

## **"GOLD-COLLAR" PROFESSIONALS A NEW BREED FOR THE NEW CENTURY**

Sheila Tobias

Author, Consultant, Tucson, Arizona

WEPAN has much to be proud of in our ten years of activism. Women now constitute on average 20% of the engineering student body with a high of 48% at MIT, 30% at Caltech, and 32% of last year's entering class at University of Michigan. Thanks to the efforts of people like yourselves, they are achieving success in school; retention is as good or better than that of male students; and in time they will change the shape and complexion of the engineering work force. Women are slowly making their way onto the engineering faculties and to higher levels of administration. Only this year an African-American woman, Shirley Jackson, became president of RPI and many women are now in the deanships of engineering schools.

To be sure, residual problems exist: A recent report by the women faculty at MIT revealed widespread disparity in space allocations, promotion, and general support for women faculty compared with men. The women students at Caltech two years ago had to publish a "girls' guide to glomming" to prepare incoming freshmen women for some of the bizarre behaviors they still encounter from male undergraduates. And, while we have done much as feminists to counter myths about girls and math, girls and science, we still need to work on public acceptance of women in what have long been considered nontraditional occupations. But, in general, I would say, women engineers are now poised to take their rightful place in the engineering work force. The question I want to raise today is "Can they do even better than that?"

### **The End-Run Strategy**

We feminists have traditionally pursued a two-pronged strategy. We've worked, as you have, on the inside of the problem - how girls view themselves and how they cope with a male-dominated environment; and, at the same time, we have had to work on the outside of the problem: discrimination, sexual harassment, a "frigid climate" for women and girls, and low expectations of young women by employers and their own friends and family.

With today's increasing success rate of women in engineering, I believe the time has come to add a third strategy, one that I call (in an ironic application of a metaphor from football) the end-run strategy for success. We should be advising our engineering women to look not alone at the middle of the field, where those broad-

shouldered males are fighting each other for a little forward motion, but to break away and take the end run down to where everyone eventually is headed.

Well, where is everyone headed? And what kind of professional skills are going to be the most highly valued in the coming century? Can we make some predictions? And if so can we identify some optimum routes to travel? I think we can, and it is from some work I have been doing in recent years, that my title: "The Gold-Collar Professional" derives.

One would think that the pace of change, driven by the most rapidly evolving technology the world has ever known, coupled with globalization, and the new "flatter" mode of corporate organization, would make predicting future manpower needs impossible. Perhaps. But such flux could provide some real opportunities for women, precisely because women aren't (and never have been) where everyone else has been.

Let me put the blue-collar/white-collar/gold-collar metaphor in a historical context. Prior to the industrial revolution, only about 150 years ago, as many of you know well, America's economy was 90% farm-based. In economic terms, we were an "agrarian society." For farm work, life experience was more important than school learning. And, indeed, as late as 1910, only 10% of Americans graduated from high school. Industrialization changed all of that. By the end of the Second World War, in contrast to 90%, only 3% of our population was making a living primarily on the farm (including "agribusiness" the total was only 6%).

The bulk of working Americans as the last century became this one were involved in mining, manufacturing, and the transportation of goods. For that kind of work, the nation needed some mining, civil, and mechanical engineers, but in ever larger numbers what later came to be called "blue collar" workers. "Skilled" meant skilled with their hands. Those who were unskilled toiled with sheer physical strength. Just as they had no particular need for school-based education, they had no particular need to dress for work; hence the term "blue collar."

We know now that some women (particular African-American and immigrant women) worked outside the home, as teachers, as nurses, and office clerks, inside theirs and other people's homes growing and preserving food, taking in boarders, as household servants - but for the most part (exception: sewing work) women were excluded from the wage-earning provided by the industrial economy.

By 1925, the economy was expanding into some non-manufacturing areas, and so was education. In 1925, the nation graduated 50% of its 17 year old population from high school (compared to 10% in 1910), and colleges were slowly beginning to expand and diversify.

The reason? A new kind of working person was in demand: the white-collar worker.

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The white-collar worker, unlike the blue-collar worker worked with his head more than his hands, and was more specialized in engineering, accounting, marketing, advertizing, or law. Women were more welcome as white-collar workers than they had been as blue-collar workers because their skills were suddenly more in demand.

