

Evolving Industry Expectations for Engineers - The Impact of Global Manufacturing

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Abstract

Practicing engineers need to develop a career plan to ensure that they can meet the challenges in the evolving global workplace. The academic foundation established by an engineering degree may launch a professional career, but individuals must take a proactive role in their professional development activities to permit career advancement. This task is becoming more crucial as international conglomerates continue to establish manufacturing plants around the world. Engineering activities on “world” products are often performed at multiple design centers located in various countries and are staffed by nationals. To facilitate the design and manufacturing processes, frequent teleconferences and electronic mail are necessary between these centers, as well as periodic international travel to explore technical issues. To successfully compete in today’s global engineering market, individuals must develop and follow a career plan. The key elements include a life-long learning plan to maintain and expand technology skills, the ability to embrace continual workplace changes, the gaining of international skills, and a crucial need for professional engineering registration. In this article, some of the major workplace issues facing engineers are discussed with recommended steps to ensure that their skills and contributions maintain pace with engineers around the world throughout their careers.

1. Introduction

The intense competition among corporations around the world to increase their share of North American, European, South American, and Pacific Rim consumer markets is profoundly altering business activities. The global economic challenges faced by American manufacturing companies during the past decade has impacted their technical staffs through new workplace attitudes, paradigm shifts, and engineering challenges. Vanishing are those positions where a new engineer could enter a company, rely primarily on those academic skills acquired in a bachelor of science engineering program, and reside in the same facility throughout one’s career. The competition has forced companies to constantly review their engineering, manufacturing, and support processes to reduce costs. Furthermore, the need to establish a presence in overseas markets has accelerated the placement of manufacturing operations in foreign countries to meet local content requirements. Truly, the workplace is undergoing dramatic changes [1].

Today’s engineering landscape requires a revised set of technical and interpersonal skills. American engineers are increasingly interacting with engineers from different countries, learning foreign languages to conduct business worldwide, and accommodating international travel/relocation. To maintain a healthy professional career, individuals must commit to a life-

long learning process and learn to accept change. Furthermore, the emergence of international standards for corporate quality management systems may initiate the need for engineering staffs to seek professional licensure to conduct business worldwide. In this article, some of the major issues currently facing engineers are discussed with recommended steps to ensure that they can maintain their careers.

2. Evolving Workplace Changes and Challenges

What are some of the factors influencing change in the engineering workplace? One of the primary issues is the need to compete on a global basis for manufactured products. The motivation for this business strategy is three fold. First, there is the need to establish a manufacturing presence in countries around the world to satisfy "local content" laws and permit product customization for regional requirements. Frequently, countries use tariffs to encourage companies to manufacture a percentage of the product locally to provide jobs and build a manufacturing infrastructure. Second, the desire to lower labor costs, as well as cultivate markets in underdeveloped and developed regions. Significant cost reductions can often be realized by manufacturing products off shore. Finally, companies have a desire to harvest technological innovation from creative individuals and suppliers worldwide. To observe the impact of globalization activities on manufacturing, lets examine the introduction of global sourcing by General Motors in the early 1990's.

General Motors traditionally procured over 70% of its automobile parts from captive internal suppliers, now called Delphi Automotive Systems, per the idea of vertical integration. In 1992, J. Ignacio Lopez de Arriortua was appointed as GM's worldwide purchasing director and quickly promoted the concept of global sourcing automobile parts for its assembly plants [2]. Although somewhat different from the Toyota Motor Company's policy to develop long term multiple (primary and secondary) supplier relations, opening up bidding to all qualified suppliers produced dramatic results. The competition to win contracts resulted in favorable double-digit price cuts, quality improvements, and technological innovations for GM. Simply put, all vendors now needed to provide world-class quality, service, and price. In addition, first-tier suppliers are required to obtain QS-9000 certification to continue participating in the worldwide sourcing process [3]. Consequentially, in-house suppliers saw their parts become a commodity which could be procured throughout the world at prevailing market prices.

A number of observations can be drawn from the impact of this purchasing strategy on suppliers:

- Products must be competitively priced to maintain, or gain new, customer accounts.
- Market share may erode due to increased competition; new customers must be identified through new product offerings to maintain existing manufacturing volume and revenue.
- Pressure exists to lower the material, engineering, manufacturing, and administrative (burden) costs to maintain profitability; leverage suppliers for price concessions.
- Product quality must continually rise (i.e., fewer defects) and products need to be shipped on time to minimize premium freight charges.
- Companies need to continually upgrade their technology features to distinguish products and attract new customers.

