Leveraging Talent Globally to Scale Indian Innovation

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India has all the ingredients needed to become a global driver of innovation: It has a strong market potential, an excellent talent pool, and an underlying culture of frugal innovation. Innovative countries have demonstrated the leverage of their cultural advantage to capture markets. Japan leveraged its cultural emphasis on 'efficiency and team work',[1] to revolutionize the manufacturing and engineering industries. The Republic of Korea (Korea) utilized its cultural emphasis on 'speed',[2] and it built world-class companies such as Samsung and LG. China has sustained a GDP growth in excess of 10% for more than two decades by virtue of its 'ability to scale.'[3] The United States of America (USA) and Israel have leveraged the diversity of their populations to lead innovation globally.

Similarly, India can build on its cultural bias of frugality and sustainability to capture markets not only within its shores but globally. For this to happen, however, India's industries need to have the hunger to be at the top of the value chain, its customers have to be more demanding, its policies have to be more transparent, and its talent pool has to get more hands-on experience while simultaneously growing to leverage the global talent pool.

Leveraging global talent

An often-cited example of a US company leveraging global talent is that of General Electric (GE). GE has been an early pioneer of globalizing research with its centres in India, China, Germany, and Brazil, in addition to the parent research centre in the USA. The centre in Bangalore, the John F. Welch Technology Center (JFWTC), was set up in September 2000 at its present 50 acre campus. Today the JFWTC is home to over 4,000 researchers and engineers contributing to product development and intellectual property filed and owned by the parent GE. Close to 2,000 of the 30,000 patents awarded between 2011 and 2016 to GE have Indian inventors from the JFWTC and Indian talent in other global centres.[4] Contributions from the JFWTC include low wind regime wind turbines, locomotive designs for emerging markets including India, low-cost ultrasound and ECG machines, and aircraft engine component designs.[5] Going by awarded patents, other global companies with strong contributions from Indian inventors include IBM, Intel, Qualcomm, and Google (see Table 1). An interesting aspect of these data is that US companies, especially GE and IBM, have leveraged Indian inventors more than non-US companies have. This could point to the fact that the Asian companies have only recently started leveraging talent outside their own geographies.

Similarly, Indian corporations show an increasing trend in patent filing and a healthy leverage of global talent, as shown in Table 2.

Innovating for the immediate needs of the Indian market

As India embarks on its innovation journey, Indian corporations and the government should first focus on the significant internal market needs in the energy, water, transport, healthcare, food security, and digital products and services sectors to deliver tangible human and environmental benefits. India should build out its own capabilities while simultaneously leveraging global talent to speed up delivery in these critical sectors. Identified below are the opportunities and challenges in the six sectors:

- **Energy.** India would need to generate 0.5 kW of electricity per person to provide a reasonable level of opportunity to its population. Based on current population projections for 2025, India needs to increase its generation capacity by 2.5, from roughly 280 GW to 710 GW. The energy requirement of 0.5 kW per person is roughly half of the European average and a quarter of the US average. Transmission and distribution capacity should be upgraded accordingly.[6]

Table 1: Contributions of Indian inventors to patents granted to multinational corporations

Company	Patents granted (total, 1 January 2011 to 31 March 2016)	Patents with at least one Indian inventor (total)	Patents with at least one Indian inventor (%)
GE	29,001	1,966	6.8
IBM	45,527	1,894	4.1
Intel	16,542	284	1.7
Amazon	3,631	62	1.7
Google	12,116	192	1.5
Microsoft	24,696	365	1.4
Qualcomm	32,218	421	1.3
Samsung	95,298	441	0.46
Apple	14,007	31	0.22
LG	71,443	47	0.06
Sony	47,336	9	0.01
Toshiba	51,703	8	0.01
Toyota	53,122	6	0.01
Canon KK	56,987	3	0.005
BMW	75	0	0

Data source: Patent Inspiration, http://www.patentinspiration.com/.