Since the white-collar working environment involved much more human interaction, ability to communicate and new styles of working (in teams and groups) emerged. Managing people became a skill set of its own, and "management science" was born.

### **The Technology Revolution**

We are engaged today in a change as wrenching as the shift from blue-collar to white-collar employment was 75 years ago. Today, the bulk of both the simple tasks that used to be done by blue-collar workers along with the complex tasks that used to be done by white-collar workers have been given over to what one computer analyst calls smarter and ever smarter machines. Our manufacturing sector has shrunk from about 35% of our nation's work force in 1947, to 18.5% in 1988, and 15% today. Four hundred thousand manufacturing jobs were lost last year alone in the United State at the same time that manufacturing production increased, by 7 percent.

And no wonder. "Hard" technology innovations, have speeded up production by means of computer-driven machinery. "Soft" technology innovations have altered the way people, equipment, and materials are organized and managed. Thus, both the blue-collar worker and the older kind of white-collar worker are in decline. "Tomorrow's workers," says I. MacAllister Booth, chairman and CEO of the Polaroid company, "have to be both comfortable with technology and inquisitive about it."<sup>1</sup>

That's the good news for the engineering women that your universities are sending out into the work force. They are comfortable with technology and inquisitive about it. The "bad news" to continue to quote Booth, is that in the future "no one will be able to hide behind a single specialization." People who do will be left behind. Why? Booth explains: "While specialists will continue to be vital to a business, the inherent danger of specialization is isolation." "We need," says Booth, "to find ways for specialists in one area to understand, help, and work with specialists in other disciplines. What we need most are: people who can act as catalysts (that is, energizers) to focus and harmonize all the creative forces within an organization."

For Booth and many other CEO's addressing future manpower needs, a new type of professional is being called for. Not necessarily interdisciplinary in his or her core training, but people with a capacity to interface with other specialists. Some are calling for a "double specialization;" others name this new hybrid, the "science-trained" or "gold-collar professional."<sup>2</sup> Booth's point is this: Technology is not only meeting old needs; it is providing new possibilities that only those with a background

in technology can appreciate, but those with only a background in technology may not be able to realize. The engineer who is capable of interacting with other professionals, in the "borderlands" between specializations, is the one who will end run the crowd.

### **Let's talk about Broadening**

Some years ago, a young friend of mine went to work for a group of doctors as a computer engineer. His first task was to rationalize the doctors' payroll and accounting systems. He was confident that he could learn the rudiments of accounting, which he promptly did. But then his doctors decided their computers could help with off-site diagnostics. And my friend had to learn more about medicine than he ever thought he would. That's just one example.

Chemical products used to be produced by chemical engineers. Today, the manufacturer of choice is a bacterium, sometimes genetically engineered to do a particular "job." Chemical engineers who aren't familiar with molecular biology and genetic engineering, or with P-1-, P-2, and P-3 clean-room requirements, may find themselves replaced by chemical engineers who are. That's another example. Regulatory affairs, to take a farther-out example (whether involving OSHA, EPA, or FDA) has become so important to industry that many more management professionals, including engineers, are having to understand the workings of government agencies; not just political science majors.

How can we provide our engineering students -- especially our women students -- with additional exposure to the Borderlands without adding to an already overcrowded curriculum? How can we get them to pay attention: to medicine and health care, to intellectual property rights, to transportation policy, to marketing and finance, as well as to regulatory affairs? If we can get our women students to understand that broadening will increase their ability to work with other specialists, we can start them on their end run around the crowd.

One way is to stock your resource rooms with more than just the standard engineering journals and news about the standard graduate programs. Material on patents, on tech transfer, the daily Wall St. Journal, even the Harvard Business Review - all provide exposure to the "Borderlands." For post-graduate study, the engineer has some new options you should know about. M.S. programs in engineering and law, engineering and management, and engineering and the life sciences are rapidly coming on line. These are designed precisely for science/mathematics/ and engineering majors who have a solid technical background but not yet enough breadth and capacity to interface. The Keck Institute is in some ways typical.

Keck is a brand new graduate school, designed to produce mainly Master's students. The Institute will be enrolling 50% engineers, 50% life-science majors in Claremont California in the next few years. Two new M.S. professional degree programs in

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bioinformatics, one at Georgia Tech, one at USC in Los Angeles, want to do the same for engineering, mathematics, and/or life science majors who have an interest in biotech.

