NASSCOM™

Globalization of Engineering Services

The next frontier for India

Booz | Allen | Hamilton

Globalization of Engineering Services

The next frontier for India

Booz | Allen | Hamilton

NASSCOM™

Executive Summary

Introduction

A new window of opportunity is opening now for India. Even as Indian vendors continue to move from strength to strength as providers of Information Technology Outsourcing (ITO) and Business Process Outsourcing (BPO) services to companies around the world, the possibility now exists for India to add a third major services growth stream—Engineering Services Outsourcing (ESO) —to its rapidly evolving economy.

Engineering services is a huge market: Global spending for engineering services is currently estimated at $750 billion per year, an amount nearly equal to India's entire gross domestic product. By 2020, the worldwide spend on engineering services is expected to increase to more than $1 trillion.

Of the $750 billion spent today, only $10-15 billion is currently being offshored—a tiny fraction of the total. India brings home about 12 percent of today's offshored market, which it currently shares with Canada, China, Mexico, and Eastern Europe. By 2020, we estimate that as much as 25 to 30 percent of a much larger $150 to $225 billion market for offshored engineering services could belong to India—as much as $50 billion in annual revenue—if the country builds the capacities, capabilities, infrastructure, and the international reputation it needs to become the preferred destination for these complex, high-value services.

Some of those elements are in place; others are not. On the positive side, India has the single largest pool of engineering talent among the emerging countries capable of taking on this kind of work—more than Russia and China combined. The current graduate talent pool suitable for ESO and ITO/BPO work in India represents 28 percent of the total in low-cost countries. The outsourcing boom has also created what one might call the habits of success: extensive experience in forging strong client partnerships, in building strong, technically focused organizations, in competing in the fast-changing global market, and most importantly, in creating the business model necessary to deliver value to clients thousands of miles away.

However, India must also overcome some serious challenges if it is to succeed. First, although India trains more engineers suitable for BPO and ESO than any other low-cost countries, not all are equipped with the skill sets required to succeed in this market. Even allowing for a healthy growth rate of 4 percent a year in the number of graduates,

the projected number of engineers with the right specialized skills will not be nearly enough to meet the potential demand. Second, India's weak engineering and physical infrastructures are likely to hamper growth as well. As opposed to ITO/BPO, ESO has close links with manufacturing and it may be difficult for India succeed without significantly enhancing manufacturing capabilities – not easily accomplished given the infrastructural constraints. ITO/BPO success has been driven by companies investing in almost "standalone" facilities to de-risk themselves; however, this won't work with manufacturing.

Achieving more than a moderate degree of success in ESO will require a serious commitment from India's business and political leadership to make India a more attractive business destination. To capture its full potential share of this new business, India needs to take steps to address the gaps. While the infrastructure improvements that India must take are nothing out of the ordinary for an emerging market, they will require attention and commitment from all involved parties.

To capitalize on its opportunity, India must equip five to seven cities with world-class infrastructure over the next 14 years (by 2020). It must expand its opportunities for engineering education. And it must market itself in a systematic way, to let corporate decision-makers around the world know that Indian engineers can do much more than code. Without serious investments in education and physical plants, and an unprecedented campaign that joins business and government leaders to meet these demands, ESO could be a missed opportunity for India—and part of another country's boom.

The Potential Market

Engineering services is not a negligible market. As noted above, nearly $750 billion was spent on engineering services in 2004. By 2020, that figure is expected to exceed $1 trillion.

Like many business functions, engineering is already done on an increasingly global basis. A 2005 survey by Booz Allen and Duke University's Center for International Business Education and Research (CIBER) found that 36 percent of companies

surveyed sent some of their engineering offshore, 31 percent offshored some research and development, and 16 percent shipped out a portion of their product design. To date, offshoring of innovation services has largely been done in advanced countries — only 9 percent of the world's budget for engineering found its way to low-cost countries.