- **Water.** India needs to double its available usable water from 1,000 to 2,000 cubic metres per person per year; less than 1,700 cubic metres of water per person per year is considered by the United Nations to be water-stressed.[7] To put this into perspective, currently the USA provides 8,000 cubic meters of water per person per year to its citizens. Furthermore, India needs to double the sewage treatment facilities in its urban areas to even meet its current needs.[8]
- **Transportation.** It is estimated that India will add 1,000 passenger and freight locomotives over the next 10 years, and the passenger and freight aircraft market will grow to US$100 billion or more by 2025. A detailed analysis of India's transportation sector is available in the report submitted to the Prime Minister of India by the National Transport Development Policy Committee in 2013–14 entitled *India Transport Report: Moving India to 2030*.[9] In regard to road transportation, the Government of India aims to make automobile manufacturing the main driver of its Make in India initiative, as it expects the passenger vehicles market to triple, reaching 9.4 million units by 2026, as highlighted in the Auto Mission Plan (AMP) 2016–26.[10] Efficiency, emission control, and light weighting will continue to drive the next generation of transportation in India.
- **Healthcare.** In order to provide sufficient healthcare for its citizens, India will need to boost its healthcare spend from its current 4% of GDP to 5.5% of GDP, as noted by the McKinsey report prepared for the Confederation of Indian Industry (CII) *India Healthcare: Inspiring Possibilities, Challenging Journey*. The report presents a vision for India's healthcare with clear goals and the steps that will need to be taken to achieve those goals by 2022.[11]
- **Food Security.** India will have to develop innovative, accessible, diversified food plans and supply chains to enable a diet that supplies at least around 2,100 kilocalories per capita per day for the urban population and 2,400 kilocalories per capita per day for the rural population.[12]
- **Products and Services for the Digital Consumer.** It is expected that by 2030 more than a billion Indians will be online.[13] Digital consumers today are connected individuals who leverage their interconnectivity as much as their Internet connectivity for purchasing products and services. From mobile wallets to digital lockers, digital consumers will redefine commerce as we know it.

Building innovation competence: Indian IT and automotive industries

The Indian information technology (IT) industry is discussed in the following paragraphs to outline the historical context of global leverage of Indian talent and the subsequent leverage of global talent by Indian industry. The chapter then focuses on the automotive industry as an example of a sector where global talent has played a role in the maturing of the Indian industry.

The Indian IT industry: Moving up the value chain

During the era of protected markets, companies in emerging markets predominantly focused on products based on dated technology and adapted them to local needs with local manpower. However, with emerging markets opening up to global players, traditional companies have focused on processes to improve product quality and operational efficiencies to remain competitive. Simultaneously, several start-ups seized this opportunity in sunrise sectors, specifically in the Indian IT sector, to leverage the low-cost talent available in India to initially execute manpower intensive projects for mature markets. Companies such as Tata Consultancy Services (TCS), Infosys, and Tech Mahindra have progressively expanded their scale and scope to move up the value chain with a global centre and workforce and have transformed themselves into major international players.

Table 2: Indian companies filing globally and leveraging global talent, 1 January 2011 to 31 March 2016

Company	Patents granted (total, five years)	USA	China	Australia	European Patent Office	Canada	Patents with one or more non-Indian inventors (total)
Infosys	281	275	2	1	0	0	81
TCS	244	170	22	25	4	2	21
Ranbaxy	196	58	10	23	26	8	35
Wockhardt	160	54	9	13	16	19	45
Sun Pharma	84	21	8	6	10	2	24

Source: Patent Inspiration, http://www.patentinspiration.com/.

Tata Consultancy Services: An example of leveraging talent globally

TCS established its first research centre, the Tata Research Development and Design Centre (TRDDC), in Pune, India, in 1981. The TRDDC undertakes research in software engineering, process engineering, and systems research. It is also the largest research and development (R&D) facility among the network of innovation labs at TCS.

In the USA, TCS opened centres in Cincinnati and Santa Clara with the goal of fostering research by leveraging specific talent and ecosystems available in these cities. TCS Innovation Labs in Cincinnati, established in 2008, employs more than 900 workers. This centre was created to nurture research in the areas of supply chain management and manufacturing technologies. The empowered team of researchers, located in both Cincinnati and Bangalore, is extensively engaged in co-innovation partnerships with their global partners including Purdue University, the Indian Institute of Science, and Oklahoma University. This team is piloting innovative platforms such as the supplier social network and is excited about shaping the TCS research agenda in the emerging area of cybersecurity across applications in the automotive, supply chain, and Internet of Things sectors.

