

Education and Careers 2000

Enhanced Skills for Engineers

I. INTRODUCTION

What separates “high-potential” engineers, who rapidly rise within their organizations to positions of great prominence and leadership, from those who do not advance? Why are some engineers capable of transforming their technical knowledge and experience into successful entrepreneurial ventures, while others fall short of this financially rewarding accomplishment? Or, as a dedicated individual contributor, what will best prepare you as your organization embarks on the widely dreaded “restructuring,” “downsizing,” or “right-sizing” exercise? Answers to these questions indicate that highly successful professional engineers are not only technically astute, but also often possess some of the “extra” or “soft” skills that many experts believe are necessary for engineers and scientists to increasingly embrace as we move forward in the 21st century. The critical question is: What added value do you bring to the organization beyond the technical skills, experience, and knowledge that you possess?

Ideas presented in this article are based on interviews with various industry executives and managers, and industry-savvy government leaders, as well as academic leaders—from both the United States and around the world, including Europe, South America, Central America, Australia, and New Zealand. These interviews were conducted during the three-year period 1997 through 1999. While it should be noted that local opinions did sometimes vary due to cultural differences and other factors, nevertheless the consensus results indicate that engineers and scientists—both young and experienced—should understand the career enhancing value of the soft skills in order to progress in today’s global “open market” economy.

This paper does not teach these skills, but merely discusses the importance of developing them through educational and other professional enrichment activities. It is expected that these skills, as defined by industry leaders, will be required for the members of the global workforce of the 21st century. This will also be an era in which the responsibility for career development is no longer the duty of the organization, but rather that of the individual engineer.

Publisher Item Identifier S 0018-9219(00)08095-6.

II. TEAM PLAYERS WIN!

As members of the engineering profession, our formal technical educations may have reinforced the general idea that we must be “goal-oriented,” that we must focus on the particular design or project at hand, and recognition and success will surely follow. (And this basic idea of dedication to the task at hand remains extremely important.) This concept of being focused on a particular task has evolved from the idea that engineers are “technical gurus” who can find and provide a creative answer to all problems as long as they devote 100% of their talents to finding the solution. Sometimes this approach left very little time for interdepartmental social niceties, or for playing “departmental politics” that seemed to distract us from our “real” engineering duties. However, we must strive to overcome this limiting mindset if we, as engineers, are to thrive and succeed.

Contemporary engineers can no longer afford to merely play the role of the isolated innovator working in their particular specialty, without consideration of the big picture and the changing employment realities around them. In our present matrixed work environment (and undoubtedly more so in the future), engineering and personal performance is being judged on the additional personal skills that you bring to the table—and that you practice daily within your organization. During the past three IEEE Sections Congresses, attendees have indicated a high priority for IEEE to try to improve the IEEE relationship with industry; in other words, to ascertain what IEEE might do to assist industry and their employees, and vice versa. Industry has requested the IEEE’s assistance in getting the message out to both undergraduates and academia with regard to this subject.

We define these added values as soft or extra skills, and they can cover many diverse areas—from the ability to work easily and cooperatively with others on corporate teams and assignments, to the ability to communicate your ideas, suggestions, and innovations to others, to understanding the basics of business finance—all for the mutual success of your organization.

We will take a look at some of these skills, attempt to help you understand their value, and try to encourage you to obtain—or improve—these skills, in order to make you a more valued asset to yourself and to your organization in our increasingly competitive global work environment.

III. CORPORATE EXPECTATIONS

Participants in our survey understand that everyone carries certain baseline components of these soft skills as we enter and progress along our career paths. Some individuals are more proficient in one—or several—of the skills, but lack competence and confidence in the others. And vice versa.

During our discussions and explorations with industry executives and managers regarding the characteristics and skills they felt would be required of the engineers and scientists of the 21st century, we found that they fell into three groups:

- 1) basic fundamental technically related skills expected in all engineers;
- 2) extra or soft skills—important to develop and maintain;
- 3) other, perhaps more personal, characteristics deemed to be necessary for continued organizational as well as personal success.

IV. FUNDAMENTAL ENGINEERING SKILLS

The basic, or normally expected, characteristics of graduate engineers, as defined by the executives and managers interviewed, included the following four expectations.

