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DURU ARUN KUMAR
Netaji Subhas Institute of Technology

Technology Growth in India—Some Important Concerns

Abstract: Technology has made its presence felt in various sectors of India's development in the last twenty years. Communication and information technology, manufacturing industry, transportation, defence and space technologies are some of the important sectors which have incorporated modern technology in various aspects of their development and functioning. Also significant and visible changes have taken place in the consumer products available in the Indian market, most of them imported or locally manufactured by multinational corporations based in India. Do these changes qualify India to be considered as a technologically advanced country, and thereby making technological changes an integral part of the social change process of our society? Or are these developments restricted to certain elitist sections of society with little or negligible trickle-down effect of the knowledge bases of the technology developments? In this study a deconstructivist approach is adopted to analyse some of the processes involved in development and diffusion of technology in a society. With the exception of mobile phone technology it is argued that even though India has strong scientific and technological capabilities, it is emerging as a bigger consumer of technology products than as a producer and innovator of modern technology.

Keywords: technology development, consumer market, mobile phones, education.

Technology in India

The Government of India, since its independence from British colonial rulers in 1947, has supported and promoted science and technology through its various national policies. India was one of the first countries to adopt a Science Policy Resolution in 1958, which stated, "The key to national prosperity, apart from the spirit of the people, lies, in the modern age, in the effective combination of three factors, technology, raw materials and capital, of which the first is perhaps the most important, since the creation and adoption of new scientific techniques can, in fact, make up for a deficiency in natural resources, and reduce the demands on capital. But technology can only grow out of the study of science and its applications." As a result of this, a number of science and technical educational and research institutes and laboratories were set up on government initiative in different parts of India.[1] Further, acknowledging the widespread core competence and innovation in a number of areas in the country and to make India a self dependent and advanced nation, the Technology Policy Statement, 1983 was introduced to give technological development a clear direction for the growth of indigenous technology and the acquisition of technology from outside.[2]

[1] http://www.dst.gov.in/stsysindia/spr1958.htm
[2] http://www.dst.gov.in/stsysindia/sps1983.htm

The Government of India constituted the Technology Development Board (TDB) in September 1996, as per the provisions of the Technology Development Board Act, 1995. The Act enables creation of a Fund for Technology Development and Application to be administered by TDB. The Fund receives grants from the Government of India out of the Cess collected by the Government from industrial concerns under the provisions of the Research and Development Cess Act, 1986, as amended in 1995.[3]

Thus it may be ascertained that there has been a consistent patronage and political support for science and technology activities in India. This is also indicated by a huge science and technology institutional structure and several programs created under various government departments and ministries to promote and support research and development in various fields such as Department of Science and Technology, Department of Information Technology, Department of Electronics, Indian Space Research Organization and several others.[4]

As a result of these sustained efforts through various funding schemes, significant progress has been made in certain technology sectors, particularly in strategic industries such as space sciences,[5] nuclear technology, defence technology, aviation and information technology. India's defence research laboratories have successfully developed light combat aircraft, ballistic missiles, satellite communications and several other technologies of strategic importance.

Looking at some of the examples mentioned above we notice that, most of these developments are in highly specialised and niche areas, with long gestation periods and far removed from scope for immediate application for direct public domain, but have been internationally acclaimed. These fields are highly capital intensive and depend on continuous government support.

Another important development has been that of IT and IT enabled services sectors in India, recognised globally as highly competitive sectors. The IT-ITES industry has two major components: IT Services and business process outsourcing (BPO). The growth in the service sector in India has been led by the IT-ITES sector, contributing substantially to the increase in Gross Domestic Product (GDP), employment, and exports. The sector has increased its contribution to India's GDP from 1.2% in Financial Year 1998 to 7.1% in Financial Year 2011.[6]

India's progress in Information and Communication Technologies (ICT) is also accompanied by many challenges. There is a perception that the Indian economy as a whole has not benefited from the ICT industry because of the high regional concentration of ICT activity and low diffusion of ICT to other sectors of the economy. A large part of the IT sector is involved in export-oriented services and products. It helps provide employment and earns foreign revenue for India but adds limited value

[3] http://www.dst.gov.in/stsysindia/sps1983.htm

[4] http://www.tdb.gov.in/

[5] National Centre for Astrophysics, a centre of the school of natural sciences of the Tata Institute of Fundamental Research, has set up a unique facility, the Giant Meterwave Radio Telescope for radio astronomical research at metre wavelengths. GMRT is a very versatile instrument for investigating a variety of radio astrophysical problems ranging from nearby Solar system to the edge of observable Universe. http://gmrt.ncra.tifr.res.in/

[6] http://www.indianembassy.org/indiainfo/india_2000/chapters/chp07.pdf

addition to India's technology requirements. The IT and ICT boom is visible only in special regions and locations mostly in southern India, and the concentration of skilled human resources in the IT and ICT sectors is adversely affecting other sectors of the economy.[7]

Consumer Market

In the last few decades India has emerged as a huge consumer market. This can be traced to a shift in the economic policy from socialist to market economy to tidy over the Balance of Payment crisis in 1991. As a part of the bail out plan under the International Monetary Fund, India made certain structural economic reforms. The main thrust of the 1991 economic reforms in India was to allow for the operation of a free market, where the forces of demand and supply could freely compete and the local and the national economy could be integrated into the global economy (Kothari 1997). The elaborate structure of licenses, controls and regulations was abolished to help increase production, efficiency and demand and decrease prices. Import restrictions were relaxed and steps were taken toward the liberalization of foreign trade and investments, a reduction in custom duties, an increase in incentives and policy changes to attract foreign capital. As a result of this there was an upsurge in import of mass produced goods in the Indian markets.

A wide array of products such as foreign cars, televisions, electronics, washing machines, air-conditioners, processed foods, perfumes, and other consumer goods, became freely available and have become symbolic of new status-conscious Indians. Incentive for industrial production has come primarily from these changing demands. Thus as pointed by Kothari it is not the availability of essential commodities, improved access and control over productive resources, low-cost and decentralized conventional and alternative energy sources, but rather products and services that are mostly beyond the means of the majority of the low income groups of people.

Even though a large number of imported consumer products are available in the Indian markets, most do not cater to the essential needs requirement of the poor people, there is an increasing demand for such products for different reasons. There is 'indigenization' or 'domestication' of the meaning attached to possession of these consumer products. It is considered as a symbol of higher status by the bourgeoning urban middle class and those aspiring to higher social status. The concept of domestication of foreign products and brands has been studied by other scholars too. As pointed out by some, even the most 'global' brands, such as McDonald's or Coca-Cola, have different cultural connotations and are consumed quite differently in different places.[8] Arjun Appadurai argues that 'as rapidly as forces from various metropolises are brought into new societies, they tend to become indigenized in

[7] http://www.nasscom.in/indian-itbpo-industry; http://www.digital-review.org/uploads/files/pdf/2009-2010/chap-21_india.pdf

[8] Daniel Miller's (1998) work on consumption practices in Trinidad and Marie Gillespie's (1995) ethnographic study of young Punjabis in Southall, West London are some of the examples of this 'domestication' of meaning.

one way or another' (Appadurai 1996: 32). The following years have seen most of the imports and fresh investments in the productive economy oriented not toward meeting the basic needs of a majority, but primarily toward satisfying the consumption patterns of the elite.

Besides policies of free market economy adopted by India there has also been a preference for imported products as they are believed to be of superior quality than the locally manufactured ones. Except where it is entirely unavoidable, as pointed out in a vision document, Indian administrators (whether in the public or in the private sector) avoid local designs. They consider that well-worn imported designs alone are risk free. For instance, it is the official policy in the Department of Telecommunications (and in others too) not to procure any equipment unless it has been used for a minimum of two years. As a result, Indian designs face a Catch-22 situation: They will not be accepted unless they have been in use, and they cannot be in use until they are tried out! (Indiresan 2001)

As a result of the above developments, even though there is a large influx of technology products available in Indian markets for a price, it is not clear that they play a role in India's technological capacity building. Do they fulfil the technological needs of the society at large in a equitable and inclusive manner? We illustrate our point by discussing the revolution caused by the introduction of mobile technology in India in the last two decades.

Mobile Phones

Mobile phones are the first form of electronic communication technology to be widely used in India. Since mobile networks are cheaper to build than landline networks, and communication by phone does not require literacy, mobile phones are now increasingly adopted in regions with no extensive prior form of communication technology. The rate of mobile phone sales in India has been phenomenal ever since the introduction of mobile technology in 1995. With a subscriber base of more than 851 million, the Mobile telecommunications system in India is the second largest in the world and it was thrown open to private players in the 1990s.[9] According to the International Data Corporation's Q3 2011 Mobile Phone Tracker release, the Indian Mobile phone market grew 12% in units shipped, over the previous quarter, to clock 47.07 million units.[10] According to a market survey company, mobile user base had increased to 407 million users by 2011. And interestingly it also claims that there has been higher increase in penetration and tele-density in the rural mobile connections compared to urban India.[11]

