

SCIENCE AND TECHNOLOGY IN INDIA

Overview

India envisions its position to be among top five global scientific power by 2020. It has declared 2010-2020 as the **Decade of Innovation**. One of the primary focus of Science and Technology Policy 2013 is to invest in young innovators and entrepreneurs through education, training and monitoring.

The theme on Science and Technology provides an overview under the following headings:

Energy: The social and economic development of a country and living standards of its inhabitants depends on the judicious utilisation of its energy resources. India is committed to provide adequate and affordable energy to all for the sustainable development of society. As its demand for energy increases day-by-day with technological growth and advancement, it is making progress in the development of renewable energy for supplementary energy requirement.

Natural Resources: India has vast rich and diverse assets of natural resources such as water, coal, petroleum, natural gas and minerals. India visions for optimum utilisation of mineral resources through scientific, sustainable and transparent mining practices. In order to maintain quality and efficient use of its resources, India has launched various schemes.

Agriculture: Agriculture has major role in Indian Economy. The history of Agriculture in India dates back to *Vedic* era. India ranks second in the world in agricultural output and agriculture based industries have vast scope for employment.

Industries: Food, textile, fertiliser and pharmaceutical industry have made major contribution in India economy.

Health: India perceives the meaning of health as a state of complete physical, mental and social well-being and not merely absence of diseases. It has a relatively low cost health care system because of widespread availability of indigenously manufactured generic drugs.

Environment: Air, water and soil pollution are challenges for India and it has taken a number of steps to address this challenge.

Biodiversity: In order to conserve wild life, natural beauty and cultural heritage and promote tourism, India has large number of National Parks, Botanical and Zoological Gardens and wildlife sanctuaries.

Space Science: India has made significant development in space science with the objective of human welfare.

India's defence capabilities: India's defence strategy and policies aim at providing a peaceful environment by addressing the wide spectrum of conventional and non-conventional security challenges faced by the country.

Role of Information and Technology Sector in Economic Development of India: The Information Technology (IT) industry has emerged as one of the most dynamic sectors in India's economic development and is responsible for the global recognition of India as a 'soft' power.

Institute of scientific importance and Indian Scientists: In addition to large number of universities and educational institute, India has numerous scientific organizations for the development of science and technology, and education. In the end, some information is given about them.

ENERGY

India is endowed with both non-renewable and renewable energy resources. In India, power plants using renewable energy sources contribute 28% of total energy consumption. 70% of energy is produced from power plants using non-renewable energy source and about 2% from nuclear power plants.

It is estimated that nearly 45,000 MW of electrical power can be generated if India's wind potential is fully exploited, however presently India produces 13,000 MW wind power and is ranked fifth after Denmark, Germany, Spain, and the USA in harnessing wind energy for the production of electricity. The largest wind energy farm of India established near Kanyakumari in Tamil Nadu generates 380 MW of electricity.

It is estimated that over a period of one year India receives solar energy equivalent to more than 5,000 trillion kWh. Under clear sky conditions, the daily average solar energy availability varies from 4 to 7 kWh/m². India can generate up to 20 MW solar power per square kilometre land area that can be used for variety of applications. Ministry of New and Renewable Energy of Government of India has announced 30% capital subsidy for all solar power plant projects in the country. Today India is fast becoming one of the world's most attractive markets for Renewable Energy investments.

Since India is surrounded by ocean from three sides, it has significant potential to harness energy from the ocean in the form of tidal, wave, current and thermal gradient. The technologies to harness energy are currently at demonstration stage or at the initial stage of commercialization. According to the estimates of the Indian Government, the country has a potential of about 8,000 MW of tidal energy, available from Gulf of Cambay in Gujarat, Gulf of Kutch and the Gangetic delta in the Sunderbans region of West Bengal respectively.

In India, nuclear power is the fourth largest source of electricity after thermal, hydroelectric and renewable sources of energy. There are seven nuclear power plants and twenty one nuclear reactors in operation. Nuclear power reactors located at Tarapur (Maharashtra), Rana Pratap Sagar (Rajasthan), Kalpakkam (Tamil Nadu), Narora (UP), Kakrapar (Gujarat) and Kaiga (Karnataka) have the installed capacity

of little less than 3% of the total electricity generation capacity of our country. However, many industrialised countries are meeting more than 30% of their electrical power needs from nuclear reactors. Currently all commercial nuclear reactors are based on nuclear fission. Future possibility is generation of energy from nuclear fusion. International Thermonuclear Experimental Reactor (ITER) which will be commissioned in 2020 is a fusion reactor. It has been designed in collaboration with seven countries, including India. It is estimated to produce energy amplification by a factor 10 and generate about 500 MW of fusion power. India is contributing equipment worth nearly 500 million US dollars (about 9% of total cost) to the experiment and will also participate in its subsequent operation and experiments.

NATURAL RESOURCES (Water, Fossil fuels, Minerals)

India has a rich and vast diversity of natural resources. Some information is given below:

Water: The country's inland water resources are unevenly distributed over the country with more than half of those located in five states (Orissa, Andhra Pradesh, Gujarat, Karnataka and West Bengal). Inland water resources are classified as rivers and canals; reservoirs; tanks and ponds; beels, oxbow lakes, derelict water; and brackish water. About 17 percent of the total length of rivers and canals in the country lie in Uttar Pradesh. So Uttar Pradesh occupies the first place as far as total length of rivers and canals is concerned and is followed by Jammu & Kashmir and Madhya Pradesh. Most of the area under tanks and ponds lies in Southern States of Andhra Pradesh, Karnataka and Tamil Nadu. Area under reservoirs lies largely in Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan and Uttar Pradesh. In general, ground water is of good quality and suitable for drinking, agricultural or industrial purposes.

The Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India, has many ongoing projects/ schemes to develop and manage the water resources of the country in an integrated manner. Some of these are: Accelerated Irrigation Benefits Programme (AIBP), Command Area Development (CAD), Repair, Renovation and Restoration (RRR) of Water Bodies, Ganga Action Plan, Flood Management Programme, Dam Rehabilitation and Improvement Project (DRIP). The year 2015-16 is being celebrated as "Jal Kranti Abhiyan" to consolidate water conservation and management in the country through a holistic and integrated approach involving all stakeholders, making it a mass movement.

Coal, Petroleum and Natural Gas

Coal is the most abundant fossil fuel in India. It accounts for 55% of the country's energy need. Hard coal deposits are mainly confined to eastern and south central parts of the country. Crude oil production was maximum from offshore (about 50.2%) and the remaining production was mainly from six states (Andhra Pradesh, Arunachal Pradesh, Assam, Gujarat, Rajasthan and Tamil Nadu) during 2014-15. For

natural gas, the share of offshore production in 2014-15 was about 74% and the remaining production was from ten states (Andhra Pradesh, Arunachal Pradesh, Assam, Gujarat, Rajasthan, Tamil Nadu, Tripura, Jharkhand, Madhya Pradesh and West Bengal). India's crude oil production was 0.2 Million Metric Tonne (MMT) in 1947-48 which became 37.79 MMT in 2013-14. Natural gas production for the year 2013-14 was 3.541 Billion Cubic Metric (BCM) as against nil production in 1947-48. In petroleum refining India is now self-sufficient. The government is encouraging natural oil companies to pursue equity oil and gas opportunities overseas.

Minerals

Minerals are major resource for development as these constitute the vital raw materials for many basic industries. India has huge reserves of many metallic and non-metallic minerals. There are large numbers of small operational mines in India. During the year 2014-15, mineral production was reported from 33 States/Union Territories. However, bulk of value of mineral production (of about 94.18%) was confined to only thirteen States, including offshore areas (Odisha, Chhattisgarh, Rajasthan, Andhra Pradesh, Gujarat, Jharkhand, Madhya Pradesh, Assam, Goa, Karnataka). India continues to be wholly or largely self-sufficient in minerals which constitute primary mineral raw materials to industries, such as, thermal power generation, iron and steel, ferro-alloys, aluminium, cement, various types of refractories, china clay-based ceramics, glass, chemicals like caustic soda, soda ash, calcium carbide, titania white pigment, etc. India is, by and large, self-sufficient in coal (with the exception of very low ash coking coal required by the steel plants) and lignite among mineral fuels; bauxite, chromite, iron and manganese ores, ilmenite and rutile among metallic minerals; and almost all the industrial minerals with the exception of chrysotile asbestos, borax, fluorite, kyanite, potash, rock phosphate and elemental sulphur. Despite high degree of self-sufficiency, some quantities of minerals are imported to meet the demand for either blending with locally available mineral raw materials and /or for manufacturing special qualities of mineral-based products.