- 1) *Solid Technical Education*: Obviously, the managers felt that most of the engineers employed—even those with only an undergraduate degree—had the basic technical background and education required for the company's objectives when they arrived at the organization. Therefore, the new employees were able to easily absorb the additional technical expertise required to easily assimilate the unique aspects of the organization's procedures, systems, products, customer requirements, and objectives.
- 2) *Logical Thought Process*: Young graduates who have studied engineering and the sciences traditionally exhibit a good, logical thought process. Those interviewed mentioned this as a good existing characteristic found in most of the young graduate engineers and scientists hired into their organization. In the views of the executives, the problem solving required of a student in the engineering and scientific technical courses was probably the key catalyst to aiding in the development of this important characteristic. As with the other, somewhat personal traits, the level of competence in this one varies from individual to individual.
- 3) *Good Work Ethics*: The consensus of those interviewed was that the graduate engineers hired into their companies carry good work ethics. Whether developed in the students through their participation in the intensive study required in the various engineering curricula or a characteristic prevalent in the persons that select the engineering curriculum, those interviewed felt that this was a common feature of the young engineers.
- 4) *Computer Literacy*: Executives and management, as well as all engineers, know that computer workstations

“rule” and all engineers around the world should exhibit a superior level of computer literacy that includes solid knowledge of current, applications-oriented software.

V. SOFT SKILLS EMPHASIS

While the executives interviewed were, in general, very pleased that the basic skills were indeed present in their engineering communities, they stressed that many of the soft skills were lacking in most of the graduate engineers. Therefore, they urged us to take the message to both the students and to academia of the need for these extra skills for the engineers and scientists entering the technical workforce. They stressed that they were not requiring an MBA in marketing or finance, but that they were hopeful that these extra skills could be emphasized, taught, and practiced in the undergraduate engineering curricula. The message from industry leaders is that young graduate engineers arriving at their companies do not possess these skills in either the quality or quantity required. These extra skills include written and oral communications aptitude, marketing-related knowledge, and familiarity with business and financial matters.

A. Communications—Oral and Written

Most individuals graduating from a university feel relatively confident in their communications skills—both oral and written. While it is true that some have perfected these skills to a point where they are accomplished communicators, those really proficient individuals are still in the minority.

Regarding written communications, comments received indicate that executives desire written communications that are clear and concise but also comprehensive. Specifically, written communications should cover all of the aspects of a particular subject beginning with a clearly defined statement of purpose. Each communication should include a concise statement of what, where, why, when, etc., and a final summary statement to review the content and conclusions. Emphasis should always be on content and quality. Those interviewed suggested that an increased academic emphasis—or requirement—be placed on the development of clear and concise reports in courses for both undergraduate and graduate engineers.

Oral communication is also very important, but sometimes this particular skill seems rather abstract and perhaps somewhat more difficult to refine. Many of us simply recoil at the prospect of delivering an oral presentation, but presentations are a recurring responsibility of our profession, and improvements in our presentation and delivery style will enrich our careers. But how can you develop this seemingly elusive skill?

Have you ever taped one of your presentations done in front of an audience, either via audio or video? This is one of the most telling—and individually deflating—personal evaluations to experience. How was your overall presentation? How was your diction? How was your speed? How was your

emphasis? How did you present yourself during the presentation (including posture, eye contact, poise, and body language)? In summary, executives want individuals trained in and capable of good oral presentations for a wide variety of activities.

B. Marketing

Some engineers are interested solely in design or R&D work or other engineering activity and, therefore, they may think that marketing is a subject of little or no interest to them. However, in both commercial as well as in academic organizations, some aspect of the marketing process is utilized to secure new business contracts, research grants, or other types of project funding. The managers interviewed stated that all of the engineers in their employ should undergo some marketing training. They state that marketing training should be part of the basic engineering curricula.

C. Understanding Business Finance

This was another interesting extra skill desired/expected of the engineers and scientists of the 21st century. The managers interviewed were not expecting an accounting or financial expert. However, they were expecting the engineer to have the ability to understand a corporate balance sheet and financial report. They also were expecting their engineers to understand—and undoubtedly participate in—the budgeting, forecasting, and financial analysis performance of the engineer's unit of the organization. The managers believe that the better the understanding and appreciation of business finance, including business plan development, the more effective and productive their engineers will become.

D. Higher Level Traits

There were several other characteristics that were mentioned as desirable in order for an engineer to maintain a premium organizational value versus their peers. We will group these into two categories:

- 1) corporate necessities;
- 2) personal attributes.

Today, corporate necessities consist of having a global perspective, being a “team player,” and having sufficient professional depth and versatility to provide a “multiplexing” capability.

In the past, many engineers preferred to take individual responsibility for the development of a particular product or system. Sure, they had to be concerned with system interfaces and how their system or subsystem functioned within the overall project. However, today things have become slightly more complicated, and corporations are interested in individuals exhibiting the capability to operate as a “team player”—someone who many corporations exclaim makes more efficient and effective contributions to the organization. In today’s global “open-market” economy, many multinational companies are forming product and system teams which are truly global, utilizing the particular expertise offered by their personnel in various units (sometimes referred to as skill centers) around the world. As these

products and systems are being developed and marketed, the companies must ensure that the many international cultures and conditions are recognized—thus the need for the “global perspective.”