The TCS Silicon Valley Customer Collaboration Center in Santa Clara, California, which was officially opened on 31 January 2012, is designed to provide an open, innovative, and collaborative workspace that adopts the entrepreneurial spirit and best practices employed by the world's leading start-up companies in Silicon Valley. With a state-of the-art Usability Test Lab, the centre serves as the worldwide headquarters of TCS's Mobility Solutions platform, incorporating the benefits of emerging technologies such as big data, analytics, and mobility into TCS's technology palette.

Furthermore, as one of the early adopters of collaborative innovation, TCS has actively pursued the development of new models for research and innovation. TCS's Co-Innovation Network (COIN™) includes companies with thriving, customized innovation ecosystems that enable the development of breakthrough solutions. The COIN™ network comprises leading university and research communities, tech start-ups, venture capital firms, industry analysts, and senior industry executives. Anchored at the TCS Innovation Labs across multiple cities, COIN™ provides an environment for sophisticated IT research in leading-edge technologies across various domains with the aim of delivering innovative solutions that can be globally sourced and customized to requirements.

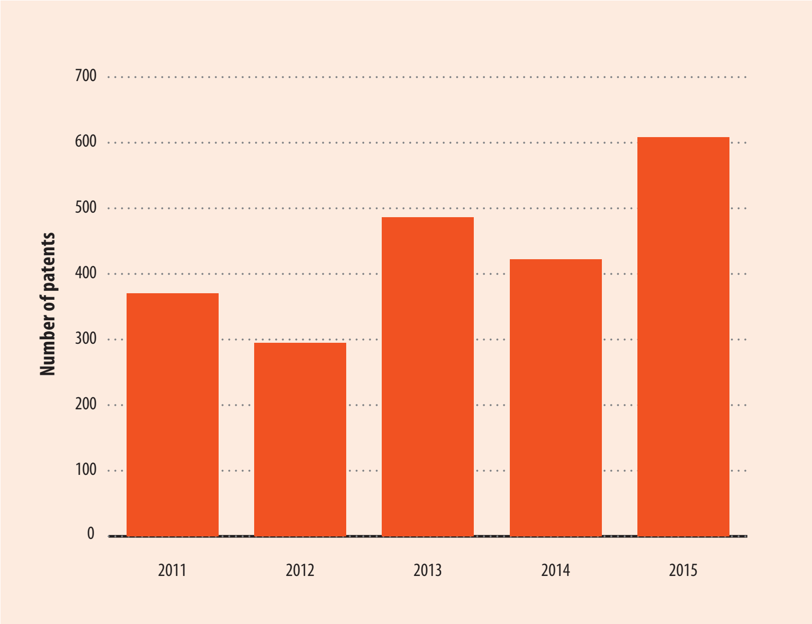
The strategic approach of TCS in building a strong Indian research base and combining it with talent at its global centres is reflected in the steady accumulation of intellectual property, as shown in Figure 1. Some of the granted patents are also well cited, indicating the relevance of the patents in the industry.

The evolution of the Indian automotive industry

The Indian automotive industry is another good case study that illustrates a transition for both Indian and global players over the past two decades.

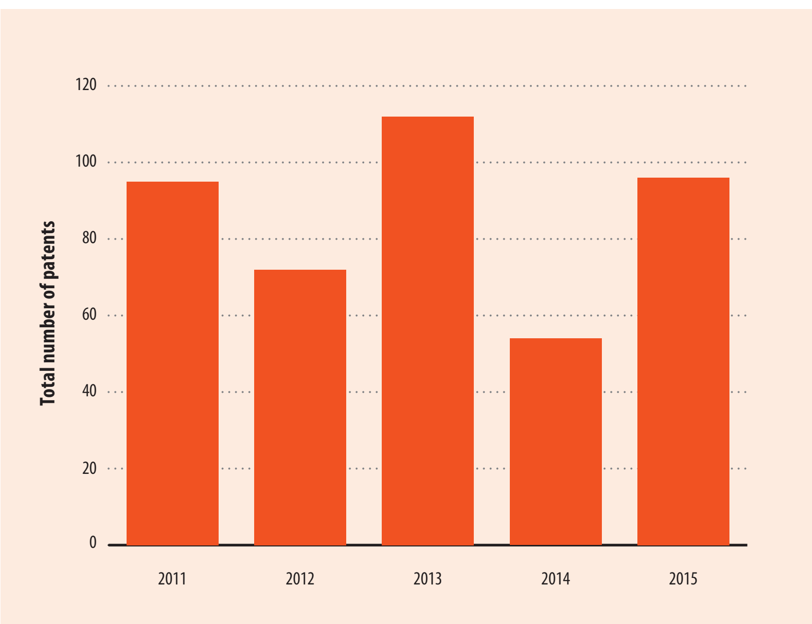
During its initial phase, the market needs drove the formation of several joint ventures between major international original equipment manufacturers (OEMs) and big Indian conglomerates. Examples include TVS Suzuki, Mahindra Ford,