AGRICULTURE

Agriculture is largest livelihood provider in India. It ranks second in the world in agricultural output. In 2013, India was the seventh largest agricultural exporter worldwide.

The major crops in India can be categorise as

1. Food grains (Rice, Wheat, Maize, Millets and Pulses)
2. Cash Crops (Cotton, Jute, Sugarcane, Tobacco, and Oilseeds)
3. Plantation Crops (Tea, Coffee, Coconut and, Rubber) and
4. Horticulture crops (Fruits and Vegetables).

On the basis of sowing season, the crops in India have been grouped as under:

1. Rabi: The Rabi crop is the spring harvest or winter crop in India. It is sown in October last and harvested in March April every year. Major Rabi crops in India include Wheat, Barley, Mustard, Sesame, Peas, etc.
2. Kharif : Kharif crops are usually sown with the beginning of the first rains in July, during the south-west monsoon season. Major Kharif crops of India include Millets (Bajra and Jowar), Paddy (Rice), Maize, Moong (Pulses), Groundnut, Red Chillies, Cotton, Soyabean, Sugarcane, Turmeric, etc.
3. Zaid: These Crops are raised throughout the year through artificial irrigation. Sowing season of zaid kharif crops is from August to September and harvesting season is from December to January. Important zaid kharif crops are rice, jowar, rapeseed, cotton, Oilseeds. Zaid rabi crops are sown from February to March and harvested from April to May. Important zaid rabi crops are watermelon, *toris*, cucumber and other vegetables.

India has observed significant increase in food grain, oil seed, milk, fish production etc. as a result of agricultural revolutions. Major agricultural revolutions in India are:

Revolution	Related with
Green Revolution	Food grain Production
Golden Revolution	Fruit Production
Golden Fibre Revolution	Jute Production
Grey Revolution	Fertilizer Production
Blue Revolution	Fish Production
Black Revolution	Petroleum Production
Pink Revolution	Prawn Production/Onion Production/Pharmaceutical(India)

Round Revolution	Potato Production
Red Revolution	Meat and Tomato Production
Silver Revolution	Egg/Poultry Production
Silver Fibre revolution Cotton	Cotton Production
White Revolution	Milk Production
Yellow Revolution	Oil seeds Production
Brown revolution	Lather/Coca production

The Indian Council of Agricultural Research (ICAR), an apex organization for conducting and coordinating agricultural research has contributed a lot in the field of agriculture. ICAR has set a vision to attain 'Rainbow Revolution' covering the entire spectrum of activities in agriculture which will make India a developed nation free of poverty, hunger, malnutrition, and environmental safety. Some of the institutions working in the field of Agriculture are –

- IARI and other 96 constituents all over India
- National Institute of Plant Health management, Hyderabad, Telangana.
- National Centre for Integrated Pest Management, LBS Building, New Delhi.
- Directorate of Plant Protection Quarantine and Storage N.H. IV, Haryana.

The main development was higher-yielding varieties of wheat, developed by Indian scientists. Indian geneticist M. S. Swaminathan, and others contributed a lot in this field. The Indian Agricultural Research Institute claims credit for enabling the Green Revolution in part by developing rust resistant strains of wheat. **Green Revolution in India** was a period during which yields in agriculture commodities in India, was increased through the introduction of high-yielding crop varieties and application of modern agricultural techniques. This led to an increase in food production in India. The methods adopted include the use of high yielding varieties (HYV) of seeds along with the use of modern farming methods. Between 1950-51 and 1998-99, the production of foodgrains increased from 50.8 to 202.5 metric tonne, cotton from 3.0 to 12.8 metric tonne and sugarcane from 5.2 to 290.7 metric tonne. The productivity of wheat increased four times and that of rice, maize and cotton three times.

Between 1950-51 and 1998-99, oilseeds from 5.2 to 25.7 metric tonne.

Development and adoption of new varieties of oilseeds and complementary technologies doubled oilseeds production in a decade (12.6 mt during 1987-88 to 24.4 mt during 1996-97), generally known as the *Yellow Revolution*.

Fish production has enhanced from 0.75 million metric tonne in 1951 to 68.7 million metric tonne in 2006-07. It was the result of *Blue Revolution*.

Operation Flood, launched in 1970 was a project of the National Dairy Development Board (NDDB), which was the world's biggest dairy development program, that made India, a milk-sufficient nation. Crossbreeding of local cows with specialised dairy breeds provided the technology for rapid increase in milk production. It helped transform the lives of more than 13.4 million farmers. Of them, 3.7 million were women. It helped women empower themselves and their families. It is named as *White Revolution*.

In India, the existing natural resources and expertise such as abundance of genetic base, diverse agro-climatic zone, highly qualified and skilled man power, agriculture-based economy etc. provide enough scope for expansion of the tissue culture industry. In India, banana, sugarcane and some flowering and medicinal plants are cultivated through tissue culture produced seedlings. Some following Indian scientists have made some landmarks in the field of plant tissue culture:

- (i) Kanta and Maheshwari developed test tube fertilization technique (1960).
- (ii) Guha and Maheshwari produced first haploid plants from pollen grains of *Datura* (Anther culture) (1964).

According to the International Service for the Acquisition of Agri-Biotech Applications (ISAAA) India has the fourth largest area planted under genetically modified (GM) crops. Bt cotton was the first crop approved for commercial cultivation in India in 2002. Nearly 96 per cent of the country's cotton area is now covered by *Bacillus thuringiensis* (Bt) hybrids. Bt technology has helped India to treble its cotton output from 13 million bales in 2002 to 40 million bales in 2014 and achieved a historical milestone, overtaking China as the world's number one producer.

India has evolved a rich history of agricultural practices and continues to adapt technologies like bio-dynamics and other systems into its organic practices. Indian farmers have increased production 40 percent by using organic fertilizers in paddy. Indian farmers have been at the forefront of developing field based technologies ranging from vermi- composting to integrate live stock practices that facilitate their ability to improve soil fertility even in semi-arid or barren areas. Different parts of India have developed their own local or regional system for ecological agriculture such as Agnihotra and Panchkavya that are now gathered under the one umbrella term 'Jaivic Krishi'.

INDUSTRIES

Some of the important Industries having major contribution in Indian economy are given below.

Food Industry

At present, Indian food and grocery market is world's sixth largest market. India is the world's largest producer of milk, second largest producer of fruits and vegetables and the third largest fish producer (it ranks second in inland fish production). Indian food processing Industry accounts for thirteen percent of India's exports and six percent of total industrial investment. Indian food brands have prime space in retail chains abroad.

In order to boost the food sector, the Government is working on agrizones and concept of mega food parks. The Idea behind setting up of food parks is to involve small and medium entrepreneurs in the capital-intensive activities. Mega Food Park Scheme is the flagship program of the Ministry of Food Processing Industries, Government of India. It proposes a demand driven/pre-marketed model with strong backward/forward linkages and sustainable supply chain with the intension is to develop food processing infrastructure. In the food parks, common facilities, cold storage, food testing and analysis lab, affluent treatment plant, packaging centre, along with basic infrastructure for water supply, power, environmental protection systems, communication, etc. will be provided. Provision for seminar/ conference/ training facilities etc. can also be made. The scheme provides for creating infrastructure for farm level primary processing centre-cum- cold chain in identified clusters, processing of intermediate products, collection centre cum cold chains The supply chain will be established on-Farm Primary Processing Centre for aggregation of the produce at village level, which will be linked to the retail outlets/processing parks.

