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Offshore outsourcing and the dawn of the post-colonial era of Western engineering education

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This paper summarizes the phenomenon of offshore outsourcing and relates it to the history and current state of engineering education and the engineering profession in Europe and the USA. In order to assess the climate affecting employment decisions by and about engineers we have used as sources mostly the serious press, with an emphasis on material dating from 2004 forward. The authors conclude that despite anxiety about the out-migration of engineering and technical jobs to places such as India and China, there is reason to see offshoring as the result of Western investment in capacity building in developing countries and to believe that the creation of new jobs will outpace the rate of job loss in Europe and the USA. The paper should serve as a prod to policy-makers and educators to set about creating an environment in which highly educated engineers and technical employees can continue a pattern of economic revitalization.

Keywords: Outsourcing; Offshoring; Engineering education; Employment; Capacity building

1. Introduction

Engineers have a problem: they are fated to be the persistent cause of their own professional obsolescence. Consider for example the 19th century threat that mechanization would take over all the jobs in industry. Who invented and built those machines? Then came worries about how technology was going to make human work obsolete. But who were the drivers of technological invention? Now the anxiety is focused on the migration of technical jobs overseas, piece by piece. But who promoted the raising of standards in engineering education overseas, to the point that many more international universities are now capable of graduating capable employees? Yes, the work of engineers today will likely serve to make significant portions of that same work redundant in the future. Is this a cause for concern? Yes, because the transition is painful and calls for interventions at the political and professional levels. But is it cause for despair? No. The fact that it is a recognizable pattern that includes regeneration

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should be a sign of current hope. Just as engineers over the past 200 years have frequently appeared to be on the brink of self-destruction, they have always regrouped, retooled and returned with new ideas that created new opportunities for employment. That is the dynamic underlying the waves of outsourcing by offshoring that are causing such a stir today across Europe and the USA.

2. The evolution of offshore outsourcing

This may be a particularly good time to step back and take another look at offshore outsourcing, despite a growing consensus that there is little hard information about the phenomenon (*The Economist* 2005, 30 June). Some of the initial panic has begun to subside and reports from around the globe indicate a growing awareness that the migration of jobs from country to country is a permanent characteristic of the contemporary world, driven by both the advanced capabilities of technology to support a dispersed workforce and the pursuit of increased profits. In fact, outsourcing has become so much a part of today's world that Dubai, in the United Arab Emirates, has already created the DOZ, Dubai Outsource Zone (*Gulf News* 2005) and cartoonists are making jokes about job migration (Breathed 2004). In addition, a few years of experience have revealed that offshore outsourcing is a more complex dynamic than a simple grab for profits. Finally, the US presidential election of November 2004 are past, and along with it the media-hyped rhetoric that suggested an imminent collapse of Western economies.

If we put offshore outsourcing into a historical context we see that competition has always been a characteristic of market economies. Competition between countries occurred long ago, such as when China lost its monopoly in silk weaving to France and Italy. In this case the market was large enough that Chinese production did not disappear. More recently, entire industries have been fought over, with one clear competitor emerging and the defeated party forced to fold. The US steel industry, faced with challenges from Japan, collapsed. Sometimes competition has been from within a single industry in the same country. Such was the case when outsourcing first came into vogue. Companies tried to cut costs by paying specialized businesses to better provide a service or product faster or cheaper than the company was able to do itself in-house. When jobs migrated from the outsourcer to a new provider or supplier in relatively close geographic proximity people might have had opportunities to move with them. As information technologies and transportation improved, along with management expertise in the outsourcing process itself, geographic distance between units mattered less and less, except to people who lost their jobs in one location and could not reasonably expect to move around the world in chase of them. In any case, as specialized industries grew to service niche functions, employees whose jobs were outsourced could not be hired by those companies without costly retraining that no one was eager to provide.

Offshore outsourcing was a logical sequence to local outsourcing. Continued pressure for profits drove a search for savings through the exploitation of large wage differentials around the world. Critical to the expansion of offshoring is the notion that a job is no longer associated with a person who has integrated knowledge, experience and judgement: a job becomes a cluster of skills and competencies that are subject to disaggregation and reassignment to one or more people. Selected components of jobs are shipped through time and space and then recompiled and expanded into whole new specialized functions at the destination (Engardio 2005). Jobs held by engineers and technically trained people have been disproportionately subjected to this dismemberment, although there is some bitter comfort in knowing that other professions are catching up (*The Emirates Evening Post* 2005).