Figure 1: TCS's globally published patents, by year of publication



Data source: Patent Inspiration, augmented with data from InPAAS for India patents.

Figure 2: Mahindra patents: Published patents including granted patents



Data source: Patent Inspiration, augmented with data from InPAAS for India patents.

Daewoo Shriram, and Hero Honda. The major objective was to launch global products and technology in India with a focus on localization for Indian conditions and consumer requirements. Although many of these partnerships were short lived, they created a strong pool of local engineering talent with exposure to global manufacturing systems, processes, and quality standards. During this period, the quality of products manufactured in India improved considerably. Subsequently, when statutory regulations synchronized with global standards were ushered in by the government, updated technology features needed to be introduced at a cost affordable to Indian customers.

Given the advantage of local market knowledge, Indian companies such as Tata Motors, Mahindra, Ashok Leyland, and TVS shifted their focus to product development. Although these companies significantly increased their investment in their own product development centres in India, they also collaborated extensively with global consultants and suppliers to accelerate their learning process. These companies reached out to mature automotive markets such as the one in the USA to recruit talented and experienced professionals to lead their product development initiatives. One outcome of this incorporation of global talent was that several products were successfully designed, developed, and launched in India for India, with a frugal engineering approach.

One such success story is that of the Scorpio vehicle, launched by Mahindra in 2002 and developed under the leadership of Pawan Goenka, who joined the company after spending more than two decades at the GM Research Labs in Detroit. Indian customers quickly embraced the Mahindra Scorpio vehicle despite the fact that it did not reach global standards because of its extremely attractive value proposition. This vehicle has maintained its place in the Indian market for more than a decade with a strong brand loyalty. This loyalty is mainly the result of periodic upgrades and quality improvement, which bridge the gap with global products, and yet it continues to provide an affordable price that meets customer expectations.

During the same period, some of the global automotive players, such as Hyundai and Ford, continued investing in manufacturing and sales operations in India. This strategy enabled them to access the local supplier ecosystem, leading to product cost reduction through increased local content in their products. In addition, their direct presence in the Indian market accelerated their understanding of emerging market customer expectations. The result was several product designs that cater to India and similar markets globally.

Late entrants such as Renault Nissan formed several joint ventures with Indian companies to access the local ecosystem and talent pool. Although most of these partnerships did not last long, their continued focus in India has helped them establish a strong presence in the Indian market within a very short time. The large-scale manufacturing operations set up by the global OEMs have been transformed into major export hubs for vehicles manufactured in India to global markets. The two major ports in the southern city of Chennai—the manufacturing base of major global OEMs such as Hyundai, Ford, and Nissan Renault—handle about 400,000 vehicles per annum. Last year, Hyundai alone accounted for more than 100,000 vehicles exported from the Chennai Port.

Table 3: Automobile export trends, aggregated for local and international OEMs

Category	2009–10	2010–11	2011–12	2012–13	2013–14	2014–15
Passenger vehicles	4,46,145	4,44,326	5,08,783	5,59,414	5,96,142	6,22,470
Commercial vehicles	45,009	74,043	92,258	80,027	77,050	85,782
Three wheelers	1,73,214	2,69,968	3,61,753	3,03,088	3,53,392	4,07,957
Two wheelers	11,40,058	15,31,619	19,75,111	19,56,378	20,84,000	24,57,597
Total	18,04,426	23,19,956	29,37,905	28,98,907	31,10,584	35,73,806

Source: Society of Indian Automobile Manufacturers.