Textile Industry

India's textile industry is one of the oldest and has an important place in the national economy. It contributes about 4 percent of the Gross Domestic Product (GDP). It is one of the largest industries in the country in terms of employment generation after agriculture. At present it ranks ninth in the world. India is the second largest producer of cotton in the world. The first successful modern cotton textile mill was established in Mumbai in 1854 by a local Parsi entrepreneur, C.N. Dewar. Some of the States which produces cotton are Punjab, Haryana, Rajasthan, Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka and Tamil Nadu. The major jute goods production of India comes from West Bengal. The jute fibre is also known as 'Golden Fibre.' The large-scale jute industry started in 1855 at Rishra, near Kolkata. India is the second largest producer of silk in the world after China. Most of the raw silk comes from the five states such as Andhra Pradesh, Karnataka, Tamil Nadu, Jammu and Kashmir, and West Bengal. India is the seventh-largest producer of wool. The first woolen mill in the country appeared in the year 1876 at Kanpur. The woolen industry is located in the states of Rajasthan, Karnataka, Jammu and Kashmir, Andhra Pradesh, Gujarat, Himachal Pradesh, and Uttar Pradesh.

Fertilizer Industry

The fertilizer industry in India began its journey way back in 1906. It is one of the vital industries in Indian economy. The first manufacture unit was started by Indian Fertilizer Industry which was of Single Super Phosphate in Ranipat near Chennai. India is the third largest producer of nitrogenous fertilizers in the world. Main objective of Indian fertilizer industry is to ensure the supply of primary and secondary nutrients to plants in the required quantities. About 29 large size units are engaged in the manufacturing of Urea, 21 units produce Diammonium Phosphate and complex fertilizers and 5 units produce straight nitrogenous fertilizers. There are also about 80 medium and small scale industries in operation producing single super phosphate.

Pharmaceutical Industry

Indian Pharmaceutical industry is about 120 years old. Production of modern medicine by indigenous company began with [Bengal Chemicals](#) in late 1800's. The Government established Drug Development Promotion Board (DDPB) for supporting Research and Development to support drug industry on the projects jointly proposed by industry and academic institutions. Some of the institutions engaged in the field of pharmaceutical researches in India are- National Institute of Pharmaceutical Education and Research (NIPER), The Central Drug Research Institute (CDRI), B.V. Patel Pharmaceutical Education and Research Development (PERD), etc. The Indian pharmaceutical industry is estimated to grow at 20 percent compound annual growth rate (CAGR) over the next five years. Indian pharmaceutical manufacturing facilities registered with US Food and Drug Administration (FDA) as on March 2014 was the highest for any country outside US. The Union Cabinet has allowed foreign direct investment (FDI) up to 100 percent under the automatic route for manufacturing medical devices subject to specified conditions. The Government of India has unveiled 'Pharma Vision 2020' aimed at making India a global leader in end-to-end drug manufacture. Telangana has proposed to set up India's largest integrated pharmaceutical city spread over 11,000 acres near Hyderabad, which is known as the bulk drug capital of India.

Chemical Industry

The chemical industry is among the most diversified industrial sectors and includes basic chemicals and its products, petrochemicals, fertilisers, paints, gases, pharmaceuticals, dyes, etc. The Indian chemical sector accounts for 13-14% of total exports and 8-9% of total imports of India. In terms of volume of production, it is the twelfth-largest in the world and the third-largest in Asia. Currently, the per capita consumption of products of the Indian chemical industry is one-tenth of the world average, which reflects the huge potential for further growth. The Indian advantage lies in the manufacturing of basic chemicals that are also known as commodity chemicals. These account for about 57% of the total domestic chemical

sector. Indian chemical industry is expected to register a growth of 8-9% in the next decade and is expected to double its share in global chemical industry to till the year 2021. In Chemical Sector, only the items Hydrocyanic acid and its derivatives, Phosgene and its derivatives, Isocyanates and di-isocyanates of hydrocarbons are covered in the compulsory licensing list because of their hazardous nature.

HEALTH

The term health is defined as a state of complete physical, mental and social well being and not merely the absence of disease. Good health permits people to lead a socially and economically productive life. The Ministry of Health and Family Welfare consist of: Department of Health and Family Welfare and Department of Health Research. The Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy (AYUSH) takes care of promotion of indigenous systems of medicine and researches in indigenous medicine. National AIDS Control Organisation (NACO) is responsible for planning and implementation of programmes for prevention and control of AIDS.

Several National Health Programmes run by govt. of India such as the National Vector Borne Diseases Control, Leprosy Eradication, TB Control, Blindness Control and Iodine Deficiency Disorder Control Programmes come under the umbrella of National Health Mission (NHM).

The National Vector Borne Diseases Control Programme (NVBDCP) is an umbrella programme for prevention and control of vector borne diseases viz. Malaria, Japanese Encephalitis (JE), Dengue, Chikungunya, Kala-azar and Lymphatic Filariasis. Out of these six diseases, two diseases namely Kalaazar and Lymphatic Filariasis have been targeted for elimination by 2015. Our government is committed to provide safe drinking water to all habitations to prevent waterborne diseases.

Vaccination

Several diseases, including cholera, tuberculosis, smallpox and hepatitis can be prevented by vaccination.

World Health Organisation (WHO), in collaboration with the government of India, established the 'National Polio Surveillance Project' (NPSP) in 1997 to provide technical support in key areas of surveillance for polio and mass vaccination campaigns. *Now India has been declared polio-free country by the World Health Organisation (WHO).*

Malaria is an acute parasitic illness caused by *Plasmodium* species. The Government of India provides technical assistance and logistics support including anti malaria drugs, larvicides etc. under NVBDCP within overall umbrella of

National Health Mission. State Governments have to implement the programme and required human resource and other logistics are to be ensured. Global fund Round 9 supported Intensified Malaria Control Project (IMCP-II) is being implemented since October 2010 for a period of five years in 7 North Eastern States. About 10% of the total cases of malaria are reported from urban areas. Maximum numbers of malaria cases are reported from Ahmedabad, Chennai, Kolkata, Mumbai, Vadodara, Vishakhapatnam, Vijayawada etc. Malaria which used to cause 75 million cases in early 1950s has been reduced to less than 1.5 million cases every year.

The risk of dengue has increased in recent years due to rapid urbanization, and deficient water management including improper water storage practices in urban and rural areas, leading to proliferation of mosquito breeding sites. The cases peak after monsoon and it is not uniformly distributed throughout the year. The Case Fatality Ratio (CFR) which was 3.3 % in 1996 had come down to 0.4% in 2010 and 0.3 in 2013. The disease is spreading to newer geographical areas every year.

Chikungunya is an infection caused by the Chikungunya virus transmitted by *Aedes* mosquito. For carrying out proactive surveillance and enhancing diagnostic facilities for Chikungunya, 439 Sentinel Surveillance hospitals involved in dengue in the affected states also conduct Chikungunya tests.

To control Tuberculosis from root level RNTC based on the internationally recommended Directly Observed Treatment Shortcourse (DOTS) strategy, was launched in 1997 and expanded across the country in a phased manner. Full nationwide coverage was achieved, then covering over a billion population (1114 million) in March 2006, expanding to 1247 million people in first quarter of 2013. The goal of TB control Programme is to decrease mortality and morbidity due to TB and cut transmission of infection until TB ceases to be a major public health problem in India.

Traditional Methods of Treatment: India is known for its traditional medicinal systems-Ayurveda, Siddha and Unani. The Ayurvedic medicinal system appeared and developed between 2500 and 500 BC in India. Many herbs and minerals used in Ayurveda are described by ancient Indian herbalists such as [Charaka](#) and [Sushruta](#) these were developed during the first millennium BC.

ENVIRONMENT

Environmental issues

Air, water & soil pollution The major air pollutants in India are-particulate matter (dust, sulphuric acid), Nitrogen dioxide, sulphur dioxide, carbon monoxide,

hydrocarbons ((Methane and Benzene), Ozone (O₃) and airtoxins like Chlorine (Cl₂). The main causes of air pollution are transportation (57%), fuel combustion (except in vehicles) (21%), industrial process (12%) and miscellaneous (10%). Government has made it mandatory that all vehicles including diesel require emission testing, to reduce sulphur content in gasoline from its current average of 330 ppm to 30 ppm. India completely phased out production and consumption of chlorofluorocarbons, carbon tetrachloride and halogens, man-made chemicals responsible for the depletion of the ozone layer. This remarkable milestone was achieved two years ahead of schedule. With this achievement, India has contributed significantly to this global environmental cause.

