Offshoring: Implications for the Engineering Workforce and Profession

Presentation by

Ralph W. Wyndrum, Eng.Sc.D
2006 President
The Institute of Electrical and Electronics Engineers – United States of America (IEEE-USA)

To the

Workshop on the Offshoring of Engineering: Facts, Myths, Unknowns, and Implications

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I am pleased to be able to speak to you today on the subject of offshore outsourcing and its implications for engineering not only as a representative of the engineering profession, but also as an engineer with high-level management experience at AT&T/Bell Labs and as an entrepreneur and consultant. The views I express today are my own, but are based on what I have learned through my experience in the global engineering services marketplace, my interactions with the engineering profession through my involvement as 2006 President of IEEE-USA, and from the various studies and analyses that look at these issues.

Let me start with a few observations designed to paint the large picture as I see it:

1) Offshore outsourcing of engineering services is an almost inevitable outcome of the globalization trends created by basic economic forces of share-holder value, efficiency, productivity enhancement and free flow of capital. They are enabled by the very technologies that engineers created and are continually improving such as broadband communications and the Internet.

2) Offshore outsourcing occurs for a number of reasons, all of which are grounded in basic business logic. Much emphasis is put on wage differentials and labor arbitrage as the principal driving force behind offshoring. Labor cost is undoubtedly the major factor at present, but offshoring is much more complex than that. Business is also motivated by such considerations as market access and market development, access to talent, the cost of capital, governmental economic incentives, special or lower cost infrastructures and capabilities (e.g. subsidized telecommunications or Internet), access to universities and research centers, comparative government regulations, and a host of other factors. Even if labor cost-margins narrow, there will still be strong incentives for offshoring.

3) The engineering profession in the U.S. is not monolithic. Offshoring doesn't affect each engineering discipline in the same way, at the same pace, or to the same degree. New opportunities for engineers are constantly being created by challenges arising from circumstances such as Katrina and Rita, oil price increases, or military operations abroad. Technologies mature and become obsolete, along with the academic disciplines that rose up around them. Certain electrical and computer engineering disciplines are maturing and in transition in many regards, but new disciplines are emerging and other disciplines are experiencing growth and new opportunity (e.g. bioengineering, nanotechnology). If the U.S. maintains it leadership in emerging technology fields, the U.S. engineering profession will enjoy opportunity and some degree of insulation from offshoring as a whole, even while engineers in affected disciplines struggle as individuals to make career transitions.

The U.S. engineering profession was already wrestling with significant challenges prior to the emergence of offshoring, not the least of which were the Dot.Com and Telecom busts, which led to major contractions (estimated at a half million jobs or more) in the high-tech sector between 2001-2003, with particular impacts on electrical engineering. These busts came on the heels of the major downturn in the U.S. aerospace industry after 1998, another engineering intensive sector.

There are other structural issues in the profession that are increasingly rising to the fore:

1. The post WW II/Cold War technology boom that fueled America's high standard of living was based on amazing productivity improvements that drove the nation's economic growth, while at the same time automating and streamlining many engineering-intensive tasks. There is a reason that engineers joke that they are the only professionals who work hard to put themselves out of a job. What that translates into is a profession that is by necessity highly mobile, moving from assignment to assignment, and from employer to employer.

2. It is also a profession whose members are challenged to keep up with the latest developments in technology. Continuing education has become increasingly critical for engineers in mid/late career, at that same time that employers are less and less likely to invest in training or support time off for involvement in professional activities. Electrical and computer engineers increasingly face early obsolescence (as early as their mid-30s-early 40s) unless they can continually reinvent themselves. With most engineering PhDs leaving school in their early 30s, the productive lifespan of a research or design engineer is shorter than ever before, making the opportunity-cost calculation less than compelling for many bright students weighing their career options.

3. It is a profession whose educational barriers to entry are continually getting higher and more expensive as more and more content is squeezed into the traditional four year degree, which typically takes nearly five years to complete.

Recently, the National Council of Examiners for Engineering and Surveying voted to amend the model state engineering licensure law to require "an additional 30 credits of acceptable upper-level undergraduate or graduate level coursework from approved course providers" in addition to a B.S. degree as a prerequisite for licensure. This would take effect no sooner than 2010.

The additional work, however, does not seem to be paying off in terms of future compensation. According to the National Association of Colleges and Employers, beginning salary offers for electrical and computer engineers graduating at both the B.S. and M.S. levels were flat or actually fell between 2001 and 2005. Other engineering disciplines saw see-saw fluctuations and/or flat to modest growth during the same period.

4. There is also a demographic issue. Our U.S. engineering workforce is aging, with a high percentage of baby-boom generation engineers reaching retirement age within the next 10-15 years. The losses will particularly be felt in mature engineering sectors such as aerospace and power. NSF's most recent Science and Engineering Indicators reports that 29% of all S&E degree holders and 44% of all S&E doctorate holders in the workforce are now age 50 or over. Among S&E doctorate holders in the labor force, 44% are age 50 or over. We see the demographic trend within IEEE where the average age is now 47 years for regular members (up from 44 in 1997). Employers taking the long term view are looking to secure labor resources to meet future needs (hence their interest in tapping the global services market) as well as to shed pension and other overhead costs, which make it difficult for them to compete.

As engineering labor has become more and more of a commodity, the fundamental relationship between engineers and employers has changed. As a consequence, a significant percentage of the U.S. engineering work force is more apprehensive about their careers and the future of the profession. Some feel they have been used and discarded. Many want or need to keep working in their later years and don't see an environment that is receptive or enabling. A small percentage challenge what they view as pervasive age discrimination in employment.

It is against this somewhat troubled backdrop that the offshore outsourcing trend gained high profile after 2001, joining the related trends of guest workers and domestic outsourcing as companies reduced their engineering payrolls and moved engineering work to services firms. New jobs were created in those services firms, but often at lower pay levels and with fewer benefits and less job security. Some of those firms rely almost exclusively on insourced guest labor (using the H-1 and L-1 visas) as their business model, which employs labor arbitrage to gain a competitive edge. Insourcing was used in many instances to facilitate planned offshoring of business operations, and/or had that consequence as insourced managers used their business contacts to offshore engineering services work. Nine of the top 10 engineering services firms that utilize L-1 visas to bring foreign high-tech workers to the U.S. are also engaged in offshore outsourcing.

In the three years since offshoring in the information technology services sector began in earnest, the whole IT industry has been transformed. Virtually all bids for commercial work now include an offshore component. The "global delivery model" has become THE business model in the IT sector. The potential for equally rapid and far-reaching transformation exists in engineering sector as well.

In this environment, engineering jobs tied to manufacturing (which was already moving overseas) or lower level service work became ripe for offshoring. Many displaced engineers were considered too expensive and/or not considered qualified for the new and often more limited opportunities that were now available. Those who could not find new jobs turned to consulting or contract work or made transitions to non-engineering jobs, while a few became chronically unemployed. In my role as IEEE-USA President, I hear from them all with some frequency.

For a while there was an almost irrational exuberance about the anticipated benefits of offshoring. Now, companies have learned a few hard lessons and are much more thoughtful in implementing their global strategies and in how they communicate about their plans. Offshoring remains a business priority and is often reflected even in smaller entrepreneurial start-ups where investment capitalists and Wall Street demand that business plans include an offshore component. While the public rhetoric has softened, the pace of offshore outsourcing appears to be steady and growing.

IMPACTS OF OFFSHORING ON ENGINEERS AND THE ENGINEERING

So what are the implications for engineers, for the engineering profession and for our nation?

One of the articles of faith offered by many offshoring proponents in the public dialogue is that only low-level, service sector jobs, such as call centers and business process support, will be offshored. IEEE-USA does not believe this is the case and notes that there is already considerable evidence that high level research and design work is moving overseas.

The Commerce Department's 2004 report on workforce globalization concluded that "long term trends in the structure of the (semiconductor) industry suggest that employment in manufacturing by U.S. semiconductor companies will decline, both in the United States and abroad, and employment in R&D and design work will increase at a faster rate outside the United States."

A Fall 2005 report by Ashok Deo Bardhan and Dwight Jaffee on Innovation, R&D and Offhshoring for the Fisher Center at the University of California-Berkeley, based on a survey of industry R&D offshoring practices, concludes that "the emerging situation with offshoring of R&D related activity is going to pose a series of challenges to white collar workers, engineers, designs and scientists, to U.S. firms, as well as to policy makers. It is possible that the future of R&D offshoring will include continued innovation and R&D in the U.S…..leading to a win-win situation where the U.S. develops/markets the "new"

good, and the now "routinized" goods and services are offshored. On the other hand, there exists the distinct possibility of major innovations originating abroad."

In a February 2006 report, the Association of Computing Machinery found that "globalization of, and offshoring within, the software industry are deeply connected and both will continue to grow." They go on to note "one example of a higher-skill area now subject to global competition is computing research. Historically, the bulk of this research was carried out in only a few countries…this situation is changing rapidly and the trend looks inexorable."

A July 2006 report on "Innovation Offshoring: Asia's Emerging Role in Global Innovation Networks" by the East-West Center, notes that "it is time to correct earlier claims that only low-level service jobs will move offshore and that there is little 'evidence' of a major push by American companies to set up research operations in the developing world. Innovation offshoring goes far beyond the migration of relatively routine services like call centers, software programming, and business process support….beyond adaptation, innovation offshoring in Asia now also encompasses the creation of new products and processes."

The National Academy's 2005 report on "Globalization of Materials Research and Development" cautions that globalization in the materials area could threaten U.S. access to advances in materials science and engineering. It notes that the effects of globalization on U.S. leadership in MSE R&D vary by field and subfield, and warns that the emergence of new centers of high-value research around the globe is challenging the ability of the U.S. to attract top research talent.

In another recent report on offshoring implications for the U.S. semiconductor and software industries, the Government Accountability Office concluded that: "more recently, U.S. firms have offshored more complex research and design activities; they have also sought to take advantage of Asian engineering talent and to target the rapidly growing Asian market." They add "as firms experienced cost savings and observed high-quality work in these offshore locations, they expanded offshore operations to include more advanced operations, such as software design and systems integration."

The "Insight 2005" study of U.S. technology innovators conducted by McClenahanBruer Communications, CMP and Electronic Engineering Times, reported that 64% of respondents "worry about the future of the engineering profession in the U.S. because of the impact of outsourcing." Of the survey respondents, 46% indicated that their company has sent electronics design work overseas, of which 70% was at the low-end of software development, hardware design or manufacturing, and 30% was characterized as high end software or hardware design.

Last May, Booz Allen Hamilton and Insead surveyed 186 companies operating in 19 countries and 17 industry sectors to assess trends in innovation R&D dispersion. What they found was that the companies are increasingly siting R&D operations outside their headquarters market (from 45% in 1975 to 66% in 2004). Foreign R&D sitings have

shifted toward China and India and away from the U.S. and Western Europe. The survey respondents suggested the pace will increase, with 77% of new R&D sites planned through 2007 slated for either China or India. By the end of 2007, China and India's share of global R&D staff is projected to jump from 19% to 31%, replacing Europe as the most important location for foreign R&D for U.S. companies.

A more recent study by Booz Allen Hamilton conducted for the National Association of Software and Service Companies (NASSCOM) in India highlights growing demand for engineering services. The study estimates that $10-15 billion of engineering services are currently being offshored, with projected growth to $150 -225 billion by 2020.

This summer, "Electronic Engineering Times conducted a further survey of its electrical engineering readership to gauge their thoughts on offshoring. What they found was described as a "grim acknowledgement" of the trend and a sense that the U.S. has been too complacent. The authors concluded that "American EEs fear that U.S. companies are looking for equally smart, but cheaper, engineers in developing markets who can be future stars once they gain experience. Moreover, they wonder if America is trading away its future industrial leadership for short-term gains in the bottom line…"

If both low level and high level engineering work is being offshored, what prospects remain for U.S. engineers in the future?

- Engineering jobs tied to creating and maintaining geographical infrastructures will clearly remain in demand.
- Large companies will keep some level of R&D and design work close to their U.S. markets and manufacturing enterprises even as they shift their investment priorities to opportunities abroad.
- Engineers with an entrepreneurial sensibility and a bright idea will create their own opportunities.
- Higher-level research jobs will be found around federal laboratories and academic research centers as long as federal R&D dollars continue to flow.
- For the foreseeable future, it seems likely that job opportunities will remain in the defense and homeland security sectors that involve sensitive or classified work.
- Hopefully, new and emerging technologies will also drive job creation in the U.S. as they are commercialized.

Under most macroeconomic projections, the overall size of the U.S. engineering workforce is projected to increase in the short-term, keeping pace with the growth of the U.S. economy. What is not clear is how the U.S. engineering workforce will fare if the U.S. is unable to retain its leadership position in technology innovation over the longer term.

POLICY IMPLICATIONS

In an October 2003 talk reported by Forbes, then Intel Chairman Andy Grove described the cost benefits driving offshore outsourcing, and acknowledged that he was torn between his responsibility to shareholders to cut costs and improve profits and to U.S. workers. He concluded that the government needs to help decide the proper balance between the two. Otherwise, he cautioned, companies will revert to their obligation to increase shareholder value. Government has not risen to that challenge and in effect, Grove's cautionary note is increasingly becoming the reality.

IEEE-USA believes that the offshoring issue is inextricably tied to the broader issue of preserving our national competitiveness and technological leadership in an increasingly global economy. IEEE-USA also believes a coordinated national strategy is needed to sustain U.S. technological leadership and promote job creation in response to the concerted strategies being used by other countries to capture U.S. industries, jobs and markets.

The National Academy's "Gathering Storm" report helped draw attention to the competitiveness challenges facing the nation, challenges inextricably linked to the engineering and the engineering profession and to offshoring and other trends. A number of advocacy coalitions have formed; more than a dozen bills have been introduced in Congress, and the President has also announced his own American Competitiveness Initiative with its focus on reprioritizing federal R&D appropriations. For all the talk, however, relatively little has actually been accomplished to date in the policy sphere.

There are certain common elements or points of consensus in the positions being advanced, most of which are supported by IEEE-USA and by other professional engineering societies, as well as industry and other groups. For example, we collectively endorse:

- a renewed federal commitment to support front end research and development to enhance innovation.
- permanent extension of the federal R&D tax credit.
- programs or tax incentives to aid human capital development/worker training.
- improvements in K-12 science, technology, engineering, and math education in the United States to ensure a technologically literate workforce.

I believe these are necessary policy responses, but not nearly sufficient. It may not be how much we spend on R&D that makes the real difference, but how effectively those expenditures are made. R&D geared toward product/process improvement helps drive incremental innovations that fuel commercialization and promote prosperity in the short-term. But to remain competitive over the long term, the United States (both in the public and private sectors) needs to invest more of its resources in both exploratory and applied

research in the physical sciences, particularly in high risk areas of new and emerging technology that can create the new technology-based industries of the future.

We also need to figure out how to better capture the benefits of that research, protect the intellectual property, and commercialize it so that we create high value jobs here in the U.S. that will drive our economic prosperity and sustain our national standard of living.

As for K-12 math/science education, we must advance technical literacy and broaden the pool of prospective scientists and engineers available to fill the gaps that will result when the Baby-Boom generation retires. At the same time, we must be wary of short-sighted responses that would encourage individuals to enter the engineering "pipeline" in numbers disproportionate to realistic projections of workforce demand and without regard for the employment opportunities and career prospects that exist at the pipeline's end.

Some have suggested that we should more aggressively promote engineering training as a pathway to non-technical careers. Data is offered suggesting that 24-40% of recent engineering graduates are ending up in fields such as investment banking, law, medicine and management consulting. I endorse the view that engineering is a good practical degree that can lead a variety of career paths. But I'm not convinced engineering is likely to become a popular degree choice for entry into non-technical professions due to the high threshold requirements and comparative difficulty of obtaining an engineering degree combined with the current career outlook for professionals in our field. Instead, I worry that engineering grads are opting out of technical careers due to financial incentives to go elsewhere or perceived lack of opportunity in their field of preference.

We must wary of the potential for the "hollowing out" of the profession if the flow of jobs overseas translates into fewer entry level jobs here where new engineering graduates can build up the experience needed to move to higher level jobs. With the probable exception of new PhDs with research backgrounds, most new engineering graduates are not fully equipped straight out of school to apply their academic background to addressing innovative solutions to engineering problems. We are already starting to read of U.S.-born electrical engineering and computer graduates going to India to build their resumes.

There are several specific points that I would emphasize from IEEE-USA's position on offshoring:

- Firstly, IEEE-USA believes that prudent steps should be taken to better understand the implications of offshoring for the nation and the engineering profession. The Federal Government must collect and publish reliable statistics on the kinds and numbers of manufacturing, R&D and service jobs that are being moved offshore.

  IEEE-USA was pleased to work with Congressman Frank Wolf in supporting the appropriation leading to the National Academy of Public Administration's

offshoring study series and we worked to secure release of the Commerce Department's offshoring study to the House Science Committee. Although useful, these reports are essentially snapshots of trends taken at a particular point in time. There needs to be a thoughtful and continuous examination of offshoring and its implications for the engineering profession and the national interest. That would enable a more strategic approach to national policy-making.

- IEEE-USA believes new U.S. workforce assistance programs should be created to help displaced high-tech workers regain productive employment and ensure that employed workers can acquire the knowledge and skills they need to remain competitive. This is an extremely challenging and potentially costly problem, compounded by the fact that employers can no longer be counted on to make those kinds of investments for the majority of their technical workforce.

- IEEE-USA believes new or more effective incentives are needed to help engineers and other professionals tackle the challenge of mid-career education.

- IEEE-USA believes it is appropriate for government procurement rules to favor engineering work done in the United States absent compelling reasons to do it elsewhere. Government often purchases products and services that stretch the envelope of the market, and firms that win those contracts accumulate knowledge and capabilities that give them comparative advantages.

- Lastly, policy-makers need to take a systematic look at U.S. immigration policy and its implications for the global trade in services. In meeting the competitiveness challenges of the future, the United States will benefit more from a system that encourages the permanent immigration of the world's best and brightest into an open and competitive labor market than one that increasingly relies on insourcing of guestworkers through a flawed regulatory system that suppresses wages, limits opportunities, and increasingly sends those guestworkers home to use what they learned to benefit our competitors overseas. This problem needs to be resolved before the baby-boomer generation of engineers begins to retire in numbers to avoid creating a further incentive for increased offshoring of engineering services.

  I emphasize this last point because it has become increasingly apparent to me that Congress has gotten so caught up in the politics of immigration policy that it is not thinking carefully about the consequences of its proposals, particularly in the area of skilled workers. As a case-in-point, IEEE-USA commissioned a study by Dr. Lindsay Lowell of the Georgetown University's Center for International Migration this summer. Dr. Lowell's study found that current legislative proposals would conservatively allow entry of 1.88 million high-tech workers to fill the 1.25 million new computer and engineering jobs projected by the Bureau of Labor Statistics to be created over the next 10 years.

To this IEEE-USA list, I would add three more points:

- While endorsing immigration as a positive means of building our talent pool, as a nation we need to do more than "poach" the world's best and brightest engineers. We need to look more closely at what will incentivize qualified American students to consider technical careers. The added challenge here is that the offshoring trend serves as one more disincentive for many of those students and is prompting an undetermined number of engineer/parents to actively discourage their children from following in their footsteps.

  To put a human face on this, let me quote James Finkel, an engineering manager for B.E. Wallace Products, from an April 29th Wall Street Journal editorial entitled "Engineering Becomes a Perilous Career Choice." Asked about recommending engineering as a career option, Finkel responded: "Given the time and effort of becoming an engineer, who wants to be unemployed every few years? .... why choose your lifetime salary the day you graduate from college."

- The global labor market in engineering services needs to work both ways. As a nation, we need to better understand and address the barriers faced by U.S. engineers seeking to work abroad and consider how best to prepare U.S.-born engineers to work in the global engineering services market.

- One final critical need; engineers as individuals and as a profession need to become more effective and more proactive participants in the public policy process and in public discourse about technology-related issues. A little bit of citizenship will go a long way towards ensuring that public policy is better informed and more responsive to the competitiveness challenge.

Other engineering societies add different points of emphasis in their offshoring position statements:

- The American Society of Mechanical Engineers rightly points to the need to secure America's job-intensive manufacturing base.

  According to one estimate, nearly 48% of American engineers work in the manufacturing sector, which also currently accounts for 62% of the total U.S. R&D investment. Because the prevailing management practice is to locate R&D as close to manufacturing production as possible, as manufacturing moves overseas, it is inevitable that engineering design and R&D will follow.

- The American Society of Civil Engineers frames a homeland security issue as offshoring allows non-U.S. architects and engineers increasing access to information concerning U.S. facilities and infrastructure.

- The National Society of Professional Engineers notes the difficulties that offshore engineering poses in administering the engineering licensure system used by U.S. states to protect the public safety.

CLOSING NOTES

In closing, I would observe that there are limits to what policy can or should do when it comes to operation of the free market. Much of what needs to be done is the responsibility of engineers and the engineering profession in attending to our own needs and best interests.

The professional engineering societies, including IEEE, will quickly lose relevance if we don't do a good job of enabling our members to thrive in their profession, providing them with better tools and direction to deal with the challenges posed by globalization. We have to be equipped to respond to members effectively when they ask: How can I be more "innovative?" What does it mean to be "entrepreneurial?" What technologies will I need to be versed in to stay competitive in the next five years? We also need to be able to break down our disciplinary smokestacks and move more nimbly to expose our members to the intersections of technology, where innovation increasingly occurs.

This is why during my tenure this year as IEEE-USA President, I have pressed our Board of Directors to shift and strengthen our focus on enhancing member value, emphasizing mid-career education and the importance of lifelong continuing education, providing innovation leadership, and enlisting engineers to help support K-12 education for future technologists. We are developing new programs, such as a proposed Innovation Institute, where we can tap the expertise of our members to help promote the profession. It will require a modicum of tough love at times to change engineers' thinking about their careers. And it will take time to affect changes and to see the results. But I am convinced we're moving in the correct direction.

The offshoring challenge is real, as is the challenge to continued U.S. technological leadership in the face of strengthening global competition. We need to move beyond the simplistic "win-win" rhetoric to thoughtfully and deliberatively understand the effects of the phenomenon and respond to it accordingly. We have many advantages as a nation and as an engineering profession. But the U.S. holds no monopoly on bright people, technical know-how, or investment capital and we will lose our competitive edge if we are not focused and persistent.

The U.S. engineering profession is in the early stages of a painful transition as it adapts to the hard realities of globalization. There will be those who are unable to make the transition and/or who will need help. As a profession, we must be prepared to help them rise to that challenge. As a nation, we must find a way to preserve and support a vital domestic engineering capability that can sustain the technological leadership and innovation that underpins America's economic and national security.

My thanks to the National Academy of Engineering for iconvening this discussion and my appreciation to the United Engineering Foundation for its role in funding it. I hope this is the start of an ongoing dialogue within the engineering community that will help us reach an actionable consensus on how best to sustain a strong U.S. engineering profession for the future.

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