

21st Century Engineers will be Independent Learning Professionals with Strategic Career Planning Skills

Vern R. Johnson

This paper contains an analysis of changes that have occurred in engineering employment during the recent past and a prediction of the future. It is included to indicate the exciting dynamics of careers in engineering and other technical fields, and to outline the career skills that need to be developed to assure participation in the excitement of the future.

Engineering products and services are sold competitively and must be of high quality or they cannot compete with other products in what is now a global marketplace. This competition demands that they are better, that they arrive at the marketplace faster, and that they are cheaper than competitive products. To succeed competing companies constantly reengineer manufacturing processes to deliver their products and services better, faster, and cheaper than in the past. By removing all elements of processes that don't add value to the customer, improvements result in product quality, process time, and cost. Good process reengineering efforts improve all three of the ingredients of a competitive product and corporations are foolish, at least in the short term, if they don't invest in them. To do otherwise invites competitive disaster. The problem is that as they do it, and companies are doing it all over the world, their employees lose career stability. As soon as employees' skills are out of date so they can no longer design products that compete with the best there is anywhere in the world, as soon as they can't justify that they are adding value to their customers all day every day, or as soon as their salary is higher than someone else with comparable skills, anywhere in the world, they no longer meet the reengineering criteria and their jobs become vulnerable. The corporate downsizing activities of the past decade have repeatedly demonstrated this phenomenon.

As existing technologies become obsolete and are replaced by new ones, employees' skills can be updated through retraining. At least that is true for those who prepared themselves with good educations in the fundamentals upon which the new technologies are founded. In the past, employees assumed that it was the responsibility of the corporation to determine what training

they needed and to provide it, or at least most of it, for them. But corporations have learned that it is more efficient to hire new employees with the needed skills than to train their present employees. Thus rather than retrain employees, many employers consider them to be unproductive and lay them off. There are several compelling reasons for corporations to take the position that they will hire new workers rather than retrain present employees:

First, most employees know that their employers do not offer stable lifetime employment and surveys show that if they have a chance to leave for a marginally better job, they do it. In fact, when asked⁸, "All other things being equal, would you leave your current organization for another place of employment to have more opportunity for advancement?" 53% of U.S. workers said yes. In addition, 42% said they would make such a move for a 10% increase in salary, and 37% would do it for more flexible work hours at the same salary. The result is that corporations know that if they pay to retrain employees, those same employees may take their training elsewhere. The companies they compete with may gain from their investment, but there is a good chance that they will not gain from it. Companies will not invest in training people if there is not a high probability those people will use that training for the company's benefit.

Second, it is older employees with higher salaries who generally need retraining, and often there are younger people with lower salaries who already have the skills. At least, if younger employees need training they will do the work at a lower cost after the training is completed. It has been found that older employees offer some distinct advantages⁹: they have more experience, better judgment, a greater commitment to quality, come to work on time more often, and are less likely to quit. But younger workers, those under 50, are more flexible, more accepting of new technology, and better at learning new skills. As one human resources manager put it⁹, "The attitude is, Why not hire someone

who's young and idealistic and will work 80 hours a week?"

Third, the corporation probably doesn't know what new skills its workers will need in the future. The needed skills will be determined as the company prepares future marketing plans, but by then the workers will need the skills and there is no time to develop them. This is especially true in a global competition where it is imperative to beat other competitors to the marketplace. Rather than retrain existing employees in all the technologies that might be needed, it is easier and faster to determine which technologies will be needed for the next product line and hire people who have been perceptive enough to have developed those skills on their own. The problem for employees is that they have far less information than the corporation about which skills to develop for tomorrow's marketplace. They are not trained with the forecasting skills that are needed to strategize for their own educational investments.

The overall result of these three phenomena is that American industry desires a free ride with regard to employee training. Employers have found that in a business sense they are better off if they adopt the operational philosophy that was so well stated by Lester Thurow¹⁰, "You train, I'll hire."

The four paradigms of engineering careers

The above are not new phenomena. They merely represent the current phase of a process that has been developing over a number of years. During the last half-century at least four different U.S. engineering career paradigms have existed. These four paradigms can be described as the 'corporate engineer,' the 'learning engineer,' the 'contract engineer,' and the 'skilled/global engineer.' As each career paradigm appeared on the scene it could be characterized as requiring more independence than its predecessor. The new paradigms didn't replace the others, but they usually made at least minor modifications to their predecessors and a sizeable part of the engineering workforce could be described by the characteristics of the new paradigm. There are now engineers of each of the four career types, but the fourth is growing and has a significant impact on most career searches.

Some aspects of these four phases are described below.