Sustained investment by Indian companies for more than a decade with the goal of establishing indigenous product development capabilities has created an ecosystem of skilled professionals across the country. While public investment by the government over the last two decades led to the creation of state-of-the-art infrastructure for vehicle testing and homologation, several technical centres that match global standards have been created by Indian companies to ensure that they are able to sustain competitiveness in the market with a slew of new product launches.

A good example of such a product development centre is the Mahindra Research Valley (MRV), which was established in the outskirts of Chennai with an investment of more than 700 crores Indian rupees (₹). Infrastructure at MRV rivals that of most global automotive R&D centres. The uniqueness of this campus, which has more than 2,500 engineers, is that it is arguably the only integrated R&D centre in the world that is involved in product development activities for both automobiles and tractors. This unique synergy has enabled the company to successfully launch several new products on the market, such as the XUV5OO, TUV3OO, and KUV1OO sport utility vehicles and the Nuovosport by leveraging the shared talented workforce for both sectors. Similar to the products of multinational operations in India, these products not only cater to the Indian market but are also exported globally. Vehicle exports from both local and international OEMs have registered an impressive growth during the last decade, as illustrated in Table 3.

The XUV5OO vehicle, which was the first product developed at MRV, is a classic example of frugal engineering that incorporates state-of-the-art technology without the frills to make a product accessible to cost-conscious customers in emerging markets. Such product development initiatives have been made possible by engineers at MRV, both local workers and expatriates, collaborating extensively with global consultants and international suppliers to bring sophisticated features to the vehicle in a simplified form. Since its launch, this product has outsold all global and local competitors in the Indian market by offering a very attractive customer value proposition. It is a testament to the collaborative efforts of engineers working across the world with a focus on developing a product to meet the unique customer requirements in emerging markets. Moreover, focus on new product development has created substantial intellectual property for Mahindra, as depicted in Figure 2.

Global automotive players such as Bosch, Cummins, Fiat Chrysler, GM, and Renault Nissan also tapped into the availability of qualified engineering professionals by establishing their captive development centres in India. Most of the engineers at these centres worked closely with experienced professionals across the globe, thus reducing product development costs for global companies while at the same time accelerating the transfer of skills across borders within a short time.

With increasing software and electronic content in the vehicles, such collaborations extended beyond Indian development centres. Several partnerships were established outside the traditional automotive domain, specifically with the already-mature Indian IT industry. Several other models of collaboration are also being attempted to leverage the highly skilled software professionals available in India, although these are finding limited success.

One such unconventional partnership was the joint venture between an Indian OEM (Ashok Leyland) and a global Tier 1 supplier (Continental AG, then Siemens VDO) called Automotive Infotronics. Its main objective was to leverage the market knowledge of the Indian player and the knowledge repository of the global partner to design and develop technology products that would meet local customer requirements at a new price performance point. Through this partnership, quite a few products were created for the commercial vehicle market segment that challenged the conventional wisdom on product cost and performance. In addition, the cross-pollination of ideas between German and Indian engineers also accelerated the development of solutions for customers in other markets. Although Automotive Infotronics did not survive because of an expectations mismatch between the Indian and German partners, the products they developed are still manufactured by Continental in India. Automotive Infotronics remains a good example of building talent in emerging markets using global partnerships.

Through its journey over the past two decades, the Indian automotive industry has fully integrated itself into the global market while maintaining its uniqueness, both in terms of market potential and in terms of the availability of skilled talent. Over the past few years the difference between the strategies of the local and global players has been significantly reduced since both have gone through the learning curve, albeit for different competencies, and are now competing in the market place as equals.