We examined global demand for ESO across five sectors —Automotive, Aerospace, High-Tech/Telecom, Utilities, and Construction/Industrial, which together represent a high percentage of the global engineering spend. For each of those sectors, we examined trends across different kinds of service offerings— product and component design, plant design, process engineering, and plant maintenance and operations. This study focused on core innovation services, aside from such IT-related work as software engineering, where India already has a substantial presence, and looked at demand, supply, and evolving competitive dynamics.

Many companies begin offshoring to cut costs, but then expand their commitments for more strategic reasons. Consider the Automotive sector, for example, which offshores engineering. While some companies—such as GM—use offshoring primarily as a tactical tool to help cut costs, others—such as Toyota—see the offshoring of product development in more strategic terms, as a way to help open up new markets and boost overall productivity and quality.

This more strategic view will become increasingly prevalent over time. Executives in many industries are now beginning to believe that sending product development offshore is a smart way not only to reduce the price tag of product innovation, but to accelerate speed to market and add to the sheer quantity of innovation.

At the same time, the cost differential between professionals in advanced and developing countries is declining. Wages for highly skilled professionals are rising in India, as in other booming emerging markets. It's a shift that's important to note because it creates a new competitive challenge for firms that would be ESO providers: Outsourcing vendors will have to compete without a dramatic cost advantage not only against vendors in other low-cost countries, but also alongside specialized engineering firms in such traditional engineering powerhouses as the United States, Germany, and Japan. However, while India's value proposition will evolve from simply low cost to a more strategic platform, it will remain a less expensive option than developed countries with talent constraints.

Finally, important differences between engineering services and other kinds of outsourcing services means that India's engineering ecosystem will have much less margin for error in meeting client demands. Although ESO has some similarities to BPO and ITO, it is also much more specialized work. Simply increasing the raw number of engineers that can be thrown at a problem won't be enough. An aeronautics engineer, for example, has a different kind of expertise than an automotive engineer, and neither of them would be any use in designing a utility plant. As a result, vendors must develop programs around the needs of particular sectors, and planners will have to correctly anticipate what kinds of expertise will be needed most— and what kind of talent can be developed to take on the tasks—five, 10, and possibly even more years into the future.

India's Value Proposition: Advantages

India possesses some formidable strengths as a potential powerhouse of engineering services. At the top of the list is the widespread availability of highly skilled, English-speaking engineers. At present, India accounts for 28 percent of all of the available ESO and BPO talent in low-cost countries. The next largest sources of low-cost supply, Russia and China, contribute only 11 percent and 10 percent, respectively.

The strong track record of Indian vendors in BPO and ITO is also likely to boost the confidence of would-be global clients in India's capabilities. It's hardly a secret that many marquee name companies have found India to be a reliable service partner. Indeed, many multinationals could easily have an "India Inside" label printed on their products. The Booz Allen study found that in innovation, for example, firms that outsourced such development work to India met projected savings goals. A third positive factor for India is the fact that many of the vendors who will evolve into engineering services providers are likely to already have a great deal of experience winning and retaining BPO and ITO contracts. The delivery models are well established, and after a decade or more in business, these vendors are likely to have developed the ability to maintain a very high level of quality control. Indeed, quality levels among current Indian providers of engineering services are already high and climbing fast. For example, one Automotive Tier 1 supplier that offshores more than 20 percent of its engineering services to India found that in a single three-year period, the number of "first time right" designs produced by its Indian ESO partners increased dramatically—going from a range of 45 to 55 percent of all designs in 2001 to 89 to 92 percent in

2004— matching or exceeding the “first time right” levels of the firm’s own engineers.

If it is handled well, India’s share of the global ESO market could take off at the same time as worldwide demand for ESO increases. India has the potential to control 20 to 25 percent of the global market for offshored engineering services by 2010. By 2020, that number could be 25 to 30 percent, or $50 billion of the expected $150 to $225 billion market. Of India’s total market share in offshored engineering services, High-Tech/Telecom will likely represent the largest slice, capitalizing on India’s existing relationships and expertise. Automotive will most likely be the second-largest sector.

