Preparing Engineers for an Outsourced World—Strategies for Change

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Abstract

Global outsourcing has the potential to become the primary challenge facing young engineers entering the job market today. As more jobs are shipped to subcontractors offshore, there will be a continued hollowing-out of intellectual property in the U.S., with the brunt of that loss being borne demographically by new graduates.

In this paper, industrial perspectives are presented that give different views on the current issue of global outsourcing. Curricular strategies for adapting engineering programs of study are discussed. A new emphasis on computer skills fluency, as well as enhanced development of knowledge of social, entrepreneurial and political skills will be needed if contemporary engineering graduates are to be viable for emergent jobs in the global workplace.

Introduction

Since last year, when the author wrote about business process outsourcing, the phenomenon of moving engineering jobs overseas has continued apace. According to [1] in July 2003 alone, 25,000 to 30,000 new outsourcing jobs were announced by U.S. companies in the Indian press. Meanwhile, there were 2087 mass layoff actions carried out by U.S. employers resulting in the loss of over 226,435 jobs. Impacts have increased to the point where major professional societies, such as the IEEE[2] and ASME[3] have become concerned regarding relative job security, and these concerns have reverberated in the government sector all the way to the halls of the U.S. Congress[2].

And while wage differentials between firms in the United States and other lower-cost competitors have driven outsourcing, this is not the only reason that jobs have moved overseas. There is a talented pool of intellectual capital in emerging economies such as India and China, and a large body of residual talent left over from Cold War military economies in the old Eastern bloc states, notably Russia. Add to this the notion of expanding markets for products, coupled with complex trade agreements enabling increased market share in companies willing to locate new development efforts overseas,

the engineering community as a whole must come to terms with the reality that the environment that young engineers must operate in is dynamically changing by the day.

The underlying driver behind global outsourcing is a sophisticated computer communications network running Product Lifecycle Management (PLM) software. The V5 Suite of Catia/Delmia /Enovia is an example of PLM software heavily used in the automotive and aerospace industries. Such software infrastructure makes sharing of files between offshore contractors and U.S. business a transparent affair, and enable 24/7 engineering cycles.

Industrial Interviews

The author had numerous discussions with practicing engineers and corporate managers in the aerospace sector in formulating some of the above observations. Some of the more interesting comments were made regarding preparation of students in advanced degrees. The standard rule of thumb has always been that improving the job skills of new graduates by raising the bar with respect to spending more time in education is the key toward raising the standard of living in the workforce. And while it is generally true that having a B.S. is a better strategy than facing an outsourced world with only a high school diploma, it is unclear that increased technical sophistication is the answer for keeping jobs in the U.S. One high-level engineering manager remarked to me that if a sophisticated mathematically-based aeroelastic analysis was to be required, such a job could be done much more cheaply and quickly in Russia, which has a surfeit of Ph.Ds, all highly trained, and willing to work for $15/hour. More education is not a panacea for solving the outsourcing issue.

Niall Glavin, a supervisor in Support Equipment Design for the Boeing Company in Seattle, runs an engineering group that designs small batch-size equipment for specialized support for customers that fly Boeing aircraft.[5] Their division is actively involved with outsourcing contracts to Russian aerospace firms. He made the point that work that is "boxable"—easily enclosed, and specified—is prone to being outsourced in the present, and more so in the future. If the constraints around the problem are easily identified, then it can and probably will be shipped overseas to a low-cost engineering services provider. Asked about giving advice to a young engineer about pursuing a career, he advised caution regarding the portability of projects. He also cautioned against following current business practice in revamping the engineering curriculum. Fundamentals will always be important. Glavin emphasized that the current round of outsourcing is a business strategy, which may or may not be successful in the long-term. He added emphasis that there would be no way that successful employers could completely expect universities to do the type of education necessary for training young engineers in global techniques. Employers would still have to shoulder the majority of the burden.

Joe Hoffman, Corporate Vice President in charge of Strategic Planning for L-3 Communications, had a different perspective regarding outsourcing in general, and the

development of skills for young engineers in particular.[6] Hoffman has been involved with outsourcing since 1993 as a program manger for Honeywell, and was involved with coordinating efforts between engineers in the U.S., England and Russia. He prefers not to use the word "outsourcing" and instead look at the business climate as an opportunity for creative teaming with companies that possess synergistic intellectual capital. He emphasizes developing a strong sense of what a given company does better than anyone else—knowing and understanding a company's core competencies. If something falls outside of these core competencies, then a company is better off subcontracting the labor. Using L-3 as an example, he stated core competencies of his company as developing complex electronic RF hardware. The software that utilizes the hardware can be written by anyone, and is outsourced out of L-3 to domestic and foreign software houses. "If it is not a competitive discriminator, or part of your core competencies, then why do it?" Hoffman emphatically related.