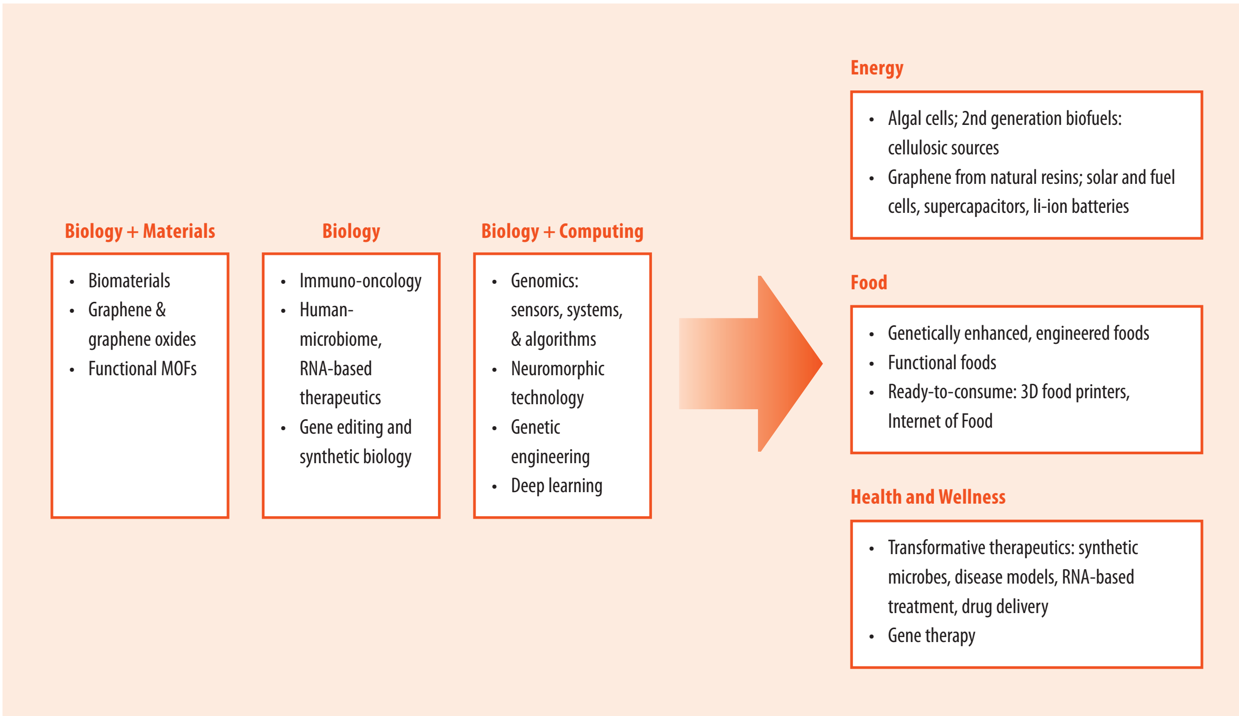
Both the multinational corporations and the Indian conglomerates have benefitted from the partnering of engineering talent across borders. Some multinationals, such as Suzuki, acquired Maruti operations in India to leverage the talent available in their Indian R&D centre to develop global products. The Indian conglomerates, on the other hand, have successfully taken over ailing operations of global companies to gain access to their global technical resources. Examples include the successful turnaround of Jaguar Land Rover after it was acquired by Tata Motors and Ssangyong after it was acquired by Mahindra. This inorganic growth has also enabled Indian companies to tap into global product development talent.

Global players such as Renault Nissan and Hyundai now have India-specific product strategies and leverage these strategies for other emerging markets. Similarly, Indian companies have established technical centres in Europe and the USA not only to develop products for emerging markets but also to enable their entry into mature markets. Examples include Tata Motors and Ashok Leyland, which established R&D centres in the United Kingdom (UK).

Tata Motors, in addition to their R&D centre in India, has design and R&D presence in the UK, Italy, and Korea. The centre of excellence in the West Midlands, UK, Tata Motors European Technical Center (TMETC)—a wholly owned subsidiary of Tata Motors—was established in 2005. One of the main reasons for having an R&D centre based in the UK was to provide a gateway to European technology, processes, personnel, and R&D. In addition to the core team of 250 members at TMETC today, a design studio in Coventry and a prototype workshop located in Gaydon have also been set up. One area that grew out of the advanced engineering at TMETC was a focus on electric and hybrid vehicles. TMETC has played a major role in helping the parent company augment capabilities in aspects such as craftsmanship, electrical system design, and platform strategy. TMETC has also provided a strong and active link to collaboration with UK and European research programmes and funding.

Recently, Mahindra has been aggressively adopting this same approach by establishing the Mahindra North American Technical Center (MNATC) in Detroit in the USA, taking controlling stakes in PSA Peugeot Citroën's motorcycles unit and also acquiring Pininfarina, the legendary Italian car designer responsible for the design of the iconic cars of Ferrari, Maserati, Rolls-Royce, and Cadillac. MNATC is currently bidding on the US Postal Service's next-generation delivery trucks.

Figure 3: Examples of opportunities at the intersection of biology, computing, and materials



Note: MOF = Metal organic framework.

This centre, which was formed just two years ago, has grown significantly and employs more than 100 engineers with decades of product development experience. Such initiatives by Indian and multinational OEMs result in the creation of a global network of product development engineers and transnational companies. Through this network they can maximize the talent available in each region to develop products to not only cater to emerging market requirements but also for the global markets.

Opportunities for leadership: Innovation in emerging sciences and materials

The previous section describes an India market-pull approach to innovation. In order to play a leadership role in innovation, India should also develop a technology-push strategy. Indian start-ups should accelerate innovating for the digital economy and large corporations, and universities should develop new opportunities at the confluence of emerging scientific knowledge and materials. One such opportunity is the intersection of biology, computing, and materials. New developments in areas such as genomics, connectomics, deep learning, graphene, and metal organic frameworks provide the palette to create global first products and services. Applications include developing sustainable fuels for transportation, predicting and preventing disease, determining ways to improve wellness, and delivering better nutrition.

This section explores some specific areas of opportunity presented by these emerging scientific knowledge and materials (see Figure 3).

The human genome project, which was officially declared complete in 2003, was a major milestone in human technological history. In 2009, the human connectome project was launched and is providing further fuel to modify the technological landscape. The connectome will provide a map of the human nervous system, just as the genome provided the map of the human DNA. A further development is the human microbiome, which is the genetic understanding of the trillions of microbes that are symbiotically part of the human system. The microbes in the gut, as examples, are now considered an important aspect of human health and the immune system. In addition, with a better understanding of our genes,[14] RNA,[15] and the proteins associated with health and disease, RNA-based therapeutics is now viable.

Precision genetic engineering using CRISPR (clustered regularly interspaced short palindromic repeats) has been heralded by *MIT Technology*

Table 4: Patents published in the last 20 years, based on inventor country

	Inventor location					
Patent topic	USA	China	Israel	UK	India	Others
Deep learning	328	135	4	15	3	Canada: 24 Japan: 18
CRISPR	893	255	15	42	2	France: 126 Germany: 48 Japan: 38
MOFs	912	381	75	71	33	Germany: 373 Korea, Rep.: 155 France: 99
Graphene	15,570	9,997	195	1,131	333	Korea, Rep: 4,712 Japan: 4,042 Germany: 1,426
Connectome and microbiome	2,192	163	32	179	28	Switzerland: 448 France: 313 Netherlands: 297

Source: Patent Inspiration, http://www.patentinspiration.com/.
Note: CRISPR = clustered regularly interspaced short palindromic repeats; MOFs = metal organic frameworks.

Review as the 'biggest biotech discovery of the century'.[16] CRISPR is a natural part of microbial (bacterial) DNA. CRISPR, interestingly, is a snipped copy of a virus DNA extracted from previous attacks on the microbe. CRISPR is used by the microbe's immune system to identify and disable new virus attacks. Recent understanding of CRISPR has led to CRISPR-based technology that allows scientists to snip any target DNA at precise location(s) and potentially replace the segments with repair strands. This technology hence has the ability, as already demonstrated in mice, to cure genetic disorders. Moreover, the technology has a range of possible applications, from producing pest-resistant crop to increasing the energy yield of biomass. These advances clearly herald the overdue age of biology and the consequent 'biofication' of other technologies.

Over the past two years, deep learning algorithms that attempt to mimic the human brain have demonstrated the power of computational biofication, particularly in voice and image recognition. In March 2016, Lee Sedol—one of the world's best players of the game of Go—lost 5 to 1 to AlphaGo, a deep learning software. Go is considered to be far more difficult for a computer algorithm to master than games such as Chess. The recent advances in deep learning are attributable to new training algorithms and increased computational power. The new training algorithms incorporate different levels of abstractions in multiple layers of learning networks, thereby enabling better utilization of layered networks. Improved hardware and the ability to handle large volumes of data now enable combining supervised and unsupervised networks to solve complex cognition problems.

While deep learning is an example of leveraging biology into computation, personal genomics is an example of the leverage of computation into biology. Personal genomics is now a reality, with an individual genome being sequenced in 2016 for US$1,000—down from US$10,000 in 2011. This accomplishment is a combination of biological, computational, and optical sensing innovations. Personal genomics will eventually enable the evolution of healthcare from a diagnose-and-cure model to a predict-and-prevent one.

Biomimetic structures ranging from roofs to hydrophobic surfaces have successfully incorporated evolutionary biological advantages into human creations. Simultaneously, advances in material sciences have offered progress in biological fields such as medicine. Recent material advances include metal organic frameworks (MOFs). MOFs are metallic ions joined together by organic ligands into structures that have a high porosity and active area. MOFs have demonstrated substantial potential for applications such as gas storage and separation. In medical applications, MOFs have shown promise in the delivery of drugs, imaging agents, and nitrogen oxide.

Graphene has been described as a 'wonder material' because of its high strength, high electric conductivity, high thermal conductivity, high flexibility, and high transparency. In medicine, the applications of graphene derive from its biocompatibility and high strength as leveraged in implants. Graphene oxide is also used for detecting specific toxins and in the targeted delivery of drugs and imaging agents.

It is interesting to note that the hotbed of innovation as measured by patent activity continues to be the USA, as shown in Table 4. Other regions, such as China and Korea, emerge as innovation hubs based solely on patent numbers. However, based on the citations of the patents, US universities and companies continue to lead in these emerging R&D areas. Furthermore, the importance of university research in creating a national innovation advantage is emphasized by the fact that many of the highly cited patents in the areas shown in Table 4 belong to universities.

Conclusions

India has the ability to create a unique spot in innovation history to meet its own market requirements by using its cultural advantages of frugality and sustainability. India's first priority for innovation should be its immediate internal needs in the areas of energy, water, transport, healthcare, food security, and digital consumption. In these market-pull areas, India should strengthen its own talent pool while also leveraging global talent. The examples from the IT and automotive sectors presented in this chapter demonstrate the role of global talent in meeting both local and export needs. In emerging research areas—such as at the intersection of biology, computing, and materials—industry R&D should double its investment and the government should provide direct R&D grants to industry. Industry and government should team up with universities to create meaningful graduate research programmes utilizing global collaboration models where appropriate. The government should adequately resource its intellectual property offices to grant intellectual property rights in a timely manner and to ensure proper enforcement of the law. With its positive demographic, political, and market outlook today, India has its best opportunity in many decades to position itself for a century of innovation.

Notes

1 Lean manufacturing and the Toyota Production System are process examples of Japan's focus on efficiency and team work.

2 'Palli Palli,' the often-used phrase meaning 'quickly quickly' in Korean, reflects the cultural emphasis on speed. Korea has the fastest Internet speeds in the world, an example of its emphasis on speed.

3 According to Forbes (2014), 'there are more than 40 Chinese phrases (*Chengyu*), to encourage children and adults to have big dream for their future'. See Forbes, 2014.

4 The patent numbers referenced in this chapter are obtained using Patent Inspiration: http://www.patentinspiration.com/. The patent inspiration database has data for all major global jurisdictions. The India-specific data is populated from CY 2015.

5 See the GE Global Research website at http://www.geglobalresearch.com/locations/bangalore-india/technology-and-discovery.

6 Gupta et al., no date.

7 For information about the UN's work on water scarcity, see http://www.un.org/waterforlifedecade/scarcity.shtml.

8 Luthra and Kundu, 2013.

9 National Transport Development Policy Committee, 2014.

10 Information about the Automotive Mission Plan is available at http://www.siamindia.com/uploads/filemanager/47AUTOMOTIVEMISSIONPLAN.pdf and http://www.siamindia.com/cpage.aspx?mpgid=16&pgid1=17&pgidtrail=83.

11 Gudwani et al., 2012.

12 Tandon and Landes, 2012.

13 The Economist, 2016.

14 Genes are portions of deoxyribonucleic acid, or DNA, that encode proteins.

15 Ribonucleic acid, or RNA, is the macromolecule that translates genes to proteins.

16 Regalado, 2014.

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