Modern media communication technologies have been developed and essentially tailored to fulfil the needs of the high-income, literate people of the developed countries. According to some studies, "…technologies… are a part of a matrix of global

[9] http://en.wikipedia.org/wiki/Communications_in_India

[10] http://www.idc.com/getdoc.jsp?containerId=prIN23230811

[11] http://indiatechonline.com/juxtconsult-india-mobile-phones-study-2011-545.php

relations that has historically placed the developing world in a derivative relationship" (Kavoori and Chaddha 2007: 227). This relationship has been reiterated in earlier histories, of television, radio, newspaper and the Internet (Kavoori and Chaddha 2001). Cell phone is also one of them. Since introduction of mobile phones in the Indian market it has found many users for many reasons. As pointed out by these studies, a majority of low-income, low-literacy populations have a fluid and temporary identity. They lack any form of permanent identification and are under the radar of governmental and institutional surveillance. For a migrant population, the mobile phone could even be their only fixed point of reference. Further it is observed that, the so-called emerging market has by-passed technological, physical, educational, amongst other barriers to creatively use mobile phones to uplift themselves.

Mobile telephony like cinema, in an earlier era, seems to be a great social leveller. Further, mobile technology probably helps rural farmers decide which market to go to sell their produce at the highest possible price. Even in the case of the urban poor such as craftsmen—electricians, plumbers etc.—the mobile phone directly gives them access to customers. Previously they were dependent on contractors and shop-keepers to point them to work. Now they can function independently as free lancers and peddle their skills without relying exclusively on contractors and shop-keepers who have land lines and were the only means of contact between the craftsman and his customer. All this is a direct result of the easy availability of mobile phones. So it is not at all surprising that India is emerging as one of the biggest consumers of mobile telephony.

Discussion

Looking at the various government policy measures with regard to science and technology we may argue that a technologically deterministic approach is adopted on the belief that based on the developed countries' model, introduction of science and technology institutions can bring about growth of science and technology. Government legitimated its policies in terms of the technological imperative. It was implied that by supporting important technology areas of research there will be a trickle down effect that will eventually lead to technological development of the society at large. However the advanced technology efforts have remained confined to areas sponsored by government funding and infrastructural support.

While on the one hand, there are regions in India which are called 'cybercities' and 'silicon valleys' of India with state of the art technology development centres in Information Technology (Kalra 2006), on the other hand, a large part of India's population lives in poverty and remains untouched and unaware of these technology achievements. There are several regions which do not have access to electricity, potable drinking water and basic health facilities. Provision of these basic facilities would probably require a small fraction of the budget spent on the so called sophisticated technology development programmes. How do we reconcile India being a technologically advanced nation on the one hand, while on the other, more than

thirty percent of its population lives in poverty with no access to basic amenities for a dignified life?

The consumer markets ruled by free market-forces, have been inundated with secondary goods, with a higher profit margin and catering to the middle and upper classes of the country. Among these, mobile phones are one of the few imported technologies which have found ready acceptance by the rich and the poor alike because of its small size, portability, user-friendly features, affordability and most importantly, fulfilling a need caused by increasing urbanization and migration of people in search of livelihood and absence of any reliable and affordable means of communication available to people based in underdeveloped parts of India. However a large number of mobile phone users in non urban areas use it only for basic communication and are not able to use several other features such as text messaging and Internet access because literacy rates in these areas is very low. Poor infrastructure and erratic or no power supply create other logistics problems. Lack of English language knowledge also poses limitations to their optimum use.

Exploring the complexities in what she calls "schizophrenic India", Rama Bijapurkar suggests that "the holy grail of the Indian market lies in understanding its plurality" (Bijapurkar 2007). India is not one homogenous society, but a collection of many different communities defined by language religion and ethnicity, each with its distinctive cultural ethos, social pattern, and demography. To be successful in the Indian market, it is not sufficient to create 'no-frills' cheaper versions of feature-rich expensive products but to invest effort in understanding use requirements and developing appropriate models (Bijapurkar 2001).

The current experiences have shown that people who don't use ICTs are willing to accept technology and put in the effort to learn to use it. But for the products to become successful, they must be designed to suit the users' real needs.[12] India presents several obstacles for widespread adoption of information and communication technologies, but perhaps the most persistent problem of all has proved to be the problem of text input in Indian languages.[13] Computer usage in India has been almost entirely in English and is restricted to the English-speaking, upper-class and middle-class people.