The corporate engineer

The corporate engineer of the '50s and '60s, and maybe before that, planned on a lifelong career with a single company. This engineer went to college and then enjoyed a career based mostly on the mission and values of a single employer. He/she had access to an understandable career ladder with the company and ample personal health and other benefits as well as a retirement plan. The technology upon which the company was based changed slowly over the engineer's career. Quality as it is known today was not questioned. Products were engineered with a focus on performance and the company sold what it produced best to customers who had learned to accept what was available as the best that could be delivered. Since companies expected their engineers to stay with them throughout their careers, they invested in their employees' success. Stock options were often available to employees and training was provided when it was needed to maintain each engineer's value to the company and to assure profitability.

The learning engineer

During the '70s things changed as new technologies were created faster and engineers learned that they had to participate in some form of continuing education to maintain employment when the technology they depended on, and thus the skills they needed, changed. As old technologies were phased out, and new ones adopted, engineers sometimes found that they needed to change employers to advance their careers. Also, the number of layoffs increased as employers found that they no longer needed the skills of some of their present engineers. Based on the movement of engineers from one employer to another, it appeared that the average engineer could plan on working for several, maybe 4-7, different employers during his/her career. In geographic areas where many engineering employers were located in relative close proximity, it was common practice for engineers who possessed currently needed skills to build their salaries by jumping from employer to employer with a 10% raise in pay each time. The result was that the concept of an engineering career changed from one of continued employment with a single employer, to a career

with continued employment in a specific field of engineering. Engineers could be described as learning professionals because of their need to continuously learn about the new technologies, and the concept of a career plan emerged to assist them during their transitions through multiple employers. At the same time, professional societies were lobbying the government to create portable pensions and individual retirement accounts for these relatively mobile engineers to compensate for their loss of a single employer sponsored pension plan, and maybe even their loss of retirement funds entirely because they did not work for a single employer long enough to become vested in its pension plan.

The contract engineer

In the late '80s or the early '90s the concept of the contract engineer made an appearance on the scene. Unemployed engineers often found work as consultants for companies who were willing to buy their services. Since they were searching for jobs and didn't want to tell prospective employers that they were unemployed, even those who were not hired as consultants purchased business cards with the title of consulting engineer on them. On employment applications they then listed their current employment as that of a consultant. Sometimes rather than being offered consulting jobs they were offered temporary employment contracts with an employer. Because these engineers moved from company to company working on temporary contracts, some started to refer to themselves as nomadic engineers. Then, after a relatively short time most of them realized that they really were not nomads because they were not moving randomly around the country. They were rotating among a finite set of what were often local employers. They could stay in their engineering specialty while the engineers who were employed by a single employer had to retrain in the new technological areas needed by their employers, or be moved to other plant sites of the employer where their present skills were still valued. For many, being a contract engineer offered a degree of local and technological permanence. They didn't need to sell their expensive homes and they focused their continued learning on their own competencies and interests.

But, there was a down side; there was no need for employers to train contract engineers because

they could be replaced at the end of the contract with engineers who already had the new skills they needed. Thus contract engineers, who were still learning professionals, had to learn how to learn by themselves. They had to become responsible for their own careers because there was no career ladder for them to follow, and they had to be ever conscious of the need to add value at a higher rate than their contracted salary. In addition, they needed to earn high enough salaries during their contracts to provide for their own personal health and retirement needs and to cover their loss of income between contracts. Some did all these things on their own, while others banded together under the management of contracting firms to broker their services and coordinate their benefits and retirement plans.

Did employers like contract engineers? Absolutely. This form of outsourcing employment allowed employers to hire the skills they needed when they were needed without long-term commitment, continuing education expenses, costly employee benefits, or termination expenses. When the contract engineers left their employment there was no reputation-damaging headline in the newspaper saying that the company had just laid off a bunch of employees. Contracting employers could keep a limited number of regular engineers to assure leadership and continuity for the company, but offer contracts to the rest.

The skilled/global engineer

The situation that existed when the 21st century began can be considered an extension of the contract engineer, but there are significant differences.

Many employers choose to hire skills rather than people. This suggests the value of hiring on a contract rather than hiring as a regular employee. But as the 21st century began, a record-setting economic boom was being experienced in the U.S. and the number of prospective employees with a given skill set was often low, especially in contemporary technological fields. Thus in many fields there was an emphasis on hiring engineers as regular employees rather than on contracts. This does not; however, mean permanent employment for every new engineer hired. Professionals who practice in a rapidly changing technological field are also in rapidly changing careers. It used to take many years, maybe a career, for a worker's skills to decrease

in value to where that person could no longer use them to earn a livelihood. Now, as new technologies rapidly replace old ones, this often happens in only a few years.