"Computational Sciences," "Physics with Business Applications," "Environmental Monitoring," "Human-Computer Interaction," "Tech Management," and "Financial Mathematics," are the subjects of new M.S. degree programs I am working with, funded by the Alfred P. Sloan Foundation, that didn't exist 5 years ago.

The point is not to pile on still more content on our undergraduates. Our engineering women have enough to master in four short years. But to use whatever influence we have to whet their appetite for breadth, and therewith to start our women students on the end-run strategy that will put them ahead of the crowd.

There is evidence that women engineering students, more even than men are ready for these kinds of challenges. At the University of Rhode Island's Engineering School, an enterprising German-born faculty affiliate created a new five-year engineering program a few years ago, featuring German language and German culture as a minor. But not the usual German language linked with literature; and not the usual German culture, with a capital C. Rather, students at URI who opt for the program, study the German economy and manufacturing; they learn to read newspapers and technical material; they travel to Germany for one semester for an on-the-job internship and to build their fluency. All the while preparing themselves for work in an American company that has or wants to go global.

And this will interest you: While only about 24% of URI's engineering students are female, fully half of the enrollees in the new five-year language-intensive program are women. The program has become so popular, a "French Option" has been added to it.

Why are women engineering students so avid? My interview of the program director went something like this: "Our women are broader," she said, "less language phobic, than our men. They are intellectually adventuresome, interested in and willing to travel. Engineering has socialized them to think of these traits as detractors; but in fact they are the foundation of emerging careers."<sup>3</sup>

### **Problem Posing vs. Problem Solving**

Engineers tend to be expert at solving problems, problems that are largely technical in nature. But in tomorrow's technical environment, we are told, it will not be enough to take a problem as given and solve it. Tomorrow's engineer will be expected to ask the more profound question: "Why is this a problem anyway?" "Is there a way to redesign or reorder the activities in this enterprise to avoid this problem altogether?"

Related to a too-narrow definition of problem-solving is another engineering habit

of mind. Engineers are primed, through their course work and above all their exams, to focus on getting the "right answer." But in tomorrow's working environment, we are told, there will be multiple teams working on the same question. The engineer's ability to figure out why two or more teams, starting from the same premises disagree may be a bigger asset than simply getting the "right answer" herself. Our engineers will need: exposure to multiple interpretations of texts and events; how to weigh evidence, to consider alternatives, to be intellectually flexible.

### **Team Work**

Engineering is better than most fields in incorporating team learning into the curriculum. Many courses promote collaboration as students work together on design projects. And we know they study in groups. But when it comes to exams, in many cases we have asked students to show us only what they can do individually, under time pressure, and at their own seats. In the world they will be entering, however, team work with its requirement of cooperation and constructive thinking together will be the norm. Even in manufacturing, a new organizational concept that of the "cell," has replaced the old assembly line. "Modular production" involving teams of multi-specializations is becoming the norm, just as a network of "business units" is replacing the old management hierarchy.

Engineers who manage such teams will have to have different skills and understanding of the work than previous time management models (Taylorism, and Ford's assembly line) addressed. Indeed, management is changing so rapidly both because of the information revolution and because of modularism, that McKinsey and Company, a consulting firm, that used to hire predominantly MBA's to work with its varied clients today seeks people with some mathematics, science, and engineering backgrounds, willing to learn new skills, instead.

### **Preparing for an Uncertain Future**

Not all these new skills and knowledge-expansion need to take place in formal courses. Tomorrow's professionals will be able to access much of what they need to know by way of distance learning. And reading beyond their immediate professional interests will never go out of style.

One day, the women engineers you are advising now, may find themselves having to study some law, finance, or marketing to give them greater access to the "Borderlands." Or, to fill some gaps, it might be something even farther afield from engineering, like "organization theory," communications, or psychology. When that happens, they will be grateful that you whetted their appetite and their potential for breadth.

You have done a great job. Let's press on and see if we can't do even more for women engineers, help them color their collars gold.

## REFERENCES

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2. Sheila Tobias and Frans Birrer: "The Science-Trained Professional: A New Breed for the New Century," Industry and Higher Education (London, Eng.) August 1998, 213-216.
3. Personal communication from Doris Kirchner, URI engineering, to the author.

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