Realising the deteriorating air, water and soil quality, increasing vehicular emission and maximum noise levels. The Government has made a policy abatement of pollution, which provides multipronged strategies in the form of regulations, agreements, and other measures and control through adoption of clean and low-waste technology, reuse and recycling of waste, natural resource accounting, environment audit. Now, an "Eco-mark" label is marked on consumer products that are environment friendly. Government has taken various steps to reduce pollution. Bharat Stage-IV emission norms have been implemented in 13 mega cities including National Capital Region (NCR). Metro Rails have been introduced in some of the metro cities as public transport system. A regular monitoring of industrial units that are the biggest polluters of river water; construction of proper sanitary land fill sites; investigation of ground water quality; participation of public awareness raising activities; throwing garbage in cans and reuse of waste materials are promoted.

Government of India has launched a nationwide sanitation initiative of *Swachh Bharat Mission* on 2nd October, 2014. It seeks to achieve the goal of clean India by 2019 so that 150th birth anniversary of Mahatma Gandhi can be celebrated as an accomplishment of his dream. It is a collective responsibility of all individuals and organisations to bring cleanliness, keeping the environment green, maintaining ecological and environmental balance.

Some of the sources of soil pollution are industrial wastes, agricultural practices, biological agents, mining and smelting, radioactive pollutants, acid rains and urban wastes. Not only does accumulation of these wastes results in poor human health, these also cause pollution of the soil. In 2000, Supreme Court of India directed that all Indian cities to implement a comprehensive waste management programme that would include household collection of segregated waste, recycling and composting. In 2011, several Indian cities embarked on waste-to-energy project. New Delhi is planning to install two incinerator trashes to generate electricity. Along with Waste-to-energy projects, some cities and towns such as Pune and Maharashtra are introducing privatisation of solid waste collection, street cleaning operations and bio-mining to dispose the solid waste.

Pollution Control act and regulations – The environment protection act, 1986 is an act to provide for the protection and improvement of environment and for matters connected there with. India participated in Nations Conference on the Human Environment held at Stockholm in June, 1972 to take appropriate steps for the protection and improvement of human environment.

One of the movement over environment issues has been Chipko movement under Resistance to destruction of forests spread in the hills of Uttaranchal in 1970's. Some famous Environmentalists have been Sunderlal Bahuguna (got Padmabhushan for his contribution), Anna Hazare (highlighted that government funds should be earmarked for social forestry and soil conservation), Rajendra Singh ("Waterman of Rajasthan", well-known for his efforts in water harvesting by building check dams across the Rajasthan), Madhav Gadgil (known for Gadgil Commission).

Pollution control measures undertaken by government include: regulating factories as per laws and ordinances, maintaining and constructing additional sewerage lines and sewage treatment system, purifying water in waterways, controlling pollution from new high tech industries such as the electronic industries.

BIODIVERSITY

Biodiversity is the term popularized by the sociobiologist Edward Wilson to describe the combined diversity at all the levels of biological organisation which can be expressed in terms of genetic diversity, species diversity and ecosystem diversity. India is a diverse nation housing around 10% of world's species.

Biodiversity and Endemic Species: Biodiversity is known to be exceptionally high in specific biogeographic regions known "biodiversity hotspot". The biodiversity hotspots, thirty four in number as of 2015, hold especially high numbers of endemic species (a species only found in a given region or location and nowhere else in the world). Four hotspots are part of the Indian subcontinent such as (1) Himalaya: Includes the entire Indian Himalayan region (and that falling in Pakistan, Tibet, Nepal, Bhutan, China and Myanmar), (2) Indo-Burma: Includes entire North-eastern India, except Assam and Andaman group of Islands (and Myanmar, Thailand, Vietnam, Laos, Cambodia and southern China), (3) Sundaland: Includes Nicobar group of Islands (and Indonesia, Malaysia, Singapore, Brunei, Philippines) and (4) Western Ghats and Sri Lanka: Includes entire Western Ghats (and Sri Lanka).

Endangered Species: Some of the critically endangered species (highest risk category assigned to wild species which are likely to become extinct) of plants and animals from India as listed in the International Union for Conservation of Nature Red List include – (1) The Great Indian Bustard (confined mostly to the arid regions of Rajasthan, Gujarat and Ahmednagar, Maharashtra), (2) Ganges River Dolphin (recently recognized by the government of India as its National Aquatic Animal), (3)

Lion Tailed Macaque (found in the Western Ghats), (4) Olive Ridley Sea Turtle (Females come to hatch in the shores in Gahirmatha, Orissa), (5) The leopard cat (that live in the foothills of the Himalayas).

National Parks: India's first National Park was established in 1936 as Hailey National Park, now known as Jim Corbett National Park, Uttarakhand. National Parks in India which are protected areas are more than 100 in number, some of these are – (1) Nokrek National Park, or Nokrek Biosphere Reserve in West Garo Hills district of Meghalaya, (popular for its Red panda), (2) Dachigam National Park in Jammu & Kashmir, (only area where Kashmir stag is found), (3) Kaziranga National Park, (popular for being home to Indian rhinoceros), (4) South Button Island National Park, Andaman and Nicobar Islands, (notable for Dugong, Dolphin, Water Monitor Lizard, Blue Whale, etc). (5) Keibul Lamjao National Park, (the only floating park in the world).

Botanical Gardens: There are more than 100 botanical gardens in India located in different parts of the country. The Acharya Jagadish Chandra Bose Indian Botanic Garden, previously known as the Royal Botanic Garden situated in Shibpur, Howrah near Kolkata is the largest botanical garden of India. The garden is renowned for the Great Banyan, an enormous banyan tree. Other popular botanical gardens is the Government Botanical Garden Ooty, Tamil Nadu (with about 300 varieties of rose) etc.

Zoological Gardens (Zoos): Almost every state in India has a zoo. The National Zoological Park is located in Delhi. Some of the largest zoos in terms of area are - Arignar Anna Zoological Park (Vandalur Zoo), Chennai, Tamil Nadu, Nandankanan Zoological Park, Bhubaneswar, Odisha, Indira Gandhi Zoological Park, Visakhapatnam, Andhra Pradesh.

Wildlife Sanctuaries: India has more than 500 animal sanctuaries referred to as wildlife sanctuaries which are protected areas. Some of the famous Wildlife Sanctuaries include – (1) Bharatpur Wildlife Sanctuary, Rajasthan (Bird paradise), (2) Sariska Wildlife Sanctuary (Popular for Project Tiger), (3) Orang Wildlife Sanctuary, Assam (One-Horned Rhinoceros, Elephants, Leopard, Sambar, Barking Deer, Tiger, etc.).

SPACE SCIENCE

Dr. Vikram Sarabhai, the father of Indian space programme, recognized the benefits of space technologies for India and this efforts led to the foundation of **Indian Space Research Organisation (ISRO)** in 1969, ISRO is the space agency of the Indian government with primary objective to advance space technology and use its applications for national benefit. ISRO built India's first satellite, Aryabhata, which

was launched by the Soviet Union on 19 April in 1975. ISRO has several centres across India with different responsibilities.

India has made tremendous strides in launch vehicle technology to achieve self-reliance in satellite launch vehicle programme with the operationalisation of Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Satellite Launch Vehicle (GSLV).

The programme is mature enough to offer launch services to the world outside other countries. ANTRIX, the commercial arm of ISRO, is concerned with India's space services globally.

For the past four decades, ISRO has launched more than 60 satellites for various scientific and technological applications like mobile communications, Direct-to-Home services, meteorological observations, disaster warning, search and rescue operations, remote sensing and scientific studies of the space.

ISRO has established two major space systems, the Indian National Satellite System (INSAT) series for communication, television broadcasting and meteorological services which is Geo-Stationary Satellites, and Indian Remote Sensing Satellites (IRS) system for resources monitoring and management which is Earth Observation Satellites. ISRO has launched several Space Science Missions to explore the space. INSAT-3D and Advanced Weather Satellite completed two successful years in orbit on July 26, 2015.