Of course, India’s potential depends in part on the amount of experience and expertise available, which vary substantially between sectors. Unsurprisingly, vendors have the most years of ESO experience in High-Tech/Telecom, with an average of 12 years of work experience. This number is nearly matched by 10 years’ average experience for vendors in the Automotive industry. Construction/ Industrial, Aerospace, and Utilities vendors, on the other hand, are all relative youngsters, with averages of five years’, five years’, and four years’ experience respectively.

As might be expected in such a burgeoning market, the engineers who work for vendors in the ESO industry have only a few years’ experience. Right now, the average level of work experience for individual engineers is less than 5 years, across all five sectors. Automotive and Construction/Industrial have the highest level of average experience, about 5.0 years, followed by High-Tech/Telecom (4.6 years), Aerospace (4.1 years) and Utilities (3.0 years).

Given the rapid expansion of the Indian economy, it is unlikely that these numbers will change appreciably any time soon. To a degree, this problem will continue to be managed through the supervision of much more senior engineers. These senior managers are either experienced local engineers or returning expatriates, whom companies have found especially useful in bridging cultural gaps between foreign clients and local engineers. Automotive senior managers had the most experience on average, with 18 years’ experience on their CVs. High-Tech/Telecom followed closely behind, with an average of 17 years of work experience. Aerospace and Construction/Industrial senior engineers had 16 and 15 years’ experience respectively. Only Utilities managers, in fact, were substantially lower, averaging only 10 years of experience.

Yet vendors' ascent on the ESO learning curve may well be more rapid than those figures indicate, as has been the case with BPO and ITO. As noted above in the statistic on "first time right" designs, Indian capacities have often developed much more quickly than might have been expected.

Beyond the capacities of individual firms, India's growing economic clout is also expected to act as an increasingly attractive lure for many global companies. The Economist Intelligence Unit forecasts that by 2015, India's GDP is likely to have grown to 2.5 times its current size, with a strong emphasis on personal consumption—a boon for consumer products companies. This trend may prove to be a powerful additional incentive for potential ESO clients to use Indian engineering services as a way to increase their presence in and knowledge of the Indian market. The increasing GDP may also become a useful lever for policymakers, who may be able to make a commitment to increase local sourcing of engineering services part of a larger deal to increase the company's domestic market access.

India's Value Proposition: Challenges

At the same time, India faces substantial challenges as well. The most crucial challenge, perhaps, is the cultivation of talent. Right now, approximately 35,000 engineers work in engineering services. By 2020, India could need as many as 250,000 to truly reach its potential in terms of market share. While India is already the largest producer of engineers suitable for BPO and ESO outsourcing among other low-wage countries, it will not have enough trained professionals to handle the projected volume of work as the ESO space develops.

Although India has almost 1,400 engineering schools, only a handful of schools are recognized as providing a world-class engineering education. Interviews with vendors suggest that recruiters consider candidates from only a fraction of these schools. Furthermore, not all of the engineering graduates from these institutions are suitable for engineering services, given the skill requirements and domain knowledge. Unlike BPO, where the primary requirement is English-speaking capability, engineering services calls for candidates with a good grasp of engineering fundamentals. Shortages will be especially acute in sectors other than High-Tech/Telecom, since

computer science, electronics and electrical engineering account for more than 60 percent of majors, drawn by rising salaries in the sector and the general excitement surrounding the IT boom.

Effectively, this means that the number of graduates suitable for ESO work today is actually a small percentage of today's 220,000 graduating engineers. Even in the most popular sector, High-Tech/Telecom, shortages are expected.

Infrastructure is another key issue. While the IT infrastructure is adequate for current needs, India still lags other key Asian countries in most respects. In speed and cost of Internet access, road infrastructure, port infrastructure, air infrastructure, and telecom infrastructure, Thailand, Malaysia, and Singapore are all still ahead of the game. In fact, of those five types of essential infrastructure, only India's telecom infrastructure can be considered adequate. Perhaps more significantly, India also lags behind China in such metrics as roads, airports, and telecom infrastructure—all of which may be of crucial importance as China is likely to become India's main competitor for this business.

