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## Global ER&D

Accelerating Innovation with  
Indian Engineering



# Executive Summary

## Introduction

The IT-BPO industry has enjoyed rapid growth – in just one decade, India has invented, transformed and reinvented the global sourcing industry several times over, staying ahead of all trends. The industry has moved up the value chain, continuously growing the overall global sourcing pie and its share in it. This industry has built a unique service-led export-oriented model away from the traditional product-based play. However, we are now entering a period in which it is clear that the current model will drive limited growth and to progress further, tomorrow's global companies need to expand their view of success and redefine it in terms of lasting positive impact for business, society and the environment. The recent economic downturn signaled the start of a new world order and a paradigm shift in the way the world thinks and operates. Conglomerates viewed this crisis as an opportunity rather than a threat and hence, there was limited impact on the global ER&D spend as companies earmarked ER&D budgets to innovate so that they could drive growth in times of economic recovery.

In order to achieve innovation-led growth, the industry is targeting new growth engines, driving globalisation of the ER&D structure across verticals and gaining a foothold in ER&D services offshoring. The Indian ER&D services offshoring industry has grown dramatically since 2005-06 due to the shift in the sourcing strategy of customers. Revenues have more than tripled in the last few years and the industry is poised for further growth due to global interdependencies and linkages that is impacting purchasing and investment activity across the globe. As the Indian supply base becomes more global and entrenches itself deeply within the customer value chain and plays an integral role in customer strategies, it is required to augment its existing capabilities to engage in end-to-end product development initiatives – develop their capabilities as ODMs, enhance their domain/vertical and product/process specialisations, develop end-to-end networks across the entire product chain (research labs-manufacturers-testing facilities-local market), establish global best practices, etc.

## Global ER&D Landscape

Over the past decade, global ER&D spend has been growing steadily – continuous ER&D investment is considered an imperative by companies, not only to pursue innovation for new markets and new products but also for margin enhancements. Global ER&D spend increased from USD 980 billion in 2008 to USD 1,100 billion in 2009, a growth of ~12 per cent and is expected to reach USD 1,400 billion by 2020. While Automotive, Consumer Electronics and Telecom – all traditionally high spenders on ER&D – continue to lead ER&D spend, emerging sectors include Computing Systems, Medical Devices, Energy and Infrastructure.

Moving forward, ER&D spend is being largely driven by four emerging trends – increased use of electronic components and communication technologies, search for alternate fuels and greater fuel efficiency, convergence of technologies enabling a single device to perform multiple functions and increasing demand from emerging markets, especially India and China, for localised products.

The current economic recession has had varying impact on different sectors. Consumer-related sectors such as Automotive, Telecom, Computing Systems and Consumer Electronics, and Infrastructure-related sectors such as Industrial Automation, Energy, and Construction/Heavy Machinery, were heavily impacted as consumers reduced spending and corporates cut back on new expenditures/investments. These sectors are expected to rebound over 2012 and 2013. However, Aerospace, due to long lead times, and government ER&D and Medical Devices, due to a robust and growing healthcare industry, saw minimum impact of the recession on ER&D spend.

Emerging markets have evolved to being the prominent players in the recent years and will become increasingly dominant in the future. This trend is reflected in the Asian ER&D spend, which has increased from 1 per cent in 1990 to ~7 per cent in 2009 and is expected to contribute ~11 per cent of the global ER&D spend by 2020. India's ER&D spend in 2009, at about USD 12-15 billion has been growing at a CAGR of 24 per cent over the last 4-5 years with Automotive, Commodities, Energy & Utilities and Pharmaceutical industries accounting for a major share. In contrast to global ER&D spend ratio, the government accounts for 60-65 per cent of the total ER&D spend in India and corporates comprise the balance. Going forward, the Indian Government is expected to provide a boost to ER&D in India through its investments in Infrastructure and Energy, amounting to over USD 350 billion by 2012.