India's first lunar mission named Chandrayaan-1, was launched successfully on October 22, 2008 from Satish Dhawan Space Centre, Sriharikota Range (SDSC, SHAR). The spacecraft was orbiting around the Moon at a height of 100 km from the lunar surface for chemical, mineralogical and photo-geologic mapping of the Moon.

Mars Orbiter Mission is India's first interplanetary mission to planet Mars with an orbiter craft designed to orbit Mars in an elliptical orbit. It was launched from, SDSC, SHAR, using PSLV C25, on November 5, 2013.

The spacecraft has been configured to carry out observation of physical features of Mars and carry out limited study of Martian atmosphere.

India has created global history by becoming the first Asian nation to reach the Mars orbit in a space mission. The success is sweeter because this has been done in its maiden attempt. No other country that has attempted a mission to Mars has succeeded in reaching the planet on debut. It is the cheapest inter-planetary mission ever to be undertaken by any country.

Recently on July 10, 2015, India has successfully launched three identical DMC3 commercial Earth Observation Satellites, along with two smaller satellites from United Kingdom, into a polar Sun Synchronous Orbit which was very close to the

intended orbit of 647 km height. It was launched by PSLV-C28 from SDSC SHAR, Sriharikota.

INDIA'S DEFENCE CAPABILITIES

The Department of Defence Production of the Ministry of Defence is responsible for the production of equipment used by the Indian Armed Forces. Defence Research and Development Organisation (DRDO) under Ministry of Defence is working dedicatedly towards enhancing self-reliance in Defence systems and undertakes design and development leading to production of world class weapon systems and equipment in accordance with the expressed needs and the qualitative requirements of Armed Forces. The Indian Armed Forces comprises the Indian Army, the Indian Navy, the Indian Air Force and the Indian Coast Guard.

The Indian Army (IA) is headed by the Chief of the Army Staff of the Indian Army (General). Indian Army is committed to the defence of the country from external and internal threats across the entire spectrum of warfare. Also, in times of disaster/ natural calamities, the Indian Army is in the forefront, providing aid and succour to the affected populace. Indian Army is well equipped with modern assault rifle, machine guns, tanks, artillery and missile systems, mine clearing devices and other utility vehicles and helicopters etc; and is fully committed to meeting the security needs of the country.

The Indian Navy (IN) is headed by the Chief of the Naval Staff of the Indian Navy (Admiral). Indian Navy is the prime enabler and guarantor of the country's maritime sovereignty and myriad use-of-sea activities. This is discharged by the Indian Navy through its four roles – military, diplomatic, constabulary and benign. The objective of the Navy's military role is deterrence/ dissuasion against any intervention or act which is against our National interests, and the ability to inflict a crushing defeat on the adversary in the event of hostilities. Indian Navy has nuclear powered submarine as well as diesel-electric submarines in its fleet. Indian Navy is also equipped with Aircraft Carriers and numerous other amphibious warships.

The Indian Air Force (IAF) is headed by the Chief of the Air Staff of the Indian Air Force (Air Chief Marshal). The Indian Air Force doctrine is to acquire strategic reach and capabilities across the spectrum of conflict that serve the ends of military diplomacy, nation building and enable force projection within India's strategic area of influence. IAF has in its fleet fighters such as Su-30 MKI aircraft, Mirage 2000, MiG-29. Besides, C-17 Globemaster III aircraft have imparted strategic dimension to airlift. Air Defence Radars have been inducted to improve coverage of Indian airspace. The indigenously built Tejas Light Combat Aircraft is expected to join the fleet in near future.

Indian Armed Forces have participated in joint military exercises with many other countries.

Missile Development in India

India has developed both ballistic as well as guided missiles capable of delivering nuclear warheads. Agni Missile Series (Agni I-V) has range capability from 700 km to 5000 km. Some other missiles are: Akash: It is a medium range surface-to-air missile with multi-target engagement capability. Astra: Beyond visual range air-to-air missile (BVRAAM), possessing high single shot kill probability to engage and destroy highly manoeuvring supersonic aerial targets. BrahMos: It is a two-stage supersonic cruise missile with a range of 290 km and can carry conventional warhead weighing 200 to 300 kgs. It is among the fastest supersonic cruise missiles in the world, at speeds ranging between Mach 2.5 to 2.8. Prithvi: Surface-to-Surface Battle field Missile. Prithvi has higher lethal effect compared to any equivalent class of missiles in the world. Prithvi is a unique missile today having manoeuvrable trajectory and high level capability with field interchangeable warheads.

Role of Information Technology (IT) Sector in Economic Development of India

Indian IT sector has a great reputation and brand value in the global markets. The industry comprises of Software sector and Information Technology Enabled Services (ITES), including the Business Process Outsourcing (BPO) industry. India has established itself as a global leader in the IT sector by capitalising on its advantages of talent pool, lower cost of operation and the innovative remote delivery model. Today India is recognised as the outsourcing destination of choice in the world. The major developed markets are sourcing IT/ITES from India to gain bottom-line benefits, improving their competitive edge.

The economic liberalization and integration with the world economy during the boom of the 1990s resulted in the IT revolution in India. In 1991, the Department of Electronics and Information Technology created a corporation called Software Technology Parks of India (STPI). Since then, the department is coordinating strategic activities, promoting skill development programmes, enhancing infrastructure capabilities and supporting R&D for India's leadership position in IT and IT-Enabled services. In 1999, the government (which placed the development of Information Technology among its top five priorities) formed the Indian National Task Force on Information Technology and Software Development. The call for a joint industry-government effort to "ensure that the Indian IT sector remains a dominant player in the global market" was made by the Govt. of India in way back 2002. It was then envisaged that this industry can be the cornerstone of India's economic progress.

The software and services industry is one of the most powerful drivers of Indian economy. The National Association of Software and Services Companies (NASSCOM) is the industry body representing 95% of the companies. The industry continued to evolve over the years and prioritized on enhancing efficiency, enabling

transformation and agility and partnering for digital initiatives. In addition to fuelling India's economy, the IT industry has been influencing the lives of its people through active direct and indirect contribution to various socio-economic parameters such as employment, standard of living and diversity of services.

This section presents an overview of the contribution of IT industries towards economic development of this country, and how they promise to improve overall lifestyle of people.

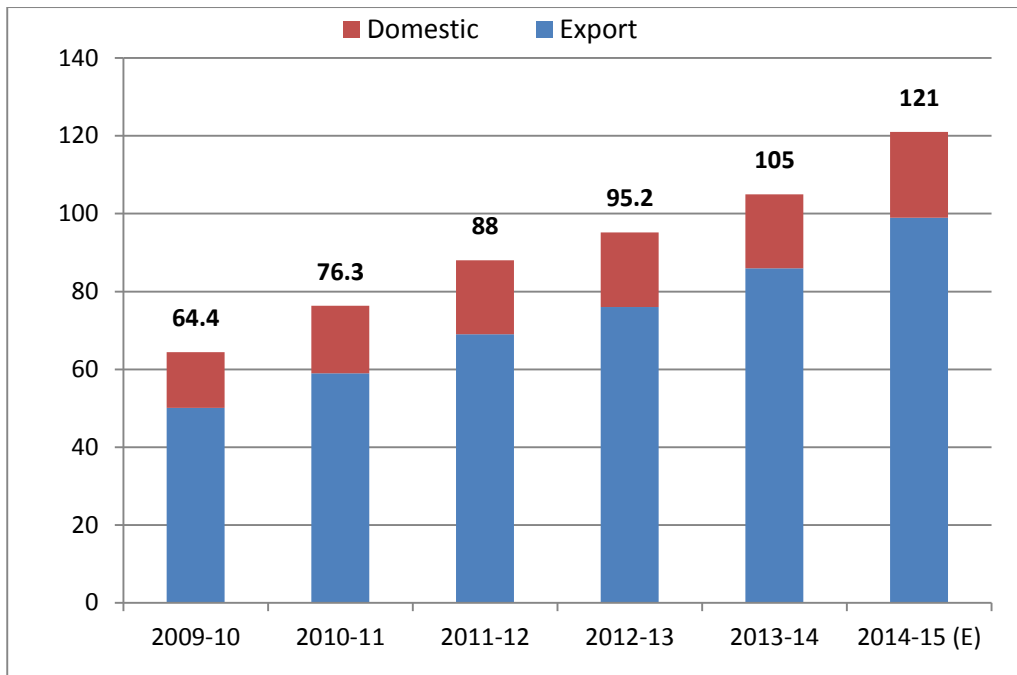
The growth story so far

The Indian Information Technology/Information Technology Enabled Services (IT/ITES) sector has registered tremendous growth over the past decade, achieving iconic status all over the world and a reputation for reliable and cost-effective delivery of services. It has helped transform India's image from a poor economy to a place of innovative entrepreneurs. Bangalore is called the Silicon Valley of India because it is the leading IT exporting city.