- Companies must shorten design times by embracing new tools; to facilitate the reuse of existing hardware/software in product offerings, a "building block" is useful.
- Design, manufacturing, and/or customer support centers established worldwide must be staffed with experienced personnel and integrated into the company's structure.

One final observation concerns change within the workplace. Rapid introduction of new digital technologies, manufacturing processes, design practices, and/or global expansion can be a stressful challenge to engineering staffs. Employees who adjust well to, and embrace, change will be successful from a health perspective.

3. Establish a Solid Academic Foundation and Commit to Life-long Learning

The adage "good grades are important" continues to be true for today's new hires. The excellence demonstrated by students in the classroom is a traditional measure of a candidate's potential success in job assignments. Although grades are an important issue, new hires may also be aggressively recruited if they have key skills and experiences gained through activities outside the classroom. Students can obtain valuable experience and maturity through cooperative education, summer internships, extra-curricular projects (e.g., SAE Mini Baja, SAE Formula Car, etc.), senior design projects, and research efforts with faculty members. For instance, the insight gained by working with experienced engineers during a summer internship can assist the student in making career choices, and will aid in the development of various skills. One should not overlook the advantages of graduate school; masters and doctoral engineering degrees are an important credential when pursuing a research position. The laboratory experiences leading to graduate degrees are attractive to companies who maintain laboratory facilities. Finally, business courses remain the gateway to senior management positions in many companies.

In light of the discussion on global challenges, what are the key factors that encourage employers to highly value new hires with well-rounded academic experiences? First, these engineers can often join existing teams (e.g., advanced development, design, manufacture, etc.) and immediately begin making productive contributions. Although some companies continue to offer new employees multi-year training and assignment rotations as part of the orientation process, the global competitive environment is minimizing this activity. Instead, employees are now being recruited to directly join product teams and receive focused training for the position's responsibilities. Second, these engineers often bring a more refined level of communication and interpersonal skills gained through internships and extra-curricular projects. These skills, available immediately to the employer, generally contribute to a team's continued efficiency and harmony as the new hire joins.

The rapid pace of technological advancement requires all engineers to commit to a life-long learning program to maintain and expand their skills [4]. Many companies offer in-house training programs and/or graduate level engineering courses (delivered by satellite) to the technical staff. Seasoned engineers can leverage this training to eliminate any technical gaps with evolving technologies. To ensure a productive engineering career, individuals must commit to maintaining a technical edge through professional development activities. The creation of a career plan is essential to achieving this goal.

4. Develop and Execute a Career Plan

The achievement of significant career goals does not generally occur by chance. In today's hectic work environment, engineers must take ownership of their professional careers by developing and following a career plan. Two of the primary motivations for this strategy are shorter work tenures at companies and reductions in human resource professionals. First, employees are likely to work for a number of companies throughout their careers, in contrast to previous generations where individuals worked exclusively for one company. To ensure that one's technical and management skills remain valuable, consideration must be given to yearly training and work experiences. Job security demands technological freshness. Second, the reduction of overhead costs to maintain a company's competitiveness often results in reduced administrative personnel, such as human resource professionals, which may eliminate career counseling and planning services. Therefore, it is important for individuals to realize the need to establish a career plan.

How does one develop a career plan [5]? One approach is to start by concisely listing five realistic and measurable short (1-3 years) and long (5-10 years) term goals. By summarizing career thoughts, one can focus their energies towards achieving them. Furthermore, the goals can be communicated to appropriate members of the company's management team or other suitable individuals. If possible, the company should assist in executing your career plan to facilitate the experiences and training required for advancement within the organization. For instance, team leaders (first level supervisors) generally require some management training, product familiarity, and knowledge of the company's structure and workforce to eliminate barriers affecting team performance. The short term goals, listed in the career plan, may include the acquisition of management skills through in-house training courses, and a short term manufacturing floor assignment to assist in solving production startup problems for the upcoming model. Once a career plan has been created and implemented, it is important to periodically measure the progress realized in fulfilling the goals. Over time, some adjustments to the goals may be necessary to capture recent job, professional, and family experiences. An additional benefit of a career plan is the ability to track the time and energies in nurturing a professional career. If one reflects on the sacrifices endured to achieve an engineering degree, the commitment to develop and execute a career plan is minor.