### **Perspectives on ER&D Services Offshoring**

ER&D has been one of the early adopters of the globalisation phenomenon. It is estimated that share of foreign ER&D sites of companies will increase from 72 per cent in 2008 to 85 per cent in 2015. The impact can be felt on the ER&D services market as companies are no longer offshoring for cost benefits, but are increasingly utilising offshoring to achieve flexible resource capacity (especially in industries with cyclical engineering workloads and short product lifecycles), to reduce time-to-market and to develop localised products for emerging markets.

The increasing sophistication and maturity of the ER&D services industry has meant a significant change in customer perception of service providers. Customers have begun to view service providers as strategic partners owing to greater confidence in their ER&D capabilities. Companies are now providing services from basic process support to high value-added services such as full product development. In addition, customers have started looking to their Indian partners and competition to leverage and design their products from first principles (Frugal engineering).

While, customers still leverage their supply base largely for sustenance and maintenance of existing products, with the shift in growth towards emerging markets, they are increasingly looking to their supply base as an innovation hub. A change in customer perception and supply capabilities has led to a shift in the Indian service providers' portfolios. In 2005-06, 95 per cent of the portfolio was dominated by traditional ER&D services. By 2009, 20 per cent of the portfolio consisted of higher-end, non-traditional services such as prototyping, tooling, manufacturing support, programme management and supplier management. In other words, complexity of services being offshored to the supply base has progressively gone up – low complexity services like CAD, CAE accounted for 70 per cent of the portfolio in 2005-06 and 50 per cent in 2009; this is expected to further drop to 40 per cent by 2020.

High complexity services like product development and middleware development will account for ~25 per cent by 2020. This proportion will be even higher in Hi-tech verticals like Telecom, Semiconductors, Consumer Electronics, Computing Systems and Medical Devices.

ER&D services sourcing is now a global industry with the emergence of several new low-cost destinations in addition to India. China has a large presence of captives driven by its manufacturing capabilities, followed by Central and Eastern Europe, ASEAN, Brazil, South Africa and North Africa, among others. While these locations are building up ER&D capabilities, India has the unique advantage of a strong and diverse service provider pool with capabilities across verticals and a range of business models to suit the diverse requirements of global corporations.

Indian domestic companies have typically retained ER&D in-house. It is estimated that less than 5 per cent of the companies utilised ER&D service providers in 2005-06 and the number grew to ~10 per cent by 2009-10. However, as Indian companies move from manufacturing products for the local market to catering to the global market, the complexity and amount of ER&D workload will increase. As a result, outsourcing will in all likelihood become more prevalent. However, within the Indian market, drivers for outsourcing are quite different from global drivers of offshoring. Indian customers will outsource to gain access to flexible ER&D capacity to reduce time-to-market, new technologies and global industry best practices.

## **ER&D Services Opportunity Assessment**

2020 landscape would be significantly different from the current landscape, driven by global trends such as shifting centres of economic activity i.e., emergence of Asia, demographic challenges in mature economies, greater technology convergence and major shift in industry structures. Simultaneously, growth in the Indian domestic market, infrastructural investments by the Indian Government and effective offset policies will drive growth in the domestic ER&D services outsourcing industry.

Based on the 11 major verticals analysed, India's ER&D services market size is expected to be between USD 40-45 billion by 2020. Of this, the export market (offshoring) is estimated to be USD 35-40 billion and the domestic market is likely to contribute about USD 4-6 billion. This estimate has been revised upwards compared to the NASSCOM-Booz estimates of 2006, due to a shift in ER&D activities closer to emerging markets, increasing confidence in supply base capabilities, ER&D support that can be provided to a large and vibrant local market and emerging new verticals supported by favourable government policies.

Growth of the global ER&D sourcing market is expected to come from all major verticals as well as geographies:

- North America has been the traditional stronghold of the Indian ER&D service market. It continues to remain the largest market. Its share though, in terms of contribution to total revenues is expected to decline from 62 per cent in 2009 to 45 per cent in 2020. In terms of incremental growth of the market from 2009 to 2020, North America's share will be ~40 per cent. The European market is opening up and is expected to contribute another 30 per cent while new opportunities from

the Japanese market (driven by focused investments of the Indian supply base in surmounting cross-cultural and language barriers) and the rest of the world will contribute 30 per cent. Suzuki, Hyundai, Philips, Siemens and LG are examples of some of the major captives in India that have been set up by East Asian and European companies

- In 2020, Automotive, Telecom and Consumer Electronics are expected to remain the highest revenue generating verticals. Consumer Electronics would exhibit significant potential if the Indian supply base invests to compete with ODM's from China, Taiwan and South Asian countries
- The offshorable opportunity of USD 35-40 billion is spread across all service offerings. Increased use of electronics and embedded components could contribute almost USD 16 billion in offshoring revenues (both software and hardware chip design), accounting for about 40 per cent of the total market size in 2020. High value-added activities like prototype building, testing, verification and validation, core product development and design are expected to add another USD 11 billion to the Indian ER&D revenues

The Indian domestic market is expected to contribute almost 10-15 per cent of the ER&D services market in 2020. Three major sources of revenues have been identified for this market – supporting growth of domestic market/companies, meeting offset requirements in the Aerospace sector, planned investments in Infrastructure (roads, highways, ports, bridges, etc.) and Energy & Utilities infrastructure (power plants, T&D, etc.) by both the Indian Government and corporates. Indian service providers have strong process and product capabilities that can be leveraged to support this growing market.

### **Indian ER&D Services Supplier Assessment**

The Indian ER&D services market has exhibited a CAGR of more than 45 per cent since 2004; from USD 1.5 billion in 2004 to USD 8.3 billion in 2009. India has established itself as the premier location for offshore ER&D services and has played a strategic role in globalising the ER&D value chain. Its attractive value proposition and capabilities are gaining popularity across the customer base, enabling suppliers to strengthen their engagement in customer processes and products.

Engineering-intensive industries such as Telecom, Semiconductors and Automotive are the biggest revenue generators with embedded software design contributing almost 40 per cent to the revenue base. Over the years, Indian service providers have focused on proactively investing in and developing their capabilities in order to provide compelling value propositions to their global and domestic customers. In 2009, the number of ODCs (Offshore Development Centres) that provide dedicated ER&D services to a customer is 3x-4x of the ODCs present in 2006. Another key focus area has been hiring experienced professionals from the US, European and Indian (domestic) markets to boost ER&D/product development capabilities. As a result, total number of engineers with >10 years of experience has increased from ~15 per cent in 2006 to ~25 per cent in 2009. Indian suppliers have gone a step further by building their own intellectual capital. Building capabilities that enable differentiation vis-à-vis competition in specific verticals has been a strategic reason for Indian ESPs to invest ~3.5 per cent of their revenues in research. Successful execution of low-medium-high complexity projects over a

period of time, higher number of experienced professionals in the workforce, and investments by Indian service providers in research and IP development has resulted in increased customer confidence.

Manufacturing-focused verticals such as Automotive and Construction/Heavy Machinery were some of the first industries to engage in ER&D offshoring and now have a mature supply base in India. Indian ESPs have since expanded their capabilities across new verticals – namely, Medical Devices, Consumer Electronics and Aerospace due to the need for low-cost solutions, critical time-to-market and easy transferability of skills respectively. Within verticals, capabilities vary across sub verticals, some exhibiting greater maturity than others. At the product development level, high level capabilities exist in the areas of Automotive interiors and exteriors, aerostructures and propulsion in Aerospace, access networks, core networks, devices in Telecom and development of small-medium size products in the Construction/Heavy Machinery vertical.

A large engineering base, with an estimated installed base of ~1 million engineers, remains one of India's key strengths. The majority of this workforce has been employed by large Indian conglomerates. Less than 15 per cent of the installed base works in the ER&D offshoring industry, either for captives or service providers; however, the number of engineers employed in the Indian ER&D services market is ahead of China and has grown at 40 per cent CAGR since 2006. In 2009, 35-45 per cent of the English-speaking engineers graduating from Indian engineering institutions were in high-demand disciplines, such as, Computer Science, Mechanical Engineering and Electronics, which was also in proportion to the demand from the global customers. However, India still faces major challenges with respect to productivity of an engineering graduate and domain expertise.

Indian service providers have invested in expanding their global footprint to service geographically distributed customers. They have established sales teams in North America and Europe, and delivery centres in China and Japan, for closer interaction with customers in the former and to coordinate efforts with existing manufacturing facilities in the latter. Within India, companies have begun to move to Tier-II cities to take advantage of lower costs of operations and to access a large graduating pool of engineers.

Currently, India is the only country that offers a flexible business model for customers. There are over 300 captive ER&D facilities in India employing about 85,000 engineers. The leading 20 independent service providers that serve multiple verticals employ over 60,000 engineers. Though the overall market in India (USD 8.3 billion) is roughly evenly split between service providers and captives, 60 per cent of captives serve Hi-tech verticals, i.e., Semiconductors, Telecom, Consumer Electronics and Computing Systems. Infrastructure and Industrial Automation are almost completely dominated by captives whereas industries such as Aerospace and Medical Devices are seeing greater involvement of ESPs.

### **India's Value Proposition (India's Competitive Position)**

Despite increasing competition from other locations, India continues to be the most preferred destination for offshoring ER&D services. It is estimated that India will continue to sustain this cost competitive advantage over the medium to long-term.

The availability of a skilled talent pool with strong communication skills and English language capabilities is another reason for India's attractiveness. Over the last five years, India's graduate engineering pool has more than doubled – over 350,000 engineers were added to the engineering talent pool in 2009. India has the world's second-largest English-speaking population, at 72 million people and the second-largest number of engineering graduates, after the US. While India scores low on tertiary enrolment and usage of internet in schools, the quality of its educational system outperforms the BRIC average and the quality of mathematics and science education is considered better than the US.

The government has played a significant role in developing India as an offshoring destination. For over a decade, the government has provided the industry with dedicated export zones (STPIs and SEZs) and an investor-friendly tax policy.

India has a well-established public R&D infrastructure with about 300 national laboratories, about 300 R&D institutions in the public sector and nearly 400 universities. However, the country lacks a formal innovation policy to guide public and private R&D and there is minimal interaction and coordination between institutions. Though overall Indian policy lags compared to peers in protecting investors, IP protection standards offered by the outsourcing industry to their customers rank as among the best in the world.

India is expected to remain a leader in 2020 though strong competition will emerge from China, Eastern Europe, Brazil and Taiwan. While India's competition varies based on the verticals, China and Eastern Europe still remain the fiercest competitors.

## Roadmap for the Future

While the IT-BPO industry has been the engine for growth during the 1990s, ER&D services could be the key driver going forward for the next 10 years. With focus and right investments in strategic areas, the Indian economy can build on the current success of the capable supply base, expand its service offering and build a robust knowledge-based economy. Such a planned development can provide tremendous boost to the economy, helping the GDP grow at a much healthier rate of more than 9 per cent for the next 10 years.

The ER&D services sector has a four-fold impact on the India economy. Investment in ER&D services has strategic benefits to the country in terms of creating self-reliance and building competency in industries critical for national security (Aerospace, Automotive, Construction, Energy, Monitoring and Surveillance). It would also strengthen India's balance sheet through reduction of imports. Direct and spillover benefits of a nearly USD 40-45 billion sized ER&D services industry have the potential to increase India's GDP growth rate by 0.5-1 per cent. In terms of employment, the ER&D services sector can create 1 million direct ER&D jobs and 3-4 million high value add engineering/science & technology jobs in spillover industries (e.g. prototyping labs, testing facilities, fundamental research institutions, etc.). In addition, the ER&D services industry has the potential to have a positive spillover impact on its ecosystem through employment and output in product-based industries directly served by it (e.g. Consumer Electronics), and employment and output of suppliers to primary industries (e.g. Tier-I Automotive suppliers).

In order to reach the USD 40-45 billion market size by 2020 and maintain its edge over emerging competition, India's ER&D services sector will need to adopt a four-pronged strategy:

- Enter new markets: Invest in building capabilities in new markets such as Europe and Japan, while simultaneously deepening penetration across existing markets. A unique set of investments and value propositions are required to capture the domestic Indian outsourcing market. Since cost is no longer an advantage, service providers must have strong technical capabilities, flexible capacity, know-how about how global ER&D networks are organised and so on to build a compelling value proposition
- Enter new industries: Invest in new, fast growing verticals in the market like Infrastructure and Energy. Though the ER&D services market will be dominated by Telecom, Automotive and Consumer Electronics, faster growth is expected from the newer verticals
- Enter new service offerings: Invest in building end-to-end ER&D capabilities in select verticals. As service providers mature, the focus should be on building vertical-centric capabilities as opposed to service-offering-centric capabilities. For some verticals like Consumer Electronics and Computing Systems, integrating design and manufacturing capabilities can produce significant benefits to service providers
- Strengthen existing business: Build collaborative infrastructure and ecosystems through a network of partnerships and alliances. These include testing facilities, prototyping facilities, laboratories, design houses, centres of excellence, training facilities and academic institutions (the last two specifically to maintain, refresh and build domain capabilities)

## Vertical Deep Dives

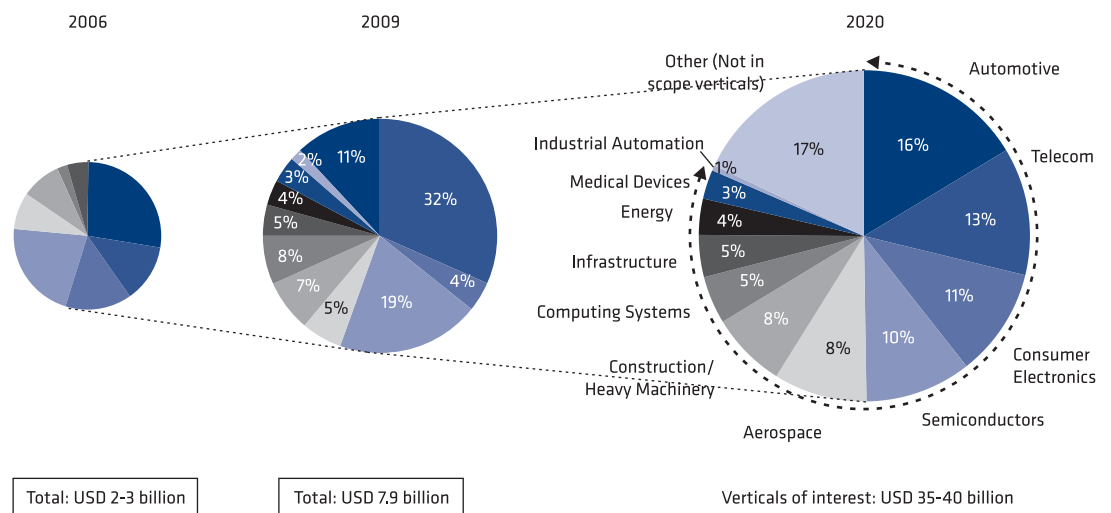
This report has undertaken a detailed analysis of 11 major verticals that are expected to generate USD 40-45 billion in Indian ER&D services revenues by 2020. These include the traditional verticals (Aerospace, Automotive, Telecom, Semiconductors, Consumer Electronics and Construction/Heavy Machinery) and emerging verticals (Computing Systems, Energy, Infrastructure, Industrial Automation and Medical Devices).

Global corporate ER&D spend of these 11 verticals amounted to USD 320-340 billion in 2009, a share of about 55-60 per cent of total corporate ER&D spend. Of this, currently offshored revenue is ~USD 38 billion and India's share in this is ~21 per cent – USD 7.9 billion. Globally offshorable revenues are expected to reach between USD 90-100 billion out of which India would garner a 40 per cent share by 2020 (i.e, USD 40-45 billion).

Major technology and ER&D initiatives are taking place across these verticals: Green technology – increasing fuel efficiency and use of alternate fuels (Aerospace, Automotive), power management (Energy smart grids, Semiconductors), convergence in technologies/voice & data convergence (Telecom handsets), portability and miniaturisation (laptops/netbooks, Medical Devices), robotics (Medical Devices, Industrial Automation, Construction/Heavy Machinery), real-time monitoring to facilitate higher levels of control/reliability/efficiency (Industrial Automation, Construction/Heavy Machinery).

Across most verticals, India and China are the leading destinations for offshoring due to their strong capabilities, cost arbitrage, manufacturing base, local demand, and large talent pool. Other emerging destinations include Taiwan (Computing Systems), Ireland (Medical Devices), Poland and Brazil (Construction/Heavy Machinery), etc.

### Indian ER&D Offshoring Market



Note: Other verticals include retail, pharmaceutical, chemicals etc.  
Source: Booz & Company analysis, NASSCOM

In line with these emerging opportunities, Indian ESPs are continually moving up the value chain by offering high-complexity services across verticals. In the **Aerospace** industry, capabilities have evolved from basic CAD/CAM, software development, homologation, etc. to composite design, tolerance analysis, and digital prototype assembly. Further, capabilities are being developed in high-complexity areas of core/advanced R&D (e.g. - materials, that involve fundamental research), bio-fuel-based engine development (environmental compliance), crash simulation, etc. Indian ESPs are providing high-end design work like aircraft engine design for companies like Airbus and Boeing. In the **Automotive** sector, current capabilities, mainly of medium complexity, include middleware and application development, sub-assembly design, digital manufacturing and technical and plant simulation. Indian ESPs are expected to move up the value chain to offer services around design automation, integrated system design, hardware and chip design, etc. Within **Telecom**, over the last few years, Indian ESPs have moved up from CAD, conversion services, embedded software design, etc. to high-end services such as system level capabilities, customised control software and product conceptualisation, etc. Large service providers have been providing design services for telecom products like mobile phones, fixed phones, set top boxes, RFID devices, WiFi devices, switches, routers, cables, etc.

Until early 2000, **Semiconductor** service providers were offering low-end services like system integration, testing of PCB design and verification of VLSI design. However, in the last 4-5 years, Indian ESPs have begun offering services such as digital/analog IP, embedded solutions, post-silicon/pre-silicon validation services. Indian ESPs are not only helping Semiconductor companies reduce their design services costs but are also supporting them in areas like power reduction and performance improvements on next-generation chips. The Indian supply base in **Computing Systems** is currently most competent in communications, networking, servers and storage – they are expected to make maximum traction in advanced computing and servers and storage through 2020. In the last few years Indian engineers have started supporting high-end ER&D activities such as product conceptualisation and end-to-end product development. With increasing supply capabilities, service providers are also getting an opportunity to work on complete product ownership models.

In **Consumer Electronics**, Indian ESPs have significant coverage of the entire product development value chain from low, mid to high-end services. ESPs have moved up from services like user interface design and testing, design evaluation, etc. to complete development of embedded components, product conceptualisation, chip design, etc. Some ESPs are mature enough to provide end-to-end services including low volume production. In the **Medical Devices** sector, India currently has a number of ER&D/design ESPs with capabilities ranging from design support, embedded software to hardware design. Some of the ESPs have moved up from low-end services like specifications development, electronics engineering, analysis and simulation to high-end services like industrial design, concept exploration, design and code reviews, test engineering, risk analysis, etc. By 2020, Indian ESPs are expected to provide services for devices from imaging to cardiovascular technologies.

In the **Energy** sector, Indian ESPs have been largely providing low-end services from conversion to process support. Very few ESPs are capable of providing services across the value chain (Upstream, Midstream, Piping, Process). However, companies are expected to offer high-complexity services including feasibility/conceptual studies, geospatial applications, GIS mapping, RoHS compliance, etc. **Infrastructure** activities have shifted from CAD and drawing/drafting work to higher level analysis and design. Over the next decade, services will include complex activities like architectural conceptualisation services, welding/materials engineering, etc. Offshore services in **Industrial Automation** consisted mostly of debugging, testing, and low-level mechanical design. Currently a large amount of software development and high level embedded product development takes place. Future activities may overlap into core ER&D and may consist of end-to-end new product development, systems engineering, model building, algorithm evaluation/implementation, etc. In the **Construction/Heavy Machinery** industry, centres in India are rapidly developing capabilities to serve both the domestic and international markets. Some centres are already involved in activities such as application development for products, design and development of new products to basic analysis and re-engineering of existing products. Few have also transitioned to more advanced technologies that include electro-mechanical control systems, electrical power technologies, imaging technologies and remote prognostics.

## Conclusion

ER&D is strategic to India and has the potential to bring a steep change to the Indian economy. The ER&D services market has played an important role in developing the ER&D capabilities of the country. India is now an emerging epicentre of the global ER&D market with more companies exploiting its supply base for future growth. It is important for major stakeholders of this industry – Indian Government, trade associations including NASSCOM and the industry – to ensure the growth trajectory of the industry and moving it to the next level of product development.

Concentrated nature of engineering sets the ER&D services market apart from the IT and BPO markets. Globally, 400-500 customers account for 80 per cent of the ER&D spend. The degree of concentration further varies by vertical – there are fewer companies with large ER&D spend in Telecom and Aerospace compared to Automotive, Semiconductors and Consumer Electronics. This makes it imperative for service providers in India to focus on building engineering ecosystems to support their global customers in specific verticals.

The success, in the space however, varies across verticals – Aerospace, Telecom, Energy & Utilities, and Infrastructure engineering have performed at par or better than expectations. However, in verticals such as Consumer Electronics, Semiconductors, Medical Devices and Automotive, India is running behind expectations. Verticals such as Semiconductors and Consumer Electronics are on the forefront of globalisation, and require product and system level solutions that can be achieved through deep domain knowledge as well as supporting ecosystem – absence of such a proposition has affected revenues in these verticals. In order for India to continue to be the preferred partner for ER&D services across all industries, it is imperative for the Indian supply base to invest in and establish a compelling value proposition.

Moving forward, stakeholders will have to take a focused and clear approach to sustain India's competitiveness in the ER&D services industry. Building innovation clusters/ecosystems for full product development, investing in new emerging technologies in industries of strategic interest, accelerating growth of engineering talent in the country in terms of capacity and capability, specifying policies that mandate minimum share of ER&D services to meet offset requirements and finally branding and showcasing Indian engineering talent, scale, scope, and delivery models are some of the priority actions that have been identified for the market growth in the near term.

**NASSCOM<sup>®</sup>**

International Youth Centre  
Teen Murti Marg, Chanakyapuri  
New Delhi 110 021, India  
T 91 11 2301 0199 F 91 11 2301 5452  
[research@nasscom.in](mailto:research@nasscom.in)  
[www.nasscom.in](http://www.nasscom.in)