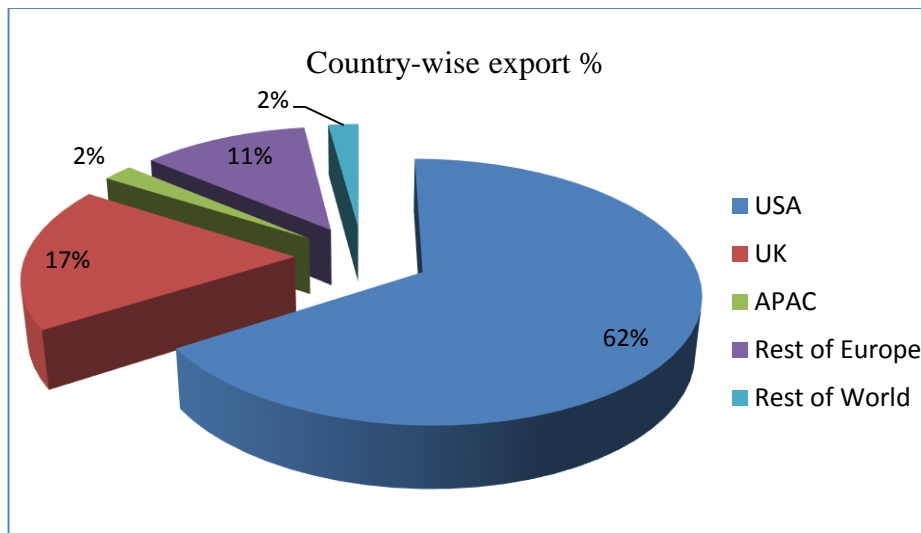
Indian IT-BPO Industry | Impact on India's Growth during 2014-15

The industry has a remarkable success story, with a persistent growth rate of more than 30% for last 20 years. According to NASSCOM, the 2015 exports projected at close to USD 100 billion with estimated revenue of USD 146 billion. The annual growth of 14 per cent is faster than the average industry growth, and is largely being driven by the booming eCommerce segment. Stable government with a technology focused growth agenda is further boosting technology adoption in the domestic market.



Indian IT – ITES Industry Revenue Trends (in USD billion)

Digitization, internet of things, agile entrepreneurial ecosystem, and improving business environment has led to this phenomenal growth. India exports software services to more than 60 countries, the largest market being USA and serves half of the fortune-500 companies.

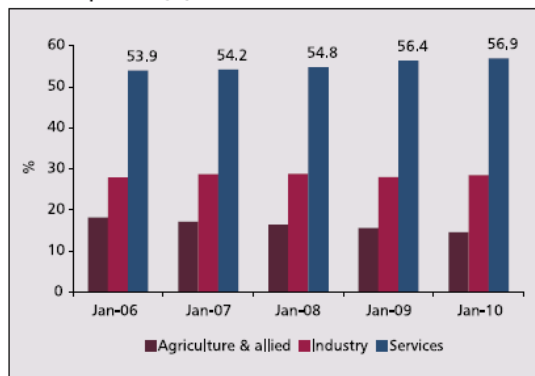


Indian IT-BPO players themselves have emerged as MNCs, operating as global companies with a local flavour, in the geographies where they are present. The IT-BPO sector has a footprint that covers 52 nations, 200 cities, and 400 delivery centres. 10 companies are listed on overseas stock exchanges and the entire industry addresses the needs of over 400 Fortune 500 customers.

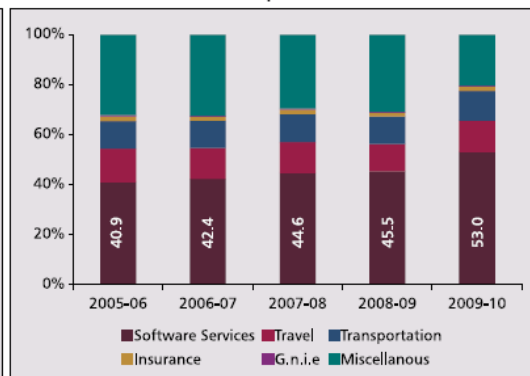
As a proportion of national GDP, the sector revenues have grown from 1.2 per cent in FY1997-98 to nearly 8.1 per cent in FY2013-14. India continues to maintain

leadership position in the global sourcing arena, accounting for almost 55 per cent of the global sourcing market size in 2013 as compared to 52 per cent in 2012.

GDP Components (%)



Structure of India's services exports



Source: RBI; Balance of Payments, G.n.i.e – Government not included elsewhere

The Software Industry

Knowledge Process outsourcing (KPO) is one of the new dimensions of BPO that has given global outsourcing scenario a new meaning. Over a decade KPO has had a tremendous growth in India. Leading countries turn to India to get their job done when compared to other countries. The main reason for outsourcing to India is the highly rated knowledge pool and low costs as compared to other countries.

Major Domestic Players

With global companies looking to make their way into the Indian IT sector, there are a tremendous number of Indian IT Companies which have impacted the industry in a big way. Today India is home to some of the finest software companies in the world. The software companies in India are reputed across the globe for their efficient IT and business related solutions. Some of the leading Indian IT companies competing globally are:

Tata Consultancy Services

TCS or Tata Consultancy Services is one of the operative subsidiaries of the Tata Group. It is the largest information technology company not only in India but Asia. Spread across 47 countries in the globe this software company was established way back in 1978.

Infosys Technologies Limited

Infosys Technologies Limited was established in 1981 by seven people: Narayana Murthy, Kris Gopalakrishnan, Nandan Nilekani, Nagavara Ramarao, S. D. Shibulal, K Dinesh and N. S. Raghavan. Infosys in a very short span of time has managed to mark a mark for itself as a major software company not only in India but across the globe, with 33 offices spread across different countries.

Wipro Technologies

Wipro is among the largest software companies in India with its headquarters in Mumbai. Listed on the New York Stock Exchange Wipro Technologies was established in 1980. According to a recent survey carried out by Brand Finance and The Economic Times in 2010, Wipro stands as the 9th most valuable brands in India. Wipro is actively involved in Application Development and Maintenance, Product Engineering, Business Process Outsourcing Technology Infrastructure etc.

HCL Technologies

HCL Technologies is the IT service wing of HCL. Founded in 1991, HCL Technologies is head quartered in Noida. Counted amongst the leading software companies in India, this company earned consolidated revenues of US\$ 3.1 billion in the year 2010.

Presence of Global Players

There are a large number of multi-national IT enterprises operating in India in sectors such as: Integrated Chip Design, System software, communication software, R&D Centres, Technology Support sector, captive support sector, BPO Sectors, etc, reaping the cost and quality advantages.

These multinational include Siemens/Philips, Intel, Texas Instruments etc. (Chip Design); Siemens, Motorola, Lucent Technologies, Sony, Nortel etc. (Communication Software); Google, Yahoo etc. (R&D Centres); Axa Business Services, Swiss Shared Services, Siemens Shared Services etc. (BPO Sector); Accenture, DELL, HSBC, GE Capital, Fidelity (Captive Support Sector), Hewlett Packard, IBM, CISCO, Oracle, Microsoft, SAP, NOKIA, Vodaphone, etc.