Finally, a few comments are merited regarding mentors and networking. Companies should be encouraged to establish a mentoring program for young engineers. Frequently, these programs match recent new hires with experienced engineers to assist in the acclimatization into the work environment, corporate culture, and engineering profession. Another important resource for engineers is the networking opportunities offered by engineering societies. Regular attendance at meetings, or conferences, allows relationships to be established which may prove invaluable for new career and/or employment opportunities.

5. Seek Professional Engineering Registration

During the last several years, manufacturing companies worldwide have been obtaining ISO-9000 certification. This international quality standards series, created by the International Organization for Standardization, requires companies to demonstrate that they have established a quality management system [6]. For instance, ISO-9001 applies to companies which design, manufacture, install, and service products, and covers twenty separate elements (e.g., design,

process control, purchasing, etc.). One of the goals of quality management is continuous improvement that encourages greater performance and efficiencies across all processes. To achieve certification, corporate procedures must be developed, documented, executed, and then appropriately tracked to show that the "company did what they said they would". Once initial certification is achieved, it is maintained through periodic on-site audits conducted by ISO approved certification inspection firms. It is interesting to note that ISO-9000 certification does not address the appropriateness of given procedures, but rather only that the company follows and documents them.

In the domestic automobile industry, QS-9000 certification is an alternative to ISO-9000. QS (Quality Systems) 9000 combines the quality assurance base of ISO-9000 with automotive industry specific quality guidelines [3]. One of the primary factors for QS-9000 is the desire to ensure that automotive suppliers can meet quality standards and production schedules per the global sourcing bid. For instance, how can a customer ensure that a supplier located halfway around the world has the appropriate design, engineering, and manufacturing processes in place to meet the quality specifications? Or what if there is a need to resolve a quality issue associated with a part? Finally, what is a typical QS-9000 procedure? Perhaps a company has decided to conduct multidiscipline peer reviews as part of the software release process, or has established a rigorous process to track product returns from the field to test for, and identify, failures. In each instance, an engineering procedure has been written for the technical staff to follow to ensure that the company performs as it says it will. In summary, through ISO and/or QS-9000 certification, companies demonstrate their ability to adhere to procedures which have been developed to help them meet quality goals.

As stated previously, the current certifications are at the corporate level for their design, engineering, and/or manufacturing practices. However, as design centers open around the world, how can companies ensure that their technical staffs are properly skilled to perform the work? Are engineers next in line for certification? What is one method to ensure that engineers have received the proper training? Obviously there are variations in university curriculums around the world so industry cannot depend solely on grades as a metric? One practical solution is the expansion of the current professional engineer (PE) registration process to license engineers worldwide who demonstrate a minimal (acceptable) level of expertise. In a recent paper, the issue of professional licensing and practice was reviewed in terms of the North American Free Trade Agreement [7]. A transnational license was discussed for licensed professional civil engineers (in Canada, Mexico, or the United States) to permit practice in neighboring countries provided that appropriate educational, work experience, and other established criteria are satisfied.

Therefore, what is the likelihood of requiring professional licensing for engineers in all disciplines? It is the author's opinion that professional engineering registration will become an important credential in the twenty-first century. Business changes occur rapidly so it may quickly become the norm, or companies may not establish a business case for the added expense. What is the best strategy for new hires, seasoned engineers, and undergraduate students? Start to consider becoming a professional engineer. It is a two step process, and information can be obtained from the National Society of Professional Engineers. All universities need to continue encouraging students to begin the registration process by completing the Fundamental of Engineering (FE) examination prior to graduation. Schools should then maintain contact with

students to encourage their efforts, when all licensing requirements are satisfied, in taking the Principles and Practice of Engineering (PE) examination.

6. Conclusions

The rapid changes in today's engineering market are requiring engineers to adopt new paradigms and strategies to remain attractive to current and future employers. The six keys to a successful engineering career can be summarized as:

- Establish a solid academic foundation.
- Commit to a life-long continuing education program.
- Take charge of your professional career by establishing a career plan.
- Obtain benefits through networking and mentors.
- Seek Professional Engineering (PE) registration; international standards may be forthcoming requiring this type of certification.
- Develop effective verbal and written communication skills.

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Author's Biography

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