Marketplace competition is now so keen that companies can't retain old product lines that cease to grow when there are exciting new technologies waiting to be exploited. And changing technology doesn't just mean new products, it also means new ways of doing business and it can substantially impact those in the workforce whose skills produce the products. Movement to the world wide web as a marketing media is just one example of a change in the business environment that is being accompanied by layoffs of sales and other personnel to enable the hiring of needed but expensive information technology workers to implement the new sales paradigm.

Both new products and new business techniques mean there is a need for new skills. Very expensive new skills are needed to match the more complex and technological environment in which employees must work. The spiraling salaries that result are accompanied by the expectation that these new employees will deliver exactly what their employers need. They also give employers a degree of justification for laying off these employees as soon as their high priced skills are out of date or otherwise devalued.

Layoffs have become a management tool. In fact, economists now refer to 'churning' as the act of hiring employees with one set of job skills while the same employer is firing those with another set of skills. Churning has become so pronounced that according to the Wall Street Journal¹¹, during the record-setting economic boom that existed in 1999 U.S. companies announced 675,000 layoffs. This was up over 600 percent from 111,285 only a decade earlier in 1989. Many of these layoffs occurred in growing companies.

Not only is there an increasing focus on technical skills, but engineers in the new paradigm are facing a more global workplace. Engineering products and services have been moving into the global marketplace for many years, but never has the resulting competition for market share been more acute. While Pacific Rim manufacturers dominated some markets a few years ago, many U.S. firms have reestablished themselves as

global leaders. But the Pacific Rim manufacturers are still present as capable producers of quality goods and services and the European common market is trying to form itself into a formidable competitor. China looms unknown as a competitor, but it is certainly a future marketplace. No matter which countries are involved, there will be increasing levels of competition in the world markets of the 21st century. In the future consumers will be able to ignore any product or service that is not of world-class quality.

But, there is more going on. The leading U.S. corporations of a decade or so ago are now almost all global corporations. They may have their headquarters in the U.S., but many have more employees outside the country than within. At the same time, many of those Pacific Rim and European corporations of the past have plants in the U.S. and though they may be managed outside the country, they employ U.S. citizens. In other cases U.S. and foreign corporations have merged so that there is no way of determining if they are domestic or foreign firms. They are both and they are neither. They are global firms.

There are several reasons for companies to become global rather than national corporations. The marketplace for their products has been mentioned, but there is at least one other reason. Strong competition demands the best possible employee skills and the lowest possible employee costs. And these characteristics are demanded now, without delay, to get products to market before competitors. There is no time for training employees. To succeed, companies need to identify low cost skilled labor, or at least low cost trainable labor, for every possible work function. A large part of the reason many corporations have globalized is to find skilled labor and the lowest possible labor costs.

The whole concept of 'off shore' manufacturing came into being for this reason. Since workers in the U.S. wouldn't work for low enough wages the companies moved their facilities off shore to locations where cheap labor existed. If some training was needed, so be it because once they were trained employees worked for relatively low wages. In many locations there are well-trained engineers and skilled technicians who live in poor economies and are willing to work for salaries much lower than their U.S. counterparts.

The other way employers find the low cost skilled labor needed is to import skilled workers from the same countries where off shore facilities had been previously established. Immigration laws place limits on this activity, but there is governmental sympathy for increases in the immigration of needed, but unavailable, skilled workers. Theoretically these are temporary workers, sometimes referred to as guest workers, but that is fine because the companies only want them for relatively short contracts. If the immigrant workers are needed for extended time periods, that can be justified later when the need is more apparent. Also, since these are temporary employees from countries with relatively poor economies, they do not demand the expensive employment benefits and retirement plans of their U.S. counterparts. The current H-1B immigration program focuses on these employees and was created by powerful corporations lobbying the government with descriptions of needed skills that are not presently available, at least not available immediately and at the price the corporations are willing to pay. The H-1B program, titled the American Competitiveness and Workforce Improvement Act, was approved at the end of 1998 and almost doubled the immigration caps set for skilled technical workers while not affecting unskilled workers. There have been constant successful efforts to increase the caps agreed upon when the H-1B Act was first enacted.

Conclusion: 21st century engineers will be independent learning professionals with strategic career planning skills

Over the past half-century engineers have migrated from being working professionals with structured careers focused on corporate success, to being independent learning professionals with flexible entrepreneurial career plans. Though this migration may seem detrimental to engineering careers, this conclusion need not be true. Many engineers were not ready for the career changes that happened to them, nor were they trained in the skills needed to cope with these changes, but change is always present in all career fields. The position in which engineers find themselves is similar to that of many other professions and it is far from hopeless. For example, doctors, lawyers, accountants, and piano teachers work for clients who come to them and contract for their services. What is more, the clients of these professionals may only

want their services for a fraction of an hour rather than a fraction of a year, or a few years, like contract engineers plan on and many skilled/global engineers experience. It was the industrial revolution that provided structured engineering employment with companies in the first place. Technical workers didn't have career ladders or employers before the industrial revolution and many independent entrepreneurial workers still don't.

There are ample numbers of good jobs with good pay for technically vital engineers who have valued skills and are flexible enough to adapt. The future is changing and engineers are well founded in the basic sciences that support the technologies that will be created in the future, thus they are capable of the needed flexibility. Educational support is becoming more and more available where and when it is needed. The government does pay for the largest share of public college education, they did help to develop portable pensions and individual retirement accounts, and they are interested in finding ways to support the continued learning of engineers in dynamic technologies. There is a bright future; some engineers are merely experiencing career paradigm shifts and need to adapt to the new realities.

In the past engineers could work as corporation engineers in isolation of what other corporations were doing; then they could work as learning engineers in isolation of what was happening on the national scene; as contract engineers they needed to become aware of what was happening nationally; but the new skilled/global engineers must keep track of what is happening in the global market to determine gaps in their knowledge, skills, and attitudes so they will know where to focus their learning. They must become experts with career development so they can strategically plan their employment and learning activities, and they must learn how to learn so they can fill their learning gaps.

What learning modules can be developed to help engineers who must move into the new paradigm?

1. A career planning module that helps people:
 - determine their core competencies and gaps
 - develop skills or procedures for forecasting technological shifts

- create plans to exploit their competencies and determine the gaps in which to invest training resources
 - create plans for developing the skills needed to continuously learn
 - assess their career vitality, flexibility, intellectual maturity, circle of influence and then recommend how they can move to higher levels
 - maintain a journal of their personal strategic plans and their career and technology ideas, a portfolio of their successful accomplishments, and a resume outlining their competencies and experiences
2. A module to help them develop career skills:
 - resume writing
 - job search
 - project management
 - learning to learn
 - maturity
 - flexibility
 - finding the resources needed to support training opportunities
 3. A module for retirement planning and preparation:
 - the value of investing in a retirement fund
 - the future value of money in inflation and deflation worlds
 - health care after retirement
 - working with pensions
 - investing the retirement fund
 4. A module dedicated to workers who can no longer make a living with their present skills. Career growth can only come from continuous improvement of an existing career or from innovation. If continuous improvement can't yield the desired results (it is hopeless), innovation is necessary. Thus the needed module consists of:
 - understanding that the present career situation is hopeless and change is necessary
 - determining what must be changed
 - learning how to change and where to find the needed resources
 - creating a plan for change
 - implementing the plan while surviving in the present situation

Individuals and the government are already partners in financing the present college education system that is accepted as a necessary step into productive adult life. No company is going to pay for a student's college education because companies can't commit the student to long enough employment contracts to assure a return on their investment. There is no control over which company will reap the benefit from the education of any individual student, so while a few scholarships are available, no company will pay the price for that student's education. The student's learning will benefit some company, and increase the wealth of the country as a whole, so there is a governmental interest in college education. Because of this interest, at public universities student tuition is substantially subsidized. Tuition covers only about 20% of the cost, and government agencies cover the rest. At private universities the government invests an equivalent amount through student financial aid.

It seems reasonable to seek a similar partnership between the government and individuals to create and maintain training modules like those described above. Lester Thurow³ noted that in the new career paradigm there is a need for governmental support of employee training. The professional societies, as representatives of their members, lobbied the government successfully for support of portable pensions and IRAs. These same societies should now consider lobbying governmental agencies for retraining and educational support for those engineers who need to transition to new technologies. This will support the career development plans of their members and the country's technological needs. This support will be an investment in U.S. economic strength as well as protection of a valuable group of educated citizens.

1. J. Buxton, P. Hessler, and C. Schaffer, "Capitalizing on the International Workplace Revolution," a report of Gemini Consulting, a Cap Gemini Group Company, www.gemcon.com
2. N. Munk, "Finished at Forty," *Fortune*, pp. 50-66, February 1, 1999.
3. L. Thurow, "Building Wealth: the New Rules for Individuals, Companies, and Nations," *The Atlantic Monthly*, pp. 57-69, June, 1999.
4. P. Barta, "Firms Face Myriad Pressures to 'Churn' Employees as They Upgrade Job Skills," *Wall Street Journal*, March 13, 2000.