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[12] International and national standardization bodies such as ISO, UNICODE, World-wide-Web consortium (W3C) and BIS (Bureau of Indian Standards) to ensure adequate representation of (http://tdil.mit.gov.in/) Technology Development for Indian Languages (TDIL) Programme initiated by the Department of Electronics & Information Technology (DEIT), Ministry of Communication

[13] Technology Development for Indian Languages (TDIL) Programme initiated by the Department of Electronics & Information Technology (DEIT), Ministry of Communication & Information Technology (MC&IT), Govt. of India has the objective of developing Information Processing Tools and Techniques to facilitate human-machine interaction without language barrier; creating and accessing multilingual knowledge resources; and integrating them to develop innovative user products and services. The Programme also promotes Language Technology standardization through active participation in & Information Technology (MC&IT), Govt. of India has the objective of developing Information Processing Tools and Techniques to facilitate human-machine interaction without language barrier; creating and accessing multilingual knowledge resources; and integrating them to develop innovative user products and services. The Programme also promotes Language Technology standardization through active participation in International and national standardization bodies such as ISO, UNICODE, World-wide-Web consortium (W3C) and BIS (Bureau of Indian Standards) to ensure adequate representation of Indian languages in existing and future language technology standards (http://tdil.mit.gov.in/).

Mobile phones have recently proved to be an exception to this rule, with a significant number of models becoming available in Indian languages, however text entry in Indian languages continues to be a rare phenomenon.

Important sectors such as manufacturing technologies, infrastructure development, electronics and power generation industry have made significant progress with regard to scale of production, quality and competitiveness, but the most frequently voiced concerns relate to lack of skilled manpower and poor infrastructure, specially, power shortages in the country, as important limiting factors in their progress.

As of 2011, there are 1522 degree-granting engineering colleges in India with an annual student intake of 582,000, plus 1,244 polytechnics with an annual intake of 265,000. However, these institutions face shortage of faculty and concerns have been raised over the quality of education[14] (Mitra 2008).

According to industry estimates "only a quarter of all graduates are employable and about 80% of job seekers in employment exchanges are without any professional skills. India is suffering from a massive shortage of skilled manpower" (Duggal 2005). But employability here refers to the management skills in marketing, finance and operations, and not technology and engineering skills, as is apparent from this report which pointed out, "Businesses in India have started spreading their tentacles in towns, cities and semi urban areas in search of newer markets. These are seen as future markets for telecommunications, FMCG and retail sector among others. As companies expand their operations, they are not finding enough trained people to fit into different positions" (Duggal 2005). Further it reports, "Retail, insurance, finance industry are booming. The recently released KPMG report on retailing in the country titled as 'Consumer Markets in India, the next big thing?' has revealed that plans are up for at least 150 new shopping malls by 2008. Also, the number of department stores has been growing at 24% annually. Such growth would again aggravate the demand for trained man power in organised sectors dramatically."

Following the services sector concentration, consumer services have been a focus area for the Business schools which include financial, banking, retail, consulting, telecom, InfoTech etc.

Because of the increase in the jobs available in the service sector many young engineering graduates prefer to join non technical service oriented and managerial jobs. As a result of this manufacturing industries and other technology sectors are not able to get technically qualified manpower. More than 90% of the engineering graduates prefer to join management professions (Arun-Kumar 2008).

How does this state of affairs impact the technology development in India? On the one hand we have a large infrastructure to support science and technology education and research activities. We also have an ever increasing demand for growth of various industrial sectors. But on the other hand, there is a steady decline of a willing and technically qualified manpower because of preference for lucrative jobs in the service sector. This problem is further compounded by the poor quality of technical and engineering education in many privately funded engineering colleges due to lack of good

[14] SPECIAL REPORT: THE EDUCATION RACE, by *Newsweek*, August 18–25, 2011 issue.

teaching faculties and infrastructural support. At the same time due to increasing investment in the market economy the demand for the service sector and management professional has increased manyfold with the corresponding disenchantment with the core technical jobs. Science and technology qualified manpower forms the backbone of this sector. In the absence of this it may be challenging for India to sustain a broad based technological development, and subsequently to become an integral part of social change. This needs to be explored further with respect to different technology sectors in India with the help of empirical studies.

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Biographical Note: Duru Arun Kumar is a faculty in Sociology of Science (Ph.D) at Netaji Subhas Institute of Technology, New Delhi, India. Her areas of interest are Higher Technical Education, Globalization, and Science and Technology Research.

Address: Netaji Subhas Institute of Technology, New Delhi, India; E-mail: duruarun@rediffmail.com