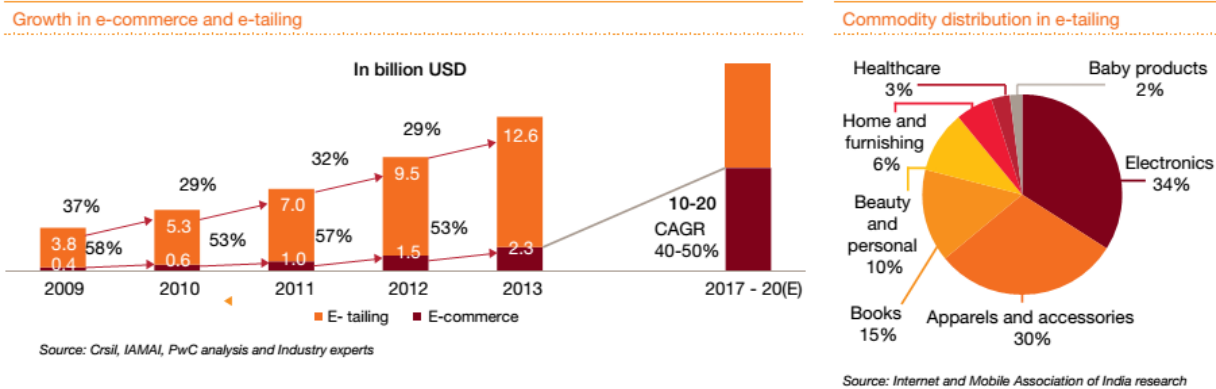
The E-Commerce Boom

Over the last two decades, rising internet and mobile phone penetration has changed the way we communicate and do business. While in countries such as the US and China, e-commerce has taken significant strides to achieve sales of over 150 billion USD in revenue, the industry in India is, still at its infancy. A joint study by ASSOCHAM-Deloitte reveals that the digital commerce market in India has grown steadily from \$4.4 billion in 2010 to \$13.6 billion in 2014 and likely to touch \$16 billion by the end of 2015 on the back of growing internet population and increased online shoppers. Internet and electronic commerce technologies are transforming the entire economy; and changing business models, revenue streams, customer bases, and supply chains.

One estimate suggests that online travel industry contributes about 71% of total net commerce in India. Ticketing is now done either in third party websites or airline sites. Customers of online shopping are delighted with prompt delivery and flawless payment mechanisms building trust in consumers. Even online classifieds have made a successful transition online with jobs and matrimonial taking the lead.

Of late, India is witnessing a paradigm shift in online-retailing (e-tailing) business. Some of the leading domestic players in e-tailing are Flipkart, Mynta,

Jabong, Snapdeal, etc. International giants like Amazon, eBay and Paytm have also entered the market with aggressive business models. Founded in 2007 by Sachin Bansal and Binny Bansal, the leader in retail e-commerce Flipkart recently announcing that it crossed \$ 1 Billion in sales early this year, this development has sent many small e-commerce companies scrambling to gather a piece of the online e-tailing action. E-Commerce in India is one of the fast growing sectors of India's Digital Economy. One of the pioneers of the Indian IT Industry, Mr Narayan Murthy recently announced that he would partner with Amazon India to launch a joint venture to create a new e-commerce entity for the Indian Market.



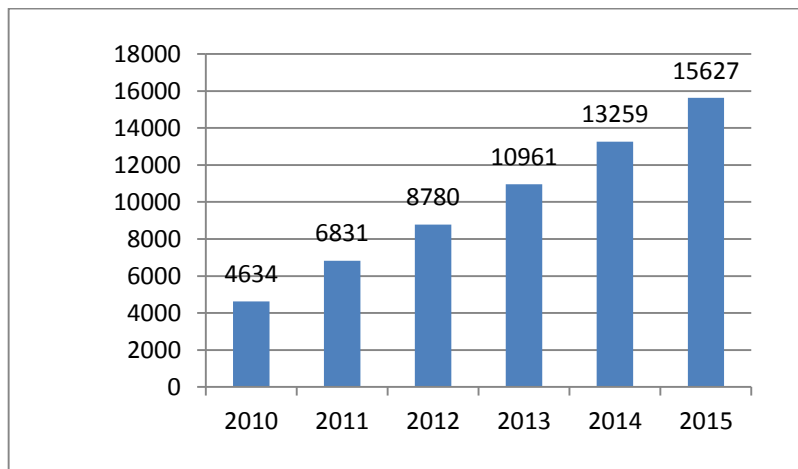
Internet penetration is rapidly increasing with around 300 million users in 2014, he said, adding, The Smartphone is steadily growing and consists of 35% of the overall mobile phones market in the country and success rate of some of the technologies is directly connected to the success of e-commerce. The ASSOCHAM-Deloitte joint study also states that the e-commerce companies are concentrating their efforts on increasing the penetration of their mobile apps for higher growth, adding that big players in this space claim to have more than 50% of their revenue coming from mobile apps.

The Telecommunication Industry

Telecom services have been acknowledged globally as an essential tool for the socio-economic development of a nation. India is currently the world's second-largest telecommunications market and has registered exceptional growth in the past few years. Government policies and regulatory framework implemented by the Telecom Regulatory Authority of India (TRAI) have produced a conducive environment for telecom service providers The Indian mobile economy is growing rapidly. Driven by strong adoption of data consumption on handheld devices, the total mobile services market revenue in India reached US\$ 29.8 billion in 2014 and is expected to touch US\$ 37 billion in 2017, registering a compound annual growth rate (CAGR) of 5.2 per cent, according to research firm IDC.

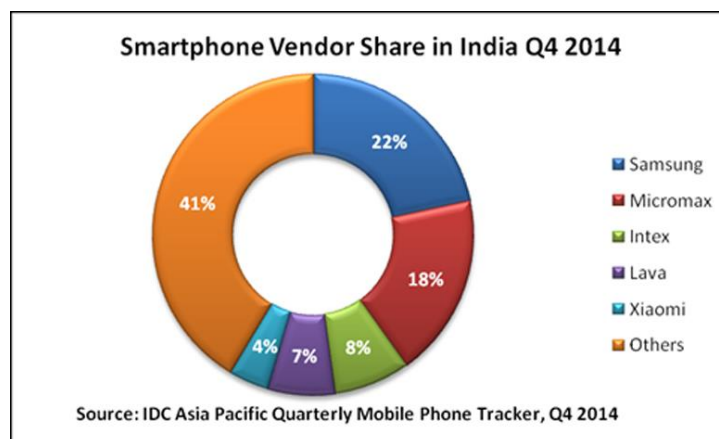
The mobile data services are the new potential area of income for cellular service providers. The forecast illustrates the mobile data service revenues in India from

2010 to 2015. The mobile data service revenue is projected to amount to 15,627 million U.S. dollars in 2015.



Driven by 3G and 4G services, it is expected that there will be huge machine-to-machine (M2M) growth in India in 2016-17, according to UST global. There is also a lot of scope for growth of M2M services in the government’s ambitious US \$ 1.1 billion smart-city program.

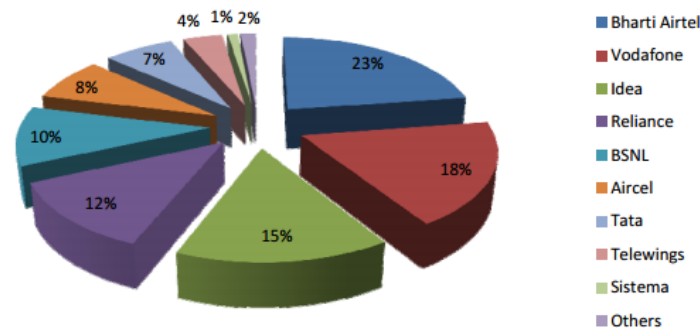
Smartphone sales in India increased by 166.8% making it the world’s fastest growing Smartphone market in the last quarter of 2013, according to Gartner. A total of 967.78 million Smartphones were sold in 2013, up 42.3% YoY from 680.11 million Smartphone sales in 2012. Nokia, Samsung, Apple, Micromax and LG are having the lion’s share of Indian mobile handset market. Domestic companies like Micromax, Karbonn, Lava, Intex, Videocon, Xolo etc are also giving a tough competition to their international counterparts. Micromax is poised to overtake soon the Samsung Electronics Pvt. Ltd. as the leading supplier in India's booming Smartphone market.



