves segregated into lower status positions, with less chance of moving into management. Yet depending on the type of organization in which they work, there are significant differences in the opportunities they find. In some workplaces, women lag far behind men, while in others they equal or outpace them.

In an effort to trace the causes of these patterns, we explore the different social worlds through which our respondents have traveled or now reside: childhood, the educational system, the workplace, and the adult family. In the process we develop an explanation, grounded in conflict theory, that synthesizes two major theoretical perspectives on women's work force status: the gender role and structural perspectives. We show how women's careers in engineering are shaped by the interaction of gender-linked attitudes and behaviors, and the structural characteristics of the school, the workplace, and the family.

We argue that interactional resources such as self-confidence and assertiveness, and a fascination with technology and "tinkering," are important to career mobility in engineering. The identification of these characteristics with the male gender role puts women at a disadvantage. But these resources are less important in some organizational settings than others. What seems to matter most is which groups have the power to define the formal and informal criteria for success—what we call the "culture of the workplace." Where engineers as a group are powerful, they are able to define workplace culture in a strongly male-identified way, and women's careers suffer. However, where engineers hold less power, the culture is less male-identified and women do well. The concept of workplace culture forms the analytic heart of our model. It is the medium in which gender behaviors interact with opportunities created by organizational structure.

If the problems that women face in engineering are complex, so are the solutions. Our analysis suggests that if we are to improve the

status of women in engineering, we will have to attack it on many fronts. We call for changes in childhood socialization and education processes, in college curricula, in the structures of workplace and family, and in public policy. A tall order, indeed.

Yet changes like these are needed if more than a few women are to succeed in engineering. Unless women are widely and visibly succeeding in the field, there will be little incentive for others to follow their lead. That means that Bonnie's experiences as the only woman engineer in her group will continue to be typical. The woman in engineering will remain a token, always standing out and often falling behind, rather than becoming a routine and well-integrated part of the work group. Rather than a significant path of opportunity for large numbers of women, engineering will continue to be one of those "men's jobs," entered only by the most hardy—or foolhardy—of women.

Given the growth of jobs in engineering and the high pay it offers, whether and how well it accepts women into its ranks is an important social issue. Engineering holds the promise of offering significant career opportunities for large numbers of college-educated women, and thereby helping to improve women's status in the work force. Is that promise being fulfilled? This study represents one of the first major efforts to answer that question.

The experiences of Bonnie and her co-workers are significant in their own right, but they also tell us much about the process of entering nontraditional occupations more generally. By identifying factors that impede or facilitate success in engineering, we can better understand the experiences of women wherever they attempt to navigate the terrain of the male-dominated workplace. Understanding is the necessary foundation of constructive social change, and we hope this book contributes to both.