With the “downsizing” or “right-sizing” of companies, which has been prevalent in industry over most of the past decade, engineers are being required to accept a much heavier workload, and also to accept a larger variety of job challenges. Thus, they are being required to develop additional flexibility and a basic “multiplexing” capability. Today’s engineers and scientists must have good work ethics, be more flexible, be readily able to “multiplex,” and have a much broader understanding of all aspects of the organization.

The corporate executives agreed that these corporate necessities (having a global perspective, being a “team player,” and having a “multiplexing” capability) were characteristics that could be, and should be, emphasized in the engineering courses. “Team” activities are certainly practiced in technical laboratory classes around the world. Even if it were not possible to teach these corporate values, the managers stated that the young engineers should be given the message that these are desirable attributes to assemble as they prepare to enter the workforce of the future.

The personal attributes managers are seeking, which are much more difficult to define and quantify, include dedication, persistence, and assertiveness. “Dedication” basically speaks for itself, but to what? And to whom? When this word was utilized, we asked if they were referring to retention. That is, having someone dedicated to stay with the corporation. While some industry executives would like to go back to the “old days” when engineers stayed with one company for their working lifetime, they recognize that in the new era of “right-sizing,” and of corporate mergers, requesting this type of dedication was unrealistic. Industry is attempting to provide superior benefits and other perks to encourage engineering workforce stability. The “dedication” to which they were referring is to the individual’s assignment at hand (which, as mentioned earlier, many practicing engineers readily accept as a duty of the profession). That is, maintaining the discipline to accomplish the basic job, while including an additional 10% in time allotted for planning activities, hopefully also improving productivity.

“Persistence” is developing an approach that accomplishes the defined task in the allotted time, regardless of the technical, logistical, organizational, or personal hurdles that appear. Just as with the subject of work ethics, this is normally an inherent quality, and not one built by training and/or reminders.

“Assertiveness” undoubtedly falls into the same category as persistence, in that it is normally an inherent quality. In this case, the executives noted that they were merely trying to ensure that the young engineers approach challenges positively. They seemed to feel that this was not a trait normally found in young engineers and scientists.

So there are the several additional characteristics which the executives and managers indicated they would like to see in their new employees. While the corporate necessities iden-

tified could be items that training and practice would elevate, the personal attributes are items that are either in the individual engineer to some variable extent or not. However, progress can always be achieved. The important concept is that, as individuals, we should remember the importance of these skills and work to improve these highly regarded traits wherever possible.

VI. REAL -LIFE EXAMPLE

Some of you are probably thinking that this idea of developing soft skills is a nice idea on paper, but what happens in reality, in the everyday work world? An example of the importance of these soft skills became apparent during discussions with a high-level management team from a midwestern U.S. utility. Although originally scheduled to interview and have discussions with the CEO and two senior vice-presidents, we found that they were unable to meet with us due to important merger negotiations. In their place, we met with the manager of operations and the human relations director.

After discussions on several subjects of mutual interest, we moved to the subject of the characteristics and skills that their company expected from the engineers of the 21st century. As part of this discussion, we reviewed the list of extra skills and characteristics that we had derived from the consensus of managers and executives interviewed up until that time.

The human relations director commented that their company agreed fully with the items/skills that we had listed. In fact, she pointed out that these were the very criteria being utilized in the retention matrixes to determine which of their present employees would be retained as part of the new post-merger organization after the resultant downsizing.

A. Individual Development and Training

The majority of executives contacted said that their corporations now felt that the responsibility for employee development—both technical and personal—was with the individual engineer or scientist.

This is in stark contrast to the position taken by most of the larger corporations some 10–15 years ago, when employee training (by the corporation) was an important initiative. The

managers stated that the IEEE could assist both the corporations and the employees by making available and publicizing personal and career management information and training tools, as well as alerting the individuals to the need for improved personal characteristics and skills beyond those normally seen in the graduate engineer.

In the many smaller companies being formed today, the required personal development and skill improvements are clearly the responsibility of the individual.

VII. SUMMARY

The world has changed. Electrical, computer, and information technology engineers are once again and for the foreseeable future in high demand. However, the executives and managers of industry are expecting enhanced skills in the graduate engineers over and above what they expected in the past. The message is clear: Young engineers and scientists who desire to move forward in an organization should work to obtain, and then improve, the identified skills and characteristics to the best of their abilities. More seasoned veterans of the engineering profession should continue to develop and maintain these skills.

With the prevalence of right-sizing in today's global open market economy, it is imperative for the engineers to develop extra aptitudes or skills, which will allow them to distinguish themselves among their peers. The message received was that there was a premium placed on individuals that have developed, practiced, and continued to improve certain extra or soft skills. When the decision had to be made during right-sizing, or as part of a corporate merger, as to which individuals to hold and which individuals would be reduction-in-force victims, those with the extra skills were the ones retained. These skills improve your personal and professional image—and thus serve to solidify your position. These extra skills are important to you, and for your future. Give them a try.

T. W. (Ted) Hissey

IEEE Director Emeritus