The number of telephone subscribers in India stood at 963 million at the end of 2014. The overall Tele-density in India at the end of 2014 was little more than 77. By 2014, the total wireless subscriber base was around 940 million and the overall wireless Tele-density was 75. The Indian telecom sector’s revenue grew by 13.4 per cent to touch US\$ 64.1 billion in FY12. In terms of market players, Airtel, Idea, Reliance, Aircel, and Tata Cellular are the key domestic service providers, along with

the State owned Bharat Sanchar Nigam Limited (BSNL) the Mahanagar Telephone Nigam Limited (MTNL). The private players have a market share of 90.55%.

Wireless market share in terms of total subscribers in India

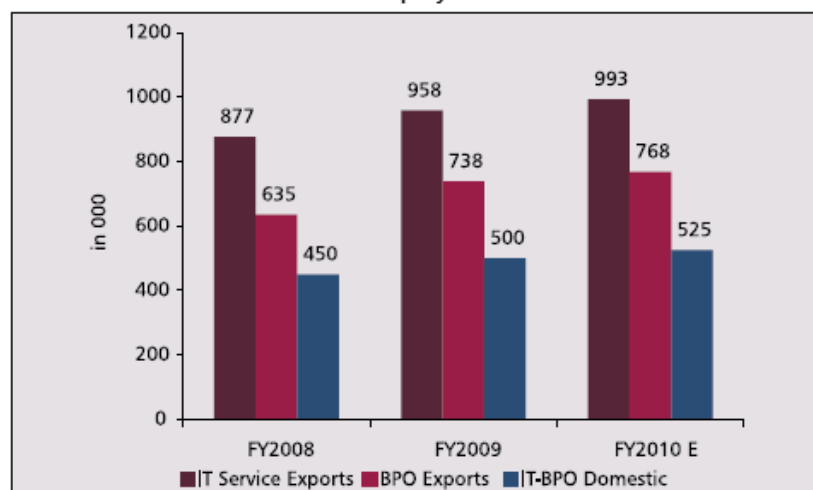


Creating employment for young India

The employment generation figures of the sector are equally impressive. With IT biggies like Infosys, Cognizant, Wipro, Tata Consultancy Services, Accenture and several other IT firms operating in some of the major Indian cities, there is no dearth of job opportunities for the Indian software professionals. The IT enabled sector of India absorbs a large number of graduates from general stream in the BPO and KPO firms. All these have solved the unemployment problem of India to a great extent.

The IT-BPO industry has created direct employment of 2.2 million and indirect employment of eight million. By 2020, the figures are expected to go up to 10 million and 20 million respectively. The indications are that significant global career opportunities will be generated due to the location-independent models.

IT-BPO - Direct Employment Generation



Source: NASSCOM, *The IT-BPO Sector in India, Strategic Review 2010*; Excludes hardware

Interestingly, the employment opportunities have touched different sections of society, going beyond the metros. Today, nearly 58 per cent of the IT-BPO workforce is from Tier 2/3 cities with 56 per cent employees being the key bread earners. The

NASSCOM study shows that by 2020, four million people will be directly employed by the IT-BPO industry from Tier 2/3 locations, a 20-fold jump in the number of employees operating.

Conclusion

A somewhat special characteristic of the IT industry is that it is a 'general purpose technology', distinguished by pervasiveness, technological dynamism and innovation complementarities. This has made it a significant and impactful contributor of growth over the past two and half decades. However, till recently, the benefits of IT had been restricted to the educated elite with access to jobs and power. The industry is now playing a special role in bringing economical changes to the country by reducing poverty and changing people's lives for the better. It has the potential to bring greater efficiency in governance and reaching remote areas address the issues of healthcare, education, delivery of goods and services and other basic needs.

INSTITUTES OF SCIENTIFIC IMPORTANCE AND INDIAN SCIENTISTS

India has large number of universities and educational institutes in addition to numerous scientific organisations for the development of and education. Listed below are few major such organisations:

Council of Scientific and Industrial Research (CSIR)

The Council of Scientific and Industrial Research, under the Department of Scientific and Industrial Research, was established as a society in 1942. One of the objectives of CSIR is to undertake research and development directed towards continuous improvement of indigenous technology developed by CSIR laboratories and institutions in India. There are thirty-nine CSIR Laboratories and Documentation Centres located all over the country. National Physical Laboratory, New Delhi; National Chemical Laboratory, Pune; National Aerospace Laboratories, Bangalore; National Botanical Research Institute, Lucknow; National Environmental Engineering Research Institute, Nagpur; National Geophysical Research Institute, Hyderabad; National Institute of Oceanography, Goa; National Metallurgical Laboratory, Jamshedpur, etc. are some of the CSIR prominent laboratories working in different areas in science and technology.

Defence Research and Development Organisation (DRDO)

It works towards enhancing self-reliance in Defence Systems and undertakes design and development leading to production of world class weapon systems and equipment. It is also working in various areas of military technology which include

aeronautics, armaments, combat vehicles, electronics, instrumentation engineering systems, missiles, materials, naval systems, advanced computing, simulation and life sciences. DRDO while striving to meet the Cutting edge weapons technology requirements provides ample spinoff benefits to the society at large thereby contributing to the nation building. Currently, DRDO has 48 centres in India.

Department of Atomic Energy (DAE)

The Department of Atomic Energy has been engaged in the development of nuclear power technology, applications of radiation technologies in the fields of agriculture, medicine, industry and basic research. The important programmes of the DAE are directed towards:

- Enhancing the share of nuclear power in the Power Sector, and to develop fast breeder reactors, as well as thorium based reactors with associated fuel cycle facilities;
- Building and operating of research reactors for the production of radioisotopes, building other sources of radiation such as accelerators and lasers, and developing and deploying radiation technology applications in the fields of medicine, agriculture, industry and basic research.
- Developing advanced technologies such as accelerators, lasers, supercomputers, robotics, areas related to Fusion research, strategic materials and instrumentation, and encouraging the transfer of technology to industry.
- Carrying out and supporting basic research in nuclear energy and related frontier areas of science; interaction with universities and academic institutions; support to research and development projects having a bearing on DAE's programmes, and international cooperation in related advanced areas of research and contribution to national security.

DAE comprises following units: It also supports eight institutes of international repute engaged in research in basic sciences, astronomy, astrophysics, cancer research and education. There are six DAE units working for research and development sector; five in public sector; two in industrial sector; sixteen in educational sector; and two boards for nuclear research and higher mathematics.

Indian Space Research Organisation (ISRO)

Indian Space Research Organisation (ISRO) is an organisation working under the Department of Space, Government of India. The Space Commission formulates the policies and oversees the implementation of the Indian space programme to promote the development and application of space science and technology for the socio-economic benefit of the country. DOS implements these programmes through, mainly, Indian Space Research Organisation (ISRO), Physical Research Laboratory (PRL), National Atmospheric Research Laboratory (NARL), North Eastern-Space Applications Centre (NE-SAC) and Semi-Conductor Laboratory (SCL). The Antrix

Corporation, established in 1992 as a government owned company, markets the space products and services. The establishment of space systems and their applications are coordinated by the national level committees, namely, INSAT Coordination Committee (ICC), Planning Committee on National Natural Resources Management System (PC-NNRMS) and Advisory Committee of on Space Sciences (ADCOS). The major establishments under ISRO are Vikram Sarabhai Space Centre VSSC at Thiruvananthapuram; ISRO Satellite Centre ISAC at Bangalore; ISRO Satellite Integration and Test Establishment ISITE; Satish Dhawan Space Centre SDSC at Sriharikota; Liquid Propulsion Systems Centre LPSC; Space Applications Centre SAC at Ahmedabad; Development and Educational Communication Unit DECU at Ahmedabad; ISRO Telemetry, Tracking and Command Network ISTRAC; Master Control Facility (MCF) MCF at Hassan; ISRO Inertial Systems Unit (IISU) IISU at Thiruvananthapuram; Laboratory for Electro-Optic Systems LEOS at Bangalore; National Remote Sensing Centre NRSC at Hyderabad; Regional Remote Sensing Centres RRSC at Bangalore, Jodhpur, Kharagpur, Dehradun and Nagpur; Physical Research Laboratory PRL at Ahmedabad; National Atmospheric Research Laboratory NARL at Gadanki; North Eastern-Space Applications Centre NE-SAC at Shillong; Antrix Corporation Limited at Bangalore; