BROOKINGS INDIA

Building a Design Economy in India

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Highlights of Main Findings

- India has design capacity in the number of patents granted that is approximately 3 percent of China and less than 2 percent of the U.S.A.
- India has industrial design capacity that is approximately 1 percent of China and 6 percent of the U.S.A.
- Historically, non-resident entities have been granted the most number of patents within India.
- Since 2012, more patents have been granted to Indian entities abroad than the number of patents granted by the Indian government to either resident or non-residents entities within India.
- While in India and the U.S.A. the most number of patents are annually granted to non-resident entities, in China the most number of patents have been granted to resident Chinese entities in all years since 2008.
- Among the broad economic factors that affect design economy in India, the role of higher education, FDI, digital connectivity, infrastructure and trade have been identified as the most important.
- Some specific policy recommendations to boost design economy in India are:
    - Curricular reform for research and development in higher education
    - Workforce development for R&D sector
    - Establishing design labs and special economic zones to focus on R&D
    - Developing and enforcing domestic legislation for intellectual property protection
    - Promoting greater collaboration between business, government, and academia

1. Introduction

Prime Minister Narendra Modi has attracted considerable attention with his "Make in India" initiative. With a vision for expanding manufacturing and attracting foreign direct investment, the chief executive hopes to use manufacturing to create jobs and stimulate overall economic activity. His goal is to create 100 million new jobs in the coming 10 years and boost that sector's contribution to Gross Domestic Product from its current 15 percent to 25 percent. India's present number lags the 34 percent for manufacturing in Thailand, 32 percent in China, 31 percent in the Philippines, and 24 percent in Malaysia and Indonesia.[1]

Yet there is more to manufacturing than building things. Manufacturing is the production of physical goods, while design involves the way in which people construct products, devise business processes, and think about service delivery for society as a whole. Conceived in such a manner, 'design' is a vital part of economic development, system operations, and overall quality of life. It refers to "solutions to the most complex and challenging problems facing humanity today – problems requiring not just local fixes using clever design objects, but solutions that re-imagine systems."[2] Design is an idea that philanthropist Melinda Gates has called "the single greatest driver of social change."[3] Relying upon the principles of creativity, functionality, and user friendliness, design creates tremendous opportunities to create jobs, boost small and medium-sized enterprises and improve trade balances.

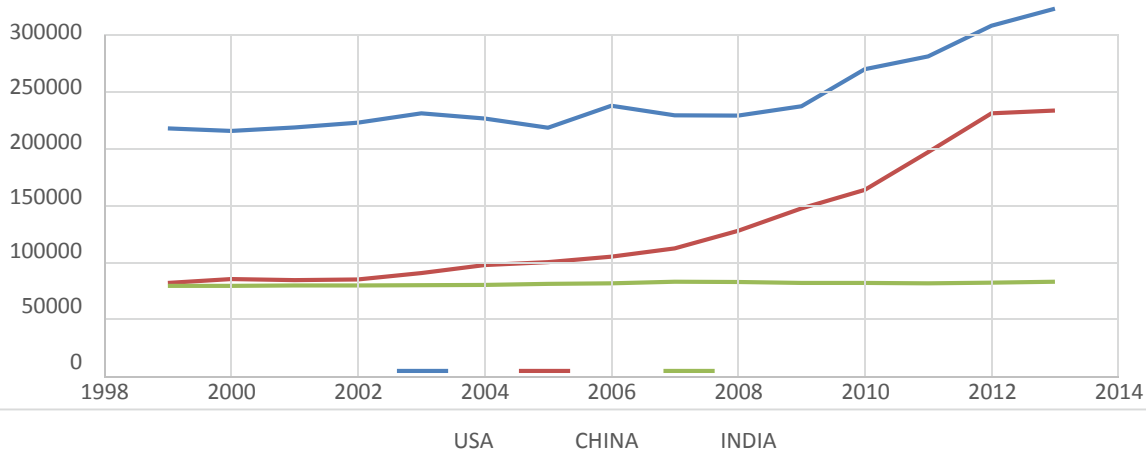
In this paper, we outline the manner in which design can help promote the Indian economy. We look at the status of design in India, review the country's development challenges, discuss the opportunities of a design economy, and make recommendations to enhance design in India. Briefly, we argue that India has competitive advantages in design. But to gain from these possibilities, it is important to develop relevant skills, reform school curricula, set up design labs, strengthen intellectual property rights, and promote greater collaboration between business, government, and academia. Making progress on these issues would enhance India's overall economy.

2. The Status of Design in India

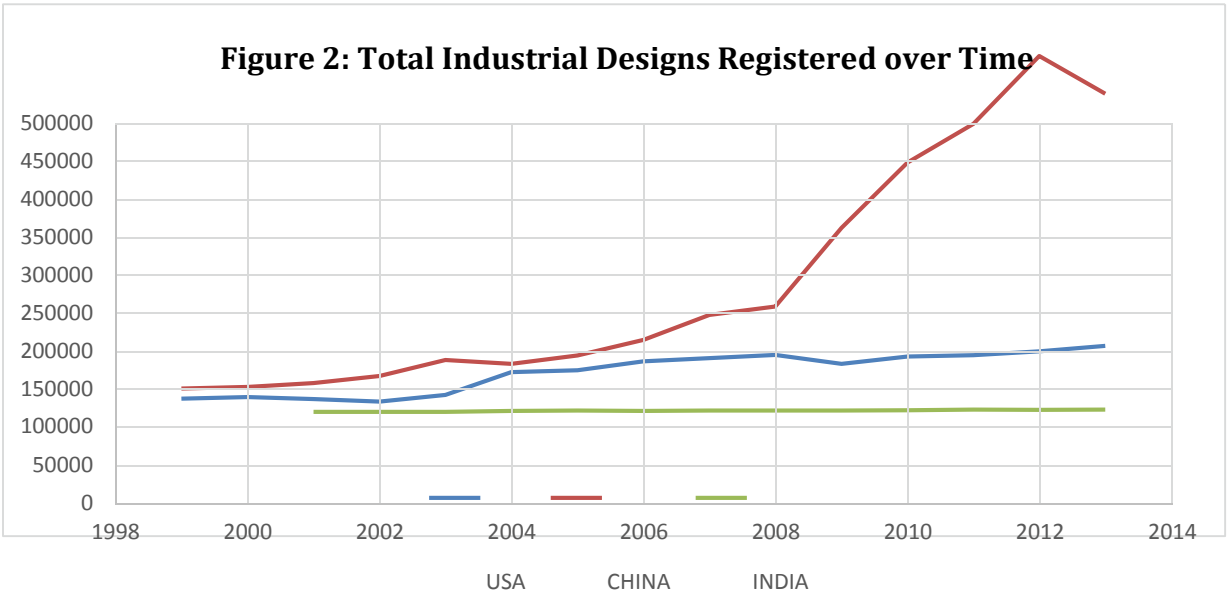
Patenting is integral to design because it involves how products are put together. The latest patent and industrial design data from the government indicates that 4,388 patents were granted in India in 2013. These are miniscule numbers compared to global data from World Intellectual Property Organization (WIPO) for the United States of America (U.S.) which is a global leader in innovation and China which is rapidly expanding its own rate of innovation. The global data shows that the U.S. granted 243,986 patents in 2013 and China granted 154,485 patents in the same year. So in terms of the number of patents granted, India is approximately 3 percent of China and less than 2 percent of the U.S (see Figure 1).

The numbers don't look very different when examining industrial designs registered in India during the same period. While India registered 5,077 industrial designs, China registered 420,888 and US registered 88,984 in the year 2013. (see Figure 2) So the number of industrial designs registered by India is approximately 6 percent of the U.S. and 1 percent of China. Innovation is one of the major factors that drive growth in an economy and India has a lot of ground to cover if it is to compete in the global space of innovation.

Figure 1: Total Patents Granted over Time



Source: World Intellectual Property Organization (WIPO)



Source: World Intellectual Property Organization (WIPO)

Beyond the total number of patents granted and industrial designs registered, it is very interesting to study who are filing patents and industrial design registrations in these countries. In looking at the distribution across the different categories of filers, the three categories are, (i) 'Resident' filers who are entities registered and residing within a country (say India), (ii) 'Non-resident' filers who are from other countries (non-Indian entities filing within India) and (iii) 'Abroad' filers which include filers going out to other countries (Indian entities filing outside the country). In India, historically the majority of patents have been granted to Non-resident entities, which peaked in 2008, as shown in Figure 3. But after the global recession, we see that the number of patents granted to non-resident entities in India has steadily fallen, though it remains significant as compared to other categories. The share of patents granted to Indian entities abroad has increased significantly over time and now their total number is more than patents granted to resident entities within India. Since 2012, more Indian entities have been granted patents abroad than patents granted by the Indian government to both resident and non-residents entities within India.

The data for industrial design, however, looks different from patents. Though overall the numbers are miniscule compared with U.S. and China there are interesting differences between categories of filers for industrial design registrations in India. Residents have

registered the maximum number of industrial designs in India, but all categories are witnessing an increase over time.

Figure 3: Patents Granted by 'Resident Category' (India)

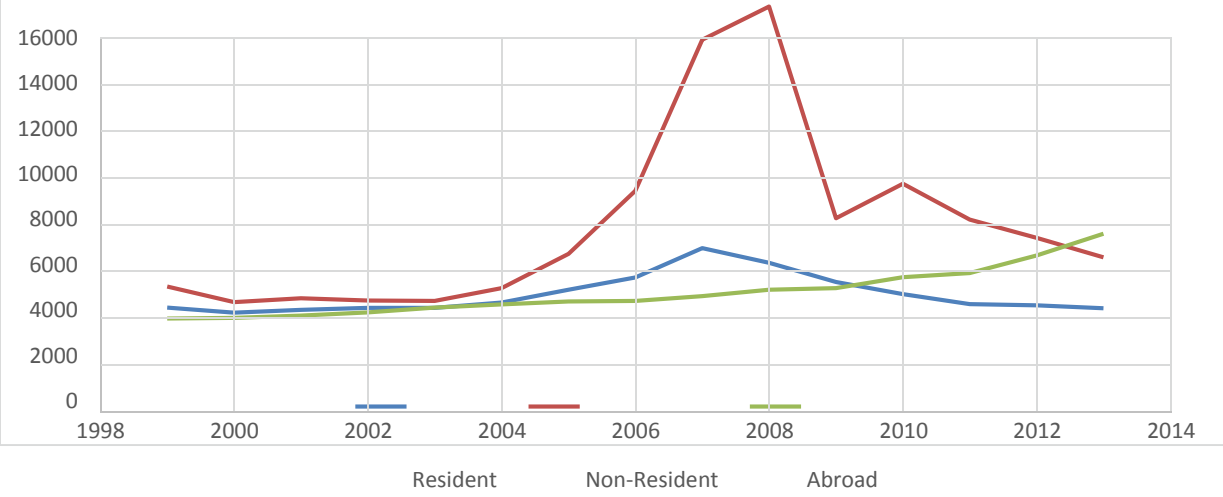
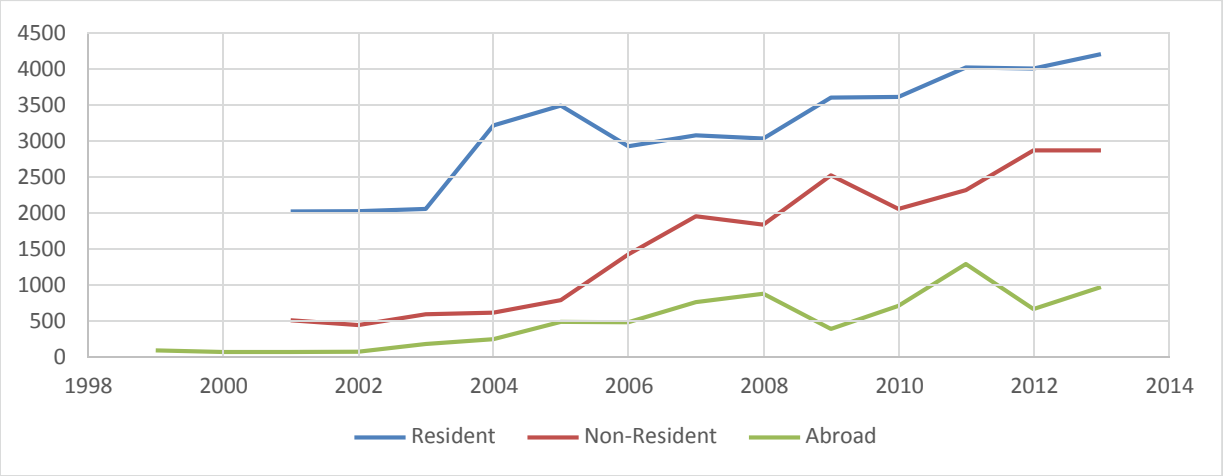