Competition for Offshored Engineering Services

A key consideration for India in its bid to become the dominant player in offshored engineering services is its competition from other low-cost countries. Within the developing world, a number of countries are likely to participate in the growth of ESO. Participants who can provide low-end services are likely to include small countries unfamiliar to players in the BPO markets, such as Nigeria and Vietnam. When it comes to high-end, complex tasks, however, the most likely scenario is that India and China will bring home the most contracts, since there are very few (if any) countries that can pose a threat, given their lack of scale relative to India and China.

China is likely to be a formidable competitor for India: While India has the advantage in terms of English language skills, cultural compatibility with the West, a robust political and legal system, and relatively strong protection of intellectual property (IP), China has a much stronger infrastructure and a well-developed manufacturing base.

"Go Get Forty!"

India has a number of options at this point in terms of how to strategically address its growth. At one end of the spectrum, it can choose to do nothing and simply rely on the growth driven by existing momentum. In this instance, India is only estimated to capture an additional $3 to $5 billion of the engineered-services market by 2010, as opposed to the $13 billion that it could achieve; by 2020, this passive path will achieve $6 to $9 billion instead of meeting India's potential of $35 billion to $50 billion.

Capturing $40 billion of the world's offshored engineering business would require a concerted effort of business and government almost without precedent in India, but long familiar to many fast-growing Asian markets, such as Singapore. To get there, stakeholders in India, from within the business community and elsewhere, will need to take six key steps to make India an attractive, viable destination for engineering services.

1. Build an "Engineered in India" brand name. A concerted marketing effort to build awareness of Indian engineering expertise could multiply opportunities for Indian ESO firms. Beyond the work that NASSCOM is doing, a separate trade organization or group within NASSCOM dedicated to the promotion of Indian engineering could help elevate global recognition of India's engineering capabilities. Such a group would create trade shows, and establish outreach offices in key markets around the world, such as San Francisco, Stuttgart, Detroit, Paris and Tokyo. Republic of India consulates could also help, by undertaking a campaign to "educate" potential outsourcers about the Indian opportunity, and offering one-off deals to a few select players in targeted industries. The experience of such key players could help create a ripple effect, much as the experience of a few earlyadopting Fortune 500 technology and finance companies in ITO and BPO outsourcing in India encouraged hundreds of other companies to follow them.

2. Improve domain expertise. Unlike previous ventures in capturing global services, good general skills will not be enough to capture the attention of companies looking to outsource high-value, mission-critical engineering projects. While wage arbitrage may provide some early advantages, such important contracts will only be entrusted to partners that clients know they can depend upon. No matter how well-regarded Indian acumen might be in general, such trust will only be forthcoming for vendors who can

demonstrate an advanced understanding of the needs of a particular sector.

In some areas, such as High-Tech/Telecom, that expertise is already well on its way to being developed. In other sectors, it will require a boost. Several measures in particular would help India develop that level of understanding. Domain expertise could be gained first by trading expertise for at-cost services. Key acquisitions of some leading foreign design shops could enhance knowledge while providing firms with access to ready-made client relationships. Hiring top engineers from outside the country could also improve vendors' abilities and enhance their cultural compatibility with key countries. Bilateral deals with countries that have expertise in a given area, such as Taiwan with semiconductors, could also prove helpful in enhancing expertise.

3. Focus on the creation of infrastructure. Overcoming India's current infrastructure challenges is the work of generations. However, when it comes to ESO, India doesn't have that much time. India should take a tiered approach to infrastructure development, and emphasize the modernization of infrastructure in a few key cities.

To put it in perspective, Bangalore currently generates $6 billion annually in ITO/ BPO revenue, compared to Chennai, Hyderabad, and Mumbai, which yield $6 billion in such revenues combined. If the $40-50 billion industry that India is aiming for in engineering services materializes, it will require five to seven or even more "Bangalore-class" cities—urban areas that equal Bangalore in terms of infrastructure and office space.

The most cost-effective choices for hubs would build upon existing pockets of expertise. Bangalore, for instance, might be designated for High Tech/Telecom development; Pune would focus on Automotive and Construction/ Industrial development; and Chennai, Utilities and Automotive. The identification and designation of these cities as primary hubs will help prioritize investment in infrastructure.

These primary hubs could be supported by archipelagos of less-advanced satellite cities, which would serve two purposes. First, the creation of satellite cities would help "spread the wealth" generated by engineering services to lower-tier cities. Second, the creation of these satellites for less complex projects would free the advanced hubs to specialize in complex, higher-margin work. The lower cost structure of these smaller cities would also help India maintain its overall cost-competitiveness.

4. Improve the workforce in terms of quality and quantity. Even if India is able to position itself as an attractive destination for engineering services, the country will only capture a limited amount of business if it lacks enough engineers to fulfill the contracts. Toward that end, a vast new investment in engineering education must be made to position India to take its full potential share of the ESO business.

This isn't just a matter of creating a few more internationally competitive schools. It would require a major commitment to create more educational opportunity at every skill level—from primary education to sector-specialized PhDs. In addition, the expansion of two-year diploma programs, focused by sector, would go a long way toward reducing candidate shortages, especially for specialized (such as tooling) and low skill level needs. Graduates of such programs could form the core of a workforce dedicated to low-end engineering tasks. A cadre of these diploma holders would also help enable India to retain its low-cost status in the marketplace. Experienced two-year graduates could, in time, assist more senior engineers with tasks of greater complexity. In some cases, a complex task that requires an engineer with a master's degree and three years of work experience could also be done by a diploma holder with eight years of experience. Of course, there is only a limited potential for such substitution. Further up the ladder, it almost goes without saying that the number of students in master's degree and PhD programs also needs to expand.

Government could play a crucial role here, and not simply through direct social investment. It could liberalize rules to allow more private-sector participation in education. Passing a law that would allow companies to pay for two years of education in exchange for a two-year contract could also go a long way toward expanding the opportunity for advanced study.

Of course, quality needs to improve at the same time as the quantity. Curricula must be upgraded to international standards at many schools, if students are to have the right skills to serve in this market, and standardized, in order to increase the number of "market-ready" graduates. Certification program standardization would play a role in this regard as well, by pushing institutions to think more about helping their students succeed in the marketplace. At the same time, adding 12-month training programs onto current educational requirements, in the form of advanced internships similar to a medical residency, could help leverage existing expertise.

As a spur to this process, NASSCOM could provide an incentive for improving the general overall institutional quality by creating an annual ranking of engineering schools. The competition could help upgrade standards of education and therefore increase the number of high-end engineers suitable for the ESO market.

Given the long lead times required to make changes to the educational infrastructure and the years of work experience that will be required to undertake a broad range of higher complexity tasks, India must begin now if it hopes to meet the projected requirements of 2020.

5. Align government priorities with business development. Of course, the government's role could extend far beyond the educational sphere. There are many steps, large and small, that federal and state governments could take to ensure that the burgeoning ESO industry grows to its full potential.

Some of these steps would require little more than a change of policy. Offering private companies access to India's considerable number of public-sector companies, for example, could be a useful training ground for ESO vendors hoping to gain advanced knowledge of a particular domain. Tax credits for investment in research and development could also encourage multinational companies to expand their Indian engineering presence. Even a seemingly minor, bureaucratic change, such as working with US and EU governments to ensure an adequate supply of visas for professionals, could make a tremendous difference in the long run.

Other kinds of development would require more intellectual work in the beginning, but not necessarily a serious, open-ended commitment. Working with NASSCOM to create a fast-track arbitration authority for settling disputes between ESO clients and vendors, for instance, would be a tremendous boon to both parties, as well as serve as notice of India's commitment to ESO to potential engineering clients around the world.