Hoffman had a different perspective with respect toward training young engineers, stating that there was a lot that the university could do to better prepare new graduates. Project management and system integration skills are paramount, Hoffman said. "For every hour spent on intelligent planning, three hours are freed for creative engineering—and creativity is the name of the game." Hoffman also emphasized understanding engineering from a business perspective, which could be introduced in the undergraduate curriculum. A final point made was that enhanced formal and informal communication skills open doors for young graduates as they move up inside companies. And in a global marketplace, though much of the technical work is done in English, knowledge of foreign languages on a social level helps build stronger, more productive business relationships.

Hoffman also commented on the development of soft skills such as negotiation as an important part of an engineer's toolkit. When teaming with other companies in other countries, specifications and division of labor must be negotiated, and this is often done at the mid- to lower- management level. He was also more optimistic about job opportunities for new graduates, and believed that if students were educated along the principles laid out above, they would have no problem finding employment. Citing the immediate retirement prospects for the Baby Boom, jobs would be plentiful. Global teaming offered one more outlet for creative, communication-oriented engineers.

Observations regarding impacts to higher education

Depending on the growth of the U.S. economy, global outsourcing will have primary, short-term effects on the system of higher education chiefly because jobs outsourced initially are often starting positions. As such, many new graduates formerly used to excellent starting employment opportunities with large corporations now see those jobs the first to go overseas. The short-term effect of global outsourcing may be a glut of unemployed and under-employed young people in the job market. In last year's paper, the author covered the trend in employment in starting engineering positions.[4] The

number of graduating engineers has generally declined, and starting salaries have remained stagnant.

If companies do not tend to the issue of keeping young people in the job market, global outsourcing will have long-term effects on intellectual property generation in the U.S. It is well-established that younger workers learn most of what they know about their profession in the first five years of employment. If they are deprived of that opportunity through under- or unemployment, as U.S. identified firms further gentrify, they will become vulnerable to takeover by the subsidiary firms providing the initial outsourced labor.

University educational systems are unprepared for educating the new workforce that will participate in global economic enterprise. Opportunity will exist for those graduates trained in the tools of global economic enterprise—notably state-of-the-art software tools such as Product Lifecycle Management software, and an appreciation and understanding for diverse cultural backgrounds, as well as an ensemble of "softer" skills, such as negotiation techniques, familiarity with foreign languages, and comfort with informal communication skills.

Some of the largest obstacles for redesigning the current engineering curriculum lay in academic culture. One of the largest is faculty's anathema toward learning new software tools as they are released, successfully integrating them into the curriculum, and educating students in the skills required to use them, as well as emphasize the notion of creative use. Faculty by and large assume teaching students software is a waste of time—something the students can learn by discovery—instead of understanding that such tools can enhance students' understanding of physical system behavior, a necessary component in any innovative engineering enterprise. The reason for the faculty's anathema comes out of the reward system for faculty—notably the fact that during most faculty members' careers, the grandest rewards come from a combination of exclusivity of knowledge, combined with idiosyncrasy of approach. Additionally, faculty can view the introduction of business skills into the curriculum as "dumbing down" the engineering course of study, though these skills are often vital for career success.

Conclusions

The rate of global outsourcing will be dictated in part by how fast curricula and businesses adapt to the changing economic environment. Outsourcing is facilitated when companies successfully implement the large software/communications packages necessary to utilize distance workers. Inside-US job growth is facilitated when students graduate with the necessary skills and insights to plug immediately into corporate environments where outsourcing is under consideration, because these students have the advantage of enhanced early productivity.

Whether outsourcing is good or bad for the U.S., one thing is for sure—students graduating under the current curricula are relatively unequipped to operate in the complex governmental/ transnational political environment that will run global commerce. In order for the U.S. to successfully deal with the outsourcing issue, students must learn to be competent engineers, as well as master a complement of business and soft skills involving communication and understanding of cultural diversity. The professoriate has an obligation to develop role models that can lead the way for students, in spite of career incentives in the academy that tend to be along the lines of technical excellence with little regard to society/policy implications of new technologies.

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Biography

Charles Pezeshki is an Associate Professor in the School of Mechanical and Materials Engineering at Washington State University, and founder of the Industrial Design Clinic. He is also the Chair of the WSU Faculty Senate, a political consultant, and writes on environmental issues and policy implications.