Figure 4: Industrial Designs Registered by 'Resident Category' (INDIA)



Source: World Intellectual Property Organization (WIPO)

We compare these disaggregated numbers for filer categories across the three countries and it reveals a stark variation. Chinese IPR performance can be gauged by the massive expansion in the number of patents granted to resident entities within China, which has overtaken the non-resident in 2008, post the recession and has rapidly grown since. The total number of

patents going to non-resident entities within China has become relatively flat since 2009. What is striking is the relatively small number of patents being granted to Chinese entities outside of China. Of course, to set the context right vis-à-vis India, this number is still ten times the number of patents granted to Indian entities outside of India. The gap is much more pronounced in the industrial design data where almost all registrations are from resident Chinese entities compared with non-resident Chinese entities and Chinese registering abroad.

Figure 5: Patents Granted by Resident Category (CHINA)

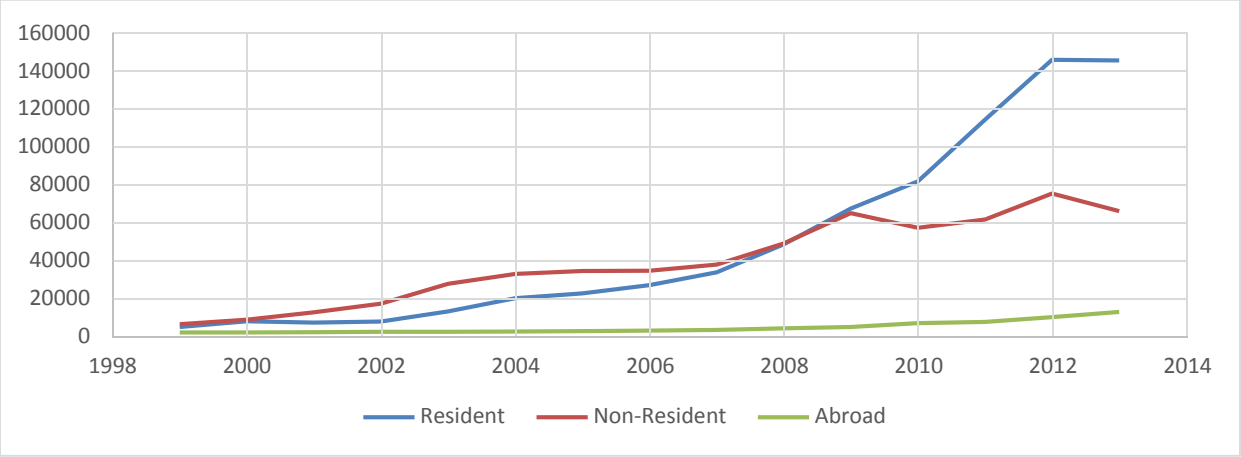
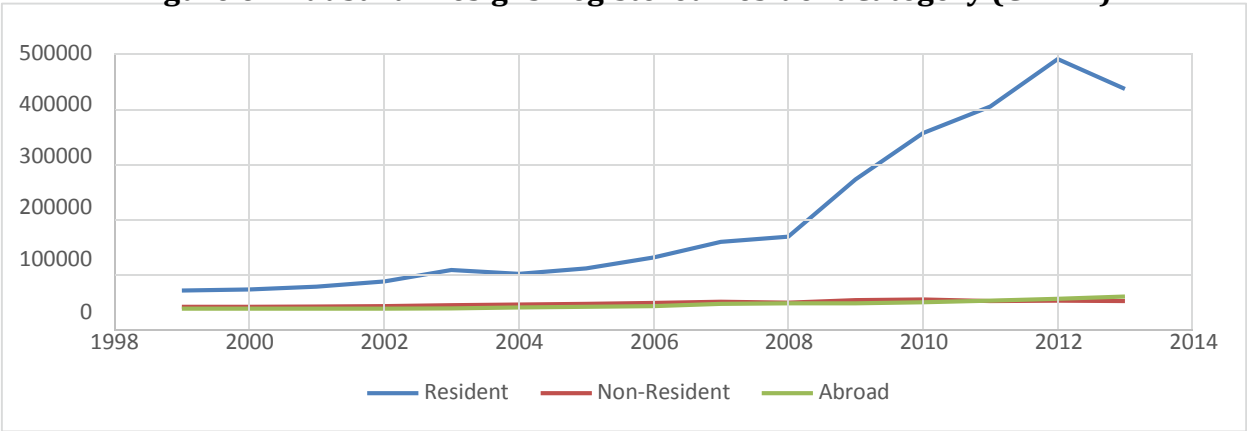


Figure 6: Industrial Designs Registered Resident Category (CHINA)



Source: World Intellectual Property Organization (WIPO)

The U.S., in comparison, has witnessed a relatively more equal growth in the number of patents granted to all three categories of filers. In absolute terms, however, the total number

of patents granted to non-resident U.S. entities has now overtaken resident U.S. entities. This change has happened steadily over the decade from year 2000 to 2010. Compared to India and China, significantly more patents have been granted to American entities globally (110,393 patents outside U.S.) than to Chinese entities (10,950 patents outside China) and Indian entities (3,794 patents outside India). In terms of the number of industrial designs registered, we note that a very large number of such registrations were made by U.S. entities abroad than registrations made in the U.S. either by residents or non-resident American entities. This is somewhat expected given the expansion of US manufacturing firms globally over the last 20 years, and rapid outsourcing or manufacturing production.

Figure 7: Patents Granted by Resident Category (U.S.A.)

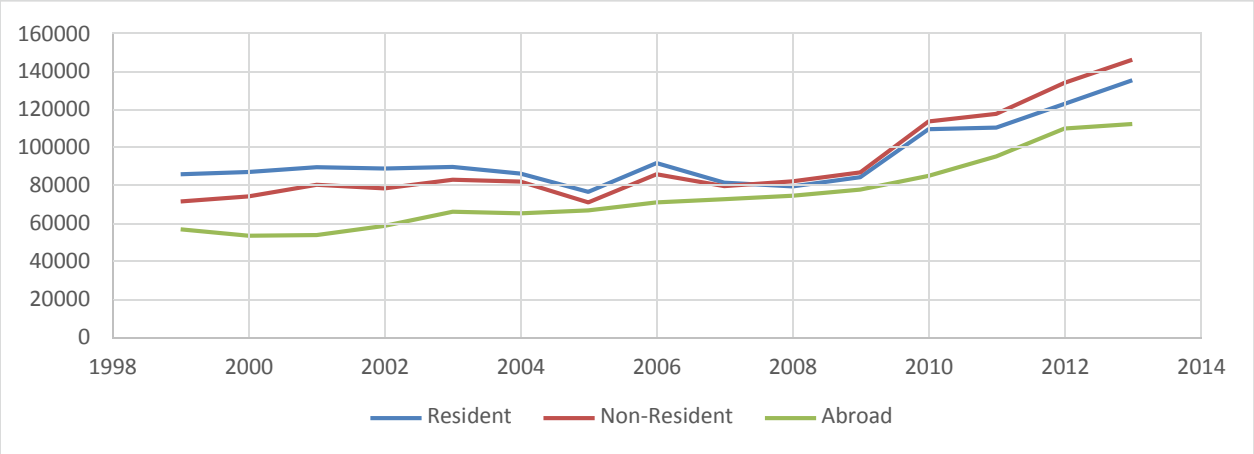
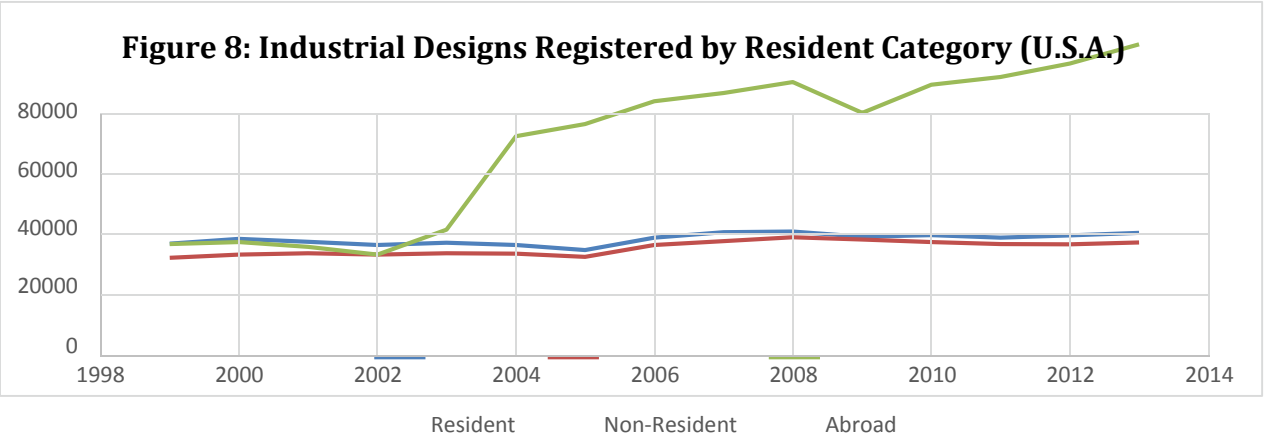


Figure 8: Industrial Designs Registered by Resident Category (U.S.A.)



Source: World Intellectual Property Organization (WIPO)

Given the very small numbers of patents in India and especially by domestic Indian entities, we begin by outlining a list of broad and specific challenges that India faces in the creation of a robust design economy to compete with the global leaders like U.S. and China. Then we proceed to analyze the opportunities that can emerge from having a thriving design sector within the country and its implications for long term growth.

3. India's Development Challenges: Broad Factors

For the creation of a robust design economy, India will have to address several large development challenges. This includes attracting foreign investment, developing infrastructure, providing digital connectivity, improving education, and promoting trade relations. In this section, we review the issues in each area and problems that they create for economic development.

(i) Attracting Foreign Direct Investment

India attracts less foreign investment than the growth potential that she possesses. For example, while China attracted around $1,531 per capita as financial in-flows between 2000 and 2014, India garnered $183 per capita.[4] Part of this underperformance is due to caps on foreign investment in construction, defense, railroads, and insurance, among other areas. Limits on the ownership stakes of non-Indian investors makes it difficult to attract foreign capital to India.

But there also are detailed licensing and permitting requirements that make it further complicated to do business in India. Foreign investors must go through detailed licensing requirements that slow the launch of businesses and expansion of employment. The difficulties in navigating the legal and regulatory environment weaken their capacity to build their businesses.

Despite these barriers, there are some signs that the investment climate is improving. For example, an Ernst and Young analysis found that venture capital investment rose from $600

million in 2006 to $1.4 billion in 2012. Regulatory changes linked to relaxing foreign investment restrictions and eliminating the capital gains tax are thought to have been major contributors to this increase.[5] With certain policy changes, it is possible to boost the amount of foreign capital that is flowing in to India.

(ii) Developing Infrastructure

Infrastructure is a major challenge in India, with there being several problems in terms of highways, trains, and power generation. Nearly 38 percent of the country's roads are unpaved, compared to about 16 percent in China. Freight trains operate at speeds about half those of Germany and the United States. In terms of electric generating capability, India averages about 173 units per thousand people, far below the 848 units of China.[6] For these reasons, the World Economic Forum ranks India, 87th in infrastructure in the world, well below the number 6 ranking for Japan, 7 for Germany, 46 for China, 48 for Thailand, and 76 for Brazil.[7]

There is a substantial gap between highway usage and quality in India. For example, roads transport, "60% of freight and 85% of passenger traffic" in India but a Global Competitiveness Report found that the country ranked 84 out of 148 nations in the quality of its roads.[8] Congestion is a major problem in most Indian cities and this limits the ability of businesses to manufacture, ship their goods, and export their products.

In addition, there are problems in terms of transportation interconnectivity. Both manufacturing and design require roads and ports that are interconnected. Both designers and manufacturers need transport systems that facilitate commerce and communications. This includes connections between schools, design labs, cargo ports, inland destinations, freight rail, and highways.[9] Integrating transportation hubs is a vital requirement for the 21st century economy.

Overall, the World Bank estimates that India needs to spend $1.7 trillion to upgrade its infrastructure in transportation, power, telecommunications, irrigation, water management, and solid waste management.[10] However, many of the private firms that devote resources to

infrastructure improvements have high debt levels. That limits their ability to make the necessary investments to improve infrastructure.

(iii) Providing Digital Connectivity

Digital usage remains low in India. Around 213 million people or 18 percent of the population has access to the Internet. Around 25 percent of Indians use mobile phones. About 9 percent of the population says that they use social media websites.[11]

However, these numbers are increasing dramatically. For example, the Internet usage is expected to rise to 236 million users by 2016 and to 500 million by 2017.[12] There is exploding demand for mobile communications and handheld devices are becoming very popular as a way to keep in touch with other people, transact business, and gain access to electronic services.

For digital and mobile usage to rise, though, there needs to be greater progress on digital connectivity. A survey in India found that "68 percent of mobile Internet users experience session failure and lengthy loading times while outdoors and 63 percent face quality and reliability issues indoors."[13] This limits the quality of the user experience and makes it difficult to take full advantage of the technology.

The Indian information technology sector generates about $88 billion a year, according to the National Association of Software and Services Companies. It directly employs around 2.2 million individuals and indirectly employs another 8 million people.[14] This area is one of the fastest growing segments of the Indian economy.

Demand for digital services is high in India. A survey by Ericsson found that currently 70 percent of respondents are using video streaming, 61 percent are using social networking, 54 percent are doing instant messaging or downloading music, 46 percent are using search engines, 45 percent are doing email, 40 percent are streaming music, 36 percent are banking online, and 35 percent are playing online games.[15] These figures likely will increase

substantially in coming years as businesses and consumers see the benefits of mobile technology.

(iv) Boosting Education

Improving education is perhaps the most crucial building block under any type of development plan. Currently, around 16.6 million Indian students are enrolled in higher education. This includes around 14.6 million at the undergraduate level and 2 million at the graduate level. However, only around 140,000 are in post-graduate research programs, suggesting that the country may not be producing enough people with the advanced degrees required for a 21st century economy.[16]

India's rate of higher education enrollment at 18 percent is below the 26 percent in China and 36 percent in Brazil. Globally, about 27 percent of the young adult population is enrolled in colleges or universities. By the end of this decade, Indian leaders hope to boost higher education enrollment to 30 percent of that population. If it achieves this goal, that would double enrollment totals to around 40 million students.[17]

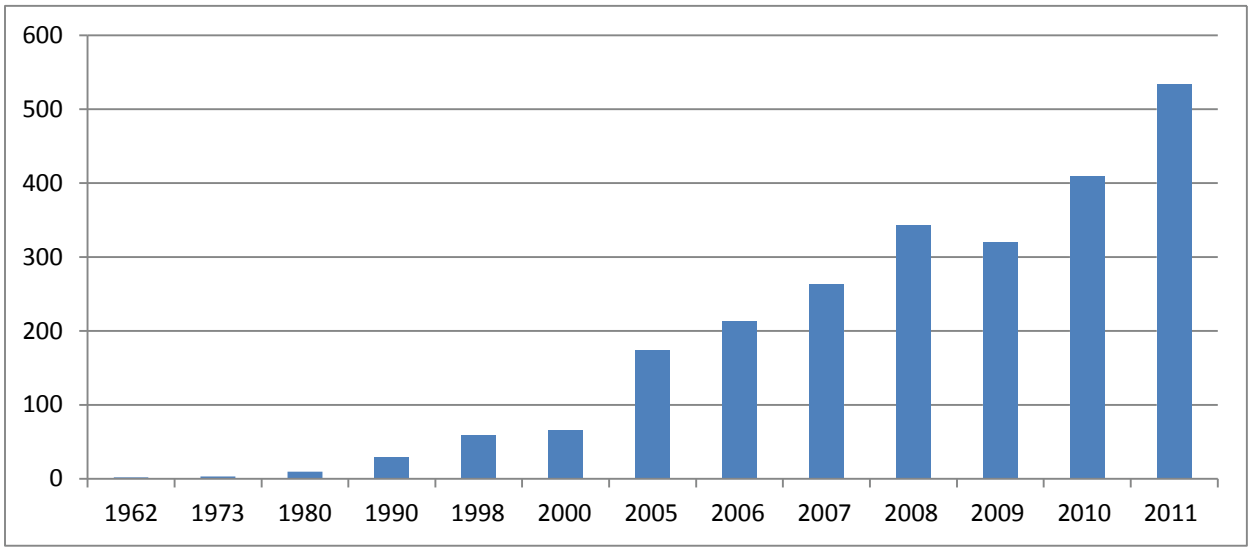
Right now, there are nearly 600 universities and over 35,000 colleges in India.[18] Yet many of them are not well-funded. The country devotes only about 1 percent of its Gross Domestic Product to post-secondary education. This is below the level of other emerging nations and significantly below that of many European countries.[19]

It is vital that India make progress in training its uneducated workforce because it is estimated that the country needs 500 million skilled workers in the future.[20] Training these workers is important for the nation to improve innovation, generate higher-paying jobs, and boost its overall economy. Having employees with advanced skills is vital for the design economy. Designers need university graduates with training in computer graphics, industrial design, and data visualization. Those who get that kind of education will have a great shot at higher paying positions.

(v) Promoting Trade Relations

Having favorable trade relations is vital for India's future. In looking at the period from 1962 to 2011, the country's total trade went from $1.98 billion to $533 billion.[21] As the country liberalized its financial regime, Indians saw their trade increase. In 2015, around $186.8 billion of India's exports come from manufacturing companies.[22] This is an area with great potential to grow in the future.

Figure 9: Total India Trade (in billions of US dollars)



Source: Pankaj Vashisht, "Creating Manufacturing Jobs in India," Indian Council for Research on International Economic Relations, June, 2015.

There is considerable evidence that boosting trade creates jobs and increases the overall economy. For example, a paper by Pankaj Vashisht demonstrates using Indian data that "trade has created more than 2.3 million net jobs."[23]Increasing those numbers is one way India can grow its economy.

India currently has a trade deficit of around $137 billion a year. This is based on exports of $310 billion and imports of $447 billion.[24] Prime Minister Modi has announced plans to

increase exports to $900 billion over the next four years. But this assumes policy and regulatory changes that would enhance the manufacturing and design sectors, and therefore improve the climate for trade and exporting.

4. Building a Design Ecosystem: Specific Steps

There are a number of things India should consider to build its design ecosystem. The goal is to turn India into "an R&D powerhouse that will create a virtuous cycle in the ecosystem that will create the scale, bring innovation in the hardware space and create manufacturing jobs, and all of that. Because of the impact it can create in the R&D space, the 'Design in India' could become the horse that pulls the economy along."[25] Doing this involves making changes in a number of specific areas.

(i) Workforce Development and Curricular Reform

India needs to develop its workforce in research and development. According to a World Bank analysis, the nation has fewer R&D professionals per million people than many other nations. India has 160, as compared to 710 in Brazil, 890 in China, 3,838 in the United States, 3,950 in Germany, and 5,151 in Japan.[26]

The country should boost its investment in higher education by doubling its expenditures to 2 percent of GDP. That would help India come closer to producing the educated workforce required for the design sector. It would increase the production of graduates with advanced degrees and the skills necessary to enhance the design ecosystem.

In particular, the nation needs to encourage technical education in engineering and design fields so that it can compete internationally in these areas. Developing new courses of study on design, data analytics, data science, and systems integration would be very beneficial. One of the crucial needs is expertise that integrates understanding across a number of different fields.

It is important to redesign curricula for the 21st century economy. Creating jobs in the manufacturing and design areas require advanced training in graphics, animation, computer design, software, architecture, and industrial design. It is not enough to offer courses in basic skills. Schools need to focus on higher-level skills that pay well and offer creative outlets.

Putting more money into higher education, though, is not sufficient as universities and professional schools need to utilize their existing financial resources more effectively. Making greater use of technology and digital learning materials is a way to improve quality and promote access for underserved populations, such as women, those living in rural areas, and members of ethnic minorities. E-Learning solutions and online courses narrow the urban-rural divide and bring pedagogic materials to a broader range of students. Similarly, massive, open, online courses (MOOCs) can introduce the latest knowledge to people in remote areas and therefore help them improve their skill set.

(ii) Design Labs and Special Economic Zones

India should boost its R&D investment. Right now, the country invests around 0.8 percent of Gross Domestic Product, well below the 3.4 percent in Japan, 2.9 percent in the United States, and 1.8 percent in China.[27] This is insufficient in light of the importance of innovation and the need to build a design economy. Without greater investment, India runs the risk of falling behind other leading nations and not gaining the full benefits of the digital economy.

One way to build a digital ecosystem is through design labs. These are places that focus on product design, engineering, systems integration, and research and development. Its experts think about how to design quality products, digitization, connect electronic systems, automation, and develop data sharing networks that help people learn from information that is being generated. Providing some flexibility in terms of regulatory filings and startup firms is a way government can help entrepreneurs gain a foothold in the new economy.

These kinds of labs can be encouraged through special economic zones that already exist in India with specific tax, labor, and regulatory advantages. The India Department of

Electronics has created Software Technology Parks that have helped software exporters through the provision of subsidized water and electricity. Some firms have gained tax-free status while others got tax breaks, land, or digital infrastructure assistance. Some have gained flexibility in dealing with labor rights. This policy is thought to have boosted the number of software businesses and laid the groundwork for the IT sector.[28]

It is important to boost design by easing the bureaucratic barriers to small and medium-sized businesses in India. There are many legal, regulatory, and tax barriers that make it difficult to launch businesses. This includes permitting and licensing, taxes, and bureaucratic fragmentation. The country should consolidate business services and make it easier to secure needed permits and clearances. Having a e-Biz portal where entrepreneurs could go would be very helpful. Adding design to the mix would streamline the process and promote the overall economy. This could be part of the national investment and manufacturing zones that already is being promoted.

To take advantage of current possibilities, Prime Minister Modi wants to create 100 smart cities that utilize digital and mobile technologies to address urban problems and ameliorate problems of transportation, energy, and commerce. This represents an opportunity to add design labs and pilot projects with the potential to boost the overall economy. This includes infrastructure enhancement, digital connectivity, improved skills training, and economic development. Smart cities help governments gain efficiency in transportation and energy, and that can free up resources for other areas.

(iii) Intellectual Property Protection

India enacted several pieces of domestic legislation for Intellectual property protection and is a signatory on various international trade agreements. This includes the Patent Act of 1970, the Geographical Indications of Goods Registration & Protection Act of 1999, the Trade Marks Act of 1999, and the Paris Convention for the Protection of Industrial Property and the Patent Co-operation Treaty.[29]

Yet despite these advances, protecting intellectual property (IP) rights is a big challenge in India. According to the Global Intellectual Property Center (GIPC), India ranks 14 out of 14 countries studied in its IP protection.[30] Its analysis gave the country a score of 24 out of 100 points, well below Singapore at 85, Malaysia at 49, China at 41, and Turkey at 40 points.

The index measured performance on IP protection and enforcement. Among the specific concerns found were that "India's patentability requirements remain outside established international best practices; India's history and current practices of using compulsory licensing for commercial and non-emergency situations is deeply troubling; there is a lack of specific IP rights for the life sciences sector; a challenging enforcement environment, with corresponding high levels of physical and online piracy, persists; and, finally, India is not a contracting party to any of the international treaties included in the GIPC Index, nor has India concluded an FTA with substantial IP provisions since acceding to the TRIPS Agreement."[31]

Right now, the country lags other nations in patent filings. India averages around 9,500 filings per year, compared to 269,000 in the United States and 535,000 in China.[32] There is little encouragement of intellectual property in India. There are few incentives to do so, and the procedures for protecting intellectual property are not well-developed.

According to the Global Intellectual Property Center, there is a significant association between innovation and intellectual property protection. "Economies with robust IP environments yield 50% more innovative output compared with economies with IP regimes in need of improvement," noted Center experts.[33]The Center recommends that India address online piracy and goods counterfeiting. It also suggests stronger IP enforcement through civil remedies and criminal penalties.[34]

The country has undertaken some IP reforms, especially in the pharmaceutical industry. It has altered the standards of patentability and added conditions for compulsory licensing of products. The goal is to encourage innovation while keeping prices accessible to consumers.[35] But it would be helpful if the government encouraged patenting so that

innovators could gain the financial rewards associated with their creativity. This would encourage other innovators to develop new products for the marketplace.

One way to promote innovation is through participation in standard-setting organizations. In the world of technology, standards development is a key part of exporting and the way that high quality products are designed. India should encourage its technical experts and technology firms to participate in international organizations that work in this area as a way to make sure that its products meet the demands of international competitiveness. Integrating its technical people into the global ecosystem is a way to build expertise and promote trade.

If products meet global standards, it will be easier to sell them internationally. Consumers want products that work across borders. Part of becoming competitive globally is meeting international standards and designing products that work across national borders.

(iv) Greater Collaboration between Business, Government, and Academia

There are a number of ways in which private firms are innovating, government agencies are promoting best practices, and academics are developing novel ideas. Yet for a design ecosystem to flourish, each of these sectors needs to work effectively with the other ones. In looking around the world at examples of innovation, there typically are synergies across sectors that create a whole that is greater than the sum of the parts. This is the case most famously in Silicon Valley, where is a close collaboration across business, government, and academia. The clustering of high-quality universities such as Stanford and Berkeley in the Bay Area with innovative technology firms and government policies that encourage entrepreneurship has led to a robust ecosystem.

India should take steps to encourage this kind of cross-sector collaboration. This could include the creation of innovation districts that bring creative types together. Having people from different backgrounds represents an excellent way to promote design because it helps innovators draw on a diverse range of skills and talents. Innovation districts furthermore are

helpful because they build links that take advantage of the strengths of each sector. Design professionals need access to technical and engineering talent so they can construct products that work well for customers and companies.

5. Opportunities for Design in India

Because of its key role in promoting innovation and manufacturing, design offers the possibility of making progress on several barriers to social and economic development. This includes attracting foreign investment, boosting education, and promoting trade relations. Design encompasses ways to make products as well as improve processes so it plays a vital role in overall economic prosperity and quality of life. According to Soren Petersen, the author of "Profit from Design," effective design refers to "the process of identifying needs, doing ideation, prototyping, selecting, implementing and learning [and] offer a comprehensive framing of opportunities by uncovering stakeholders' mental models, behaviors, and aligning their interests with effective, practical solutions."[36] Determining how to configure effective products and processes is vital to job creation and macroeconomic performance.

(i) Job Creation

Manufacturing in India has been under-performing as compared to the level of other countries. According to an analysis by the Organization for Economic Cooperation and Development, "the manufacturing sector [in India] has contributed little to income growth and its share in total merchandise exports has been declining. Manufacturing has not brought much new employment, and most of the recent rise in manufacturing employment has been in the informal sector, where workers are not covered by social security arrangements."[37]

But design is a way to create jobs. Manufacturing involves designing products that are convenient and useful to consumers. This can be a source of new products and new jobs. The

country's National Manufacturing Policy has targeted industries where India has an advantage. This includes sectors such as medical equipment, electronics, automobiles, and pharmaceuticals.[38]

In these areas, there are extensive possibilities for new jobs. There are opportunities to boost the economy through expertise in design and craftsmanship. The technology sector is one of the fastest-growing areas so it makes sense to focus resources there. It is propelling much-needed innovation in education, healthcare, energy saving, and transportation, among other areas.

Right now, the bulk of India's IT sector serves the "low-end, entry-level" part of the industry. Many of the jobs in this area consist of software services firms that that provide backend support. However, there is a chance for India to move up the value chain by providing high-end design work.[39]

It is widely acknowledged that the success of companies such as Apple and Samsung relate in part to outstanding product design. People like the look and feel of these companies' mobile products. They are easy to use and have tremendous functionality, and this has encouraged businesses and consumers to adopt new products very rapidly.[40]

(ii) Macroeconomic Impact

Design can promote overall macroeconomic performance as well. For example, Denmark has placed considerable emphasis on building a design-based economy. Its analysts estimate that 12.5 percent of its private sector employees work in the design industry. These workers design products and reengineer business operations. They account for 5.3 percent of GDP. Overall, that sector is growing at around 20 percent a year.[41]

A survey of 1,000 private Danish companies found that attention to design raised revenues in these businesses. "Companies which have experienced an increase in design activity (i.e. in investments in design-related employee training or external procurement of design

services) achieve an additional 40% gross revenue increase compared to companies where design activity is either constant or has decreased," according to Anders Kretzschmar, the director of the Danish National Agency for Enterprise and Housing.[42]

Similar results have been found in Canada. A study of Ontario documented that "over the past fifteen years, the design workforce grew at a rate of 3.9% per year, almost four times the rate of the overall workforce."[43] Taking advantage of a diverse workforce and building on local design institutions, the area was able to create jobs and promote its overall economy.

According to research by the New Zealand Institute of Economic Research, "there is a strong, positive relationship between overall national competitiveness and the use of design." Its experts say that "design is an effective tool for fueling innovation and ultimately securing value-added for the firm, region and nation-state."[44]

There are payoffs in trade too. A study of the design industry in Norway revealed that "companies that invest in design tend to be more internationally-oriented than non-design users, thereby connecting design-intensive Norwegian firms to wider, global markets."[45] This helped those companies boost exports and build their overall economies.

(iii) Growth Sectors

India is well-positioned to grow in several areas. Its engineering sector "accounts for 27 percent of the total factories in the industrial sector and represents 63 percent of the overall foreign collaborations."[46] In addition, the design market for electronics and semiconductors is rising rapidly. It has increased from INR9.6 billion (or about $150 million) in 2008 to INR26.5 billion ($400 million) in 2013. By 2022, experts believe it will total INR62.4 billion ($940 million).[47]

As the 'Internet of Things' concept rises in importance, design opportunities will increase. Through homes, appliances, security, energy, and monitoring devices, markets will grow that

require quality products enabling consumers to take advantage of digital technology. That will help create new jobs and boost long-term prosperity.[48]

Enhancing the design ecosystem furthermore is a way to help small and medium-sized businesses. There are many examples of successful design in India. Aerospace represents an example of where Indian firms have made major design contributions. According to Nirmalya Kumar of the London Business School, XCL Technologies is a company that has been very innovative. "They developed two of the mission critical systems for the new Boeing 787 Dreamliner, one to avoid collisions in the sky, and another to allow landing in zero visibility," he said.[49]

Kumar also noted that Indians have been responsible for process innovations. They involve "the injection of intelligence by Indian firms…. It's about how do you create a new product or develop a new product or manufacture a new product."[50] Designing new processes is a way to improve manufacturing productivity and quality.

As an example, the Godrej Group developed a new kind of refrigerator for poor residents. According to Mohanbir Sawhney, a strategic marketing consultant, it is "cheap and it does not use electric power because you can't count on having reliable electric power in Indian villages. Responding to these constraints, Godrej has created an easy-to-use, energy-efficient, battery-operated refrigerator. That has some really interesting applications in developed markets, such as outdoor camping."[51]

Many of the design opportunities in India arise from the mobile sector due to the rising popularity of handheld devices. India's mobile penetration is expected to rise to 72 percent by 2016.[52] This makes it one of the fastest growing countries in the world in terms of wireless technology.

In this sector, mobile applications are a popular way to access information and services. According to an analysis, there are around 2.9 million apps in use in India and there have been over 15 billion app downloads. 41 percent of Indian mobile users devote their phone

time to communications, 23 percent rely upon apps, 22 percent use entertainment, and 14 percent focus on browsing.[53]

We looked at breakdowns in smart phone usage by day in four countries: India, United States, United Kingdom, and China. Indians devote the most daily time to their smart phones (204 minutes), as compared to the other countries. They use about 7.5 apps and spent around 84 minutes on these applications.

TABLE 1: Smartphone Usage in Four Countries

	India	United States	United Kingdom	China
Daily Time (minutes) spent on Smartphone	204	150	114	170
Number of Apps	7.5	7.4	7.5	6.8
Number of minutes Spent on Apps	84	120	90	NA

Source: Shelley Singh, "The Big App Fight," The Economic Times, August 6, 2015.

E-commerce is one of the more popular activities among Internet users. It is estimated that the Indian e-commerce sector totals about $7 billion. It is expected to grow to $65 billion by 2020. According to Technopak, a retail consultancy, "nearly 65% of the e-commerce traffic at present is already on mobiles" and "by 2020, about 80% of e-commerce transactions will be done via apps."[54]

Another popular segment of apps is for restaurants. Food company executives say that "food ordering is a $15 billion a year opportunity on phones."[55] People like the convenience of ordering through mobile devices, and this is a business segment that is growing rapidly.

There are new advances in mobile education, healthcare, and transportation, among other areas. This is especially the case in rural areas. Mobile offers the potential to bridge the

urban-rural divide that exists in many countries. Handheld devices enable those in underserved areas to access educational resources that otherwise would not be available. People using mobile devices report knowing more about global affairs and a raise in their level of literacy.[56]

Medical devices are an area that is growing quickly in India. The Gujarat government has set up the country's first medical devices park.[57] It will focus on high-end devices and pharmaceutical equipment, areas where India has a competitive advantage. The national government allows foreign companies to buy up to 100 percent of Indian firms in this sector so it is an area that is attracting foreign direct investment.

Health care also is expanding rapidly. With the aging population, there is considerable attention to medical devices and health care delivery. India spends about one percent of Gross Domestic Product on health. But this may rise as the country's 12th five-year plan identifies universal health care as one of its top priorities.[58]

Finally, there are new advances in bringing financial services to poor people via mobile devices. Many people in the developing world are not able to afford the fees associated with traditional banks so they don't have financial accounts. This makes it difficult for them to pay bills, transfer money, or obtain financial credit. But there is growing popularity for mobile money and digital financial services. These types of innovations help poor people undertake financial transactions and send money to friends and family members.[59]

6. Conclusion

Building a design ecosystem is crucial for the future of any modernizing economy. This becomes especially relevant given India's young population and its competitive performance in the global IT sector. Growth of a design sector holds the promise of greater prosperity and sustained economic development for the country. Creating a "culture of innovation" represents a way to position India for long-term success. This means building its human,

digital, and physical infrastructure, enhancing its design capacity, and promoting greater collaboration between business, government, and academia.[60]

India can improve its design and manufacturing sectors by developing its workforce, building design labs, creating special economic zones, protecting intellectual property, aligning its technical standards with the rest of the world, and developing more of a culture of collaboration. Through these means, India can position itself in the global economy with a competitive design sector and enhance its long-term prosperity.

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