Strengthening IP laws could serve a similar function. While India has far better IP laws than many other emerging markets, such as China, for example, more still needs to be done. One step would be to continue to strengthen the IP laws until they reach world-class levels. A second step would be to focus on expediting Iprelated cases, possibly through special courts or a parallel legal system, since Indian courts are know to take a long time to get to decisions. The final part would be to ensure that intellectual property

laws are enforced. Beyond its value in raising potential clients' comfort that Indian engineers know how to keep corporate secrets, it would serve a practical value as well by giving local ESO vendors more incentives to extend their own advanced domain knowledge.

Other commitments might well need to be more ongoing. Getting the government to work with the ESO industry to target key companies to move some of their engineering business to India, for example, would undoubtedly be best considered as a long-range project.

The government could also help in managing a potential backlash against protectionism in other markets as well as domestic jealousies of the ESO industry's special status. In dealing with other governments as well as domestic opponents, it would be helpful to emphasize that unlike BPO and ITO, the expansion of Indian's ESO sector would serve not to shift jobs from high-cost to lower-cost markets but to actually multiply the number of jobs. Sharing that economic insight could go along way toward stifling criticism at home and abroad.

A better approach to funding infrastructure would also help generate more development. Financing infrastructure through user fees would be one way to do it, an approach that has worked in many other markets.

With 250,000 jobs at stake, and the potential to raise the level of India's intellectual leadership across a variety of industrial sectors, it almost goes without saying that nurturing ESO is clearly in the government's interest. Yet politics does not always proceed on such a utilitarian level. Making and sustaining this kind of commitment will be the work of generations of government leaders, both those holding elected office and those in the civil service.

6. Leverage local business and local demand. One other area in which the government could play a positive role is in taking a structured approach to providing incentives to multinationals wishing to create or expand their engineering presence in India. The temptation for local governments to compete in trying to attract major ESO clients will be strong. While such competition has its place, better results would be gained through a somewhat more structured program that leverages existing local industry strengths.

Offset programs, for example, could leverage large imports in Aerospace, Defense, and Utilities. Such programs could be offered as a set-off against export commitments that players are unable to meet. For example, Indian arms of international OEMs unable to meet their export commitments could offset engineering services to Indian vendors against those commitments. To maximize their impact, such programs would need to ensure that business flows to the right area, by specifying, for example, the particular sector to which it should flow.

At the same time, the desire of international companies to play in the Indian market should not be underestimated. India has one of the fastest-growing consumer markets in the world, right after China, and foreign companies' desire for greater access could be a powerful tool for growing local business.

Conclusion

The opportunity for engineering services offshoring in India is vast. Yet like all large opportunities, it won't stay available for long. Particularly in those industries where it is most advanced, India has little time before other countries make more inroads into the market. In High-Tech/Telecom, for instance, we forecast that only one to three years remain before multinationals begin looking for global partners in developing their high-end engineering projects. In Automotive, that number is probably between three to five years. In other sectors, it's likely to be six to 10 years before ESO matures.

As with any market, the ESO market is going to become progressively more difficult to break into over time, particularly as cost is unlikely to be the most important factor in sourcing a project design. That is good news for the countries that capture that market early and keep it, and not so good for those that wait for the market to mature.

Finally, it should be noted that the stakes for India are even higher than the loss of one potential market. Current service relationships in BPO and ITO could well be impacted if India fails to help its engineers further ascend the value chain. If BPO and ITO are seen merely as cost-saving commodities, sooner or later, outsourcers will look elsewhere for a lower price. To maintain their current, hard-won relationships, vendors will need to add more value— the kind of value that a mature engineering services provider will be able to offer.

NASSCOM™
National Association of Software and Service Companies
International Youth Center, Teen Murti Marg, Chanakyapuri, New Delhi 110 021
Phone: +91 11 23010199 **Fax:** +91 11 23015452
Email: research@nasscom.in **WebSite:** www.nasscom.in