3. The push and pull behind offshoring

It is becoming apparent that offshore outsourcing is a much more complex dynamic than was originally thought. It no longer suffices to assign blame to corporate greed as the sole driver of the migration of jobs around the world. There is both a 'push' and a 'pull' associated with offshore outsourcing. The push is away from the high cost employment markets of the Western world and the equally important pull is the increased availability of well-educated people graduating from newly upgraded universities in rapidly advancing economies such as India and China.

Reports from around the world indicate that the push for outsourcing by offshoring involves an escalation in the sophistication of the jobs being sent overseas, the use of offshoring as a threat to extract labour concessions at home and a more nuanced approach to the selection of offshore destinations.

Jobs that only a few years ago were considered safe from offshoring are now on the block. 'There is a demand from automobile and aerospace manufacturers to outsource engineering and design work' reported *The Economist* (2005, 5 March). Companies and analysts are speaking openly of the migration of research and development functions away from the higher priced labour markets of the developed countries to places such as India. All told, the same *Economist* article says that 51% of large firms in North America, Europe and Asia are outsourcing offshore. At the same time, however, the article goes on to report substantial amounts of dissatisfaction with the results of offshoring.

The push for profitability comes at a time when the world economy remains fragile, volatile and increasingly globally integrated. One likely target for reducing labour costs is the expensive social safety nets which underpin many European economies. Daimler-Chrysler threatened to offshore some of its production to South Africa unless German unions granted contract concessions, which they did (Czuczka 2004). Whether actual offshoring or the threat of it will create a widespread political backlash is unknown, but defensive legislation is beginning to move through the governments of Western countries. In the USA 40 state legislatures are considering bills which would punish companies that send jobs overseas (Hopkins 2005).

Many creative variations on offshoring have appeared, sometimes in response to the dissatisfaction mentioned above. In the USA 'near-shoring' can refer to efforts to retain jobs that might otherwise stray, such as recent efforts by Arizona business leaders and their Mexican counterparts to collaborate in making their region the 'project-management capital of the world' (Larson 2005). 'Near-shoring' is also a term used to describe the movement of jobs from the Western members of the European Union to countries such as Romania, Estonia, Bulgaria and Serbia, which have lower labour costs but are near enough to be monitored easily from a headquarters in Bonn or Toulouse. In this European example near-shoring is revealing the important cultural and linguistic components at play; countries whose primary language is not English are less impressed by India's famous English language skills and are turning to countries with whom they have closer cultural ties – France sending jobs to Romania, for example – when they select offshore destinations (Reinhardt 2004). A lesser known aspect of the out migration of jobs is 'in-sourcing', the creation of jobs in the USA and Europe as a consequence of foreign direct investment. Last year Samsung announced that it would add about 300 new jobs as a result of expansion of its semiconductor plant near Austin, TX (Belson 2004). There is even the new hybrid 'home-shoring', virtual call centres made up of people working in their own homes, wherever they may be.

While profit is the essential 'push' to the use of outsourcing by offshoring, we need to consider the 'pull' as well, the increasing capacity of other countries to provide quality engineering education and to employ their graduates in satisfying jobs.

Enrollments in engineering and technology programmes in India and China are booming. New universities have been created and old ones substantially modernized and upgraded, with large infusions of money. Investments have been made in faculty expertise, research, equipment and infrastructure. Chinese and Indian students have been well known for their high mathematics and science skills coming out of secondary school: now they have universities in their own countries that are fighting to attract them. With China's political leadership mainly in the hands of engineers, engineering is a prestigious profession (Byrne 2005) and there are seemingly limitless employment opportunities for graduates (*The Economist* 2005, 5 March).

At the same time there have been problems in US and European engineering education, where universities are struggling to diversify their student profiles: funding for engineering has been sporadic at best and government policies have not provided consistent support for the expansion of engineering and technical expertise. Since July 2005 the UK has joined the USA in working through immigration problems and concerns about universities harbouring foreigners who pose threats to national security. Foreign enrolments, once a mainstay of engineering graduate programmes, are significantly lower in the USA: between 2003 and 2004 there was a 36% decline in the number of applications from overseas to US graduate engineering programmes (*IEEE Spectrum* 2004).

Offshoring could not have happened if there had not been a pull of better overseas engineering education and foreign graduates moving home, coupled with a certain stagnation in the attractiveness of Western programmes.

4. The impact of offshoring on engineering education and practice

Outsourcing by offshoring is stirring up engineering education and practice considerably, or at least it should do so. With employment being changed so radically, there are important new challenges to quality control, technical retraining, the roles of engineering organizations, the future of entrepreneurship, international competencies for engineers, the links between industry and higher education and the attractiveness of the profession.

Motivation to take another look at international standards for engineering education and practice should be increased after reading reports about medical offshoring. As X-rays and various scans are more frequently being transmitted to centres offshore for interpretation, the medical profession and even the public are now alerted to potential risks associated with a misreading of medical charts if education, training and licensure are not up to the standards that prevail in the country where the patient is receiving the services. Similarly, issues related to health, safety and maintenance of the public trust placed in engineers should now be raised by the profession itself. The questions and issues are complex because of the disaggregation of job functions that occurs in offshoring (Oberst & Jones 2004). However, the need is real for the imposition of quality control measures, international accreditation of engineering programmes, upgrading of local, regional and national licensure requirements and integration of codes and regulations into law, so that the offshoring of pieces of engineering functions does not create loopholes by which the carefully crafted standards of highly industrialized countries are eroded. But be aware: 'One man's professional credentialing process can be another man's trade barrier' wrote Jessica Vaughan (2004). The path forward is neither straight nor clear, but it remains urgent.

The thorny problem of how to retrain highly skilled displaced workers is still not being addressed on a scale anywhere near approaching the potential magnitude of the problem as offshoring continues to impact on the engineering workplace. Until now retraining has focused

on bringing people into the workforce at the entry level, not on re-educating highly educated employees for a workplace where the pace of change does not respect natural generational turnover. There is a vast difference between providing retraining for those without secondary schooling and fashioning productive ways to reintegrate into the employment market someone with a master's degree in engineering (The Brookings Institution 2004). Traditionally it was the unions which insisted on protection for displaced workers: in the absence of unions what might be the role of the professional associations in collaboration with the higher education community in creating the retraining modules which will help the individual engineer in this period of rapid transition? What seems clear is that a university diploma which includes high level technical skills and a solid foundation of general education, including experience abroad, coupled with entrepreneurial skills will stand displaced engineers in good stead if the time comes for them to reposition themselves in the job market.

Europe and the USA share concerns about the need to build and maintain a highly educated technical workforce (National Academy of Engineering 2005; information on proposals to establish a European Institute of Technology is available at europa.eu.int). There has, however, been a notable absence of dialogue across the Atlantic about possible coherent responses. The time is right for policy-makers to create trans-Atlantic strategies to give engineers the opportunity to move up the career ladder to outpace the off-shoring dynamic: this would involve the selection of strategic priorities and funding, university level retraining and more education in invention, creativity and entrepreneurship. In the absence of that the separate national level discussions will continue to reduce the employment of engineers to a simple competitive market issue, never raising it to a shared social concern.

Will the people in India, China and elsewhere who are now employed in business process outsource centres be the entrepreneurs of tomorrow who will strengthen their country's economic base? As time goes by we are learning more about the environments to which outsourced jobs are being sent (*The Economist* 2005, 5 March). The infrastructure necessary for entrepreneurial activity is by and large not robust in India and China. Lacking the protection of intellectual property rights and easy access to capital, to say nothing of reliable utilities and transportation systems, will ambitious, creative people emerge from the newly created offshore business process outscourcing centres to build grass roots prosperity in their homelands? The answer is not clear. To counter those who scoff at the idea that a person would risk using their intellectual capital in societies that do not respect it we need to remember that the potential rewards in this new frontier in India and China are often perceived as sufficiently great as to overcome the threat of failure.

Engineering educators are in a privileged position to speak out on issues related to the impact of offshoring on the profession. They are the most credible source of information about the aspirations and talents of young people who are preparing themselves for a profession, not just a job. However, engineering educators also have a role in explaining how the migration of research offshore threatens the unique bond between higher education and industry. Dating from the early years of the US land grant colleges, where the 'mechanic arts' participated through experimentation and application in raising the standard of living of the greater population, the university–industry link has always ensured its continuation by involving students in the research process (Jones *et al.* 1990). Those students, then, were the multipliers, the ones who continued the practice of research and inquiry through their careers. Despite the capabilities and benefits of distance learning, it is hard to imagine a substitute for the mentoring and nurturing process of education which takes place in the laboratories, classrooms and offices of a university as undergraduates, graduates and post-graduates take on increasingly important roles in research carried out under the sponsorship of industry. The possibility that more industry sponsored research and development will be removed from university laboratories and conducted elsewhere might ultimately be a greater danger to Western economies than the

loss of jobs, cutting off opportunities for new generations of young people to acquire research skills and ambitions under the guidance of their professors.

> Today, most employees are seen as units to be stockpiled and shed as business warrants. Technology not only allows fewer people to do the jobs of many; it also allows their skills to be taught to almost anyone, quickly, anywhere around the world. (Reich 2003)

Robert Reich's statement describes an unattractive work environment and issues a challenge to educators to examine the balance in the curriculum between skills training and education. Perhaps the biggest threat of outsourcing is that it has made the engineering and technical professions less appealing, just as effective recruiting programmes were better communicating the benefits of the profession to young people selecting future careers. Of particular concern is that traditional first jobs for young engineering graduates are now being sent offshore. And a closer look also shows warning signals for India and China and other offshoring destinations. In India young employees, their appetites whetted by relatively high paying jobs, now shed those entry level positions willingly at the offer of a higher paying job, driving up the wage scales, of course, and also creating instability in the companies that employed them (Scheiber 2004).

5. The dawn of the post-colonial era of Western engineering education

Despite all these associated problems, there is reason for optimism. Looked at one way, offshore outsourcing is in large part a tribute to the success of the engineering profession in Western countries in upgrading the quality of engineering education around the world to their standards, thus creating a pull from emerging economies. European and US engineering faculty who are about to retire are now looking back with satisfaction at a career lifetime of visits to developing countries to design better curricula, to help build well equipped laboratories, to conduct joint research projects and to advise colleagues about how to work towards Western-style accreditation. While such work did not always garner for the faculty the same career advancement that well-funded research and prestigious publications did, the satisfaction and (admit it) the adventure of global travel were sufficient to keep many involved. Foreign governments have regularly invited teams of Western engineering educators to give advice on how to establish productive links between universities and local industry, how to prepare students at the secondary level for university level engineering study and how to attract more women and other under-represented groups into the profession. And so engineering educators willingly served abroad, even knowing that they were wrestling with these same issues back home as well. Over the past several decades US and European funding agencies have, with varying levels of enthusiasm and constancy, given priority to projects which built and maintained international collaboration, although funding of these projects waxed and waned, often as a function of political winds. Professional associations all made at least gestures to indicate their commitment to sharing their collective expertise abroad, and some even developed energetic and productive agendas which have borne demonstrable results.

Is it possible that all this effort and all this brain power were deployed without an understanding of the risks inherent in success? Today we are seeing the results of these endeavours. Substantial numbers of engineers who emigrated to be educated overseas in Europe and the USA are combining the best of two worlds: their excellent education and the opportunity to work back in their home culture. Engineering programmes in India and China are now showing the effects of upgrading in the form of strong graduates who never had to leave their home country to obtain a good education. And these newly strengthened universities are competing with Western universities for students and faculty. Industries in emerging economies are benefiting from larger numbers of nationals who have expert skills and are eager to invest them

in the growth of their home nations. This is another 'pull' in the offshore outsourcing environment: the readiness of countries to attract back the people and the work which were previously associated exclusively with the Western world, and even to offer to their own young people educational programmes of high enough quality to make students question the necessity of leaving home for university training.

6. Conclusion

Even the pessimists have to admit that offshore outsourcing is not the end of a process of change that engineers and engineering have played a role in launching. Jobs and functions that migrated overseas will continue to be affected by new technologies: just consider what natural language speech recognition, if perfected above present levels, will do to the call centre jobs that recently migrated to India, as *The Economist* (2004) has pointed out. There is reason for optimism. As engineering has provided the backbone both for peaks of material progress and troughs of decline, it has proven itself again and again to be capable of regeneration, both of itself and of the societies it serves. There is no reason now to believe that this will not happen again. Engineering educators and professional society leaders need to be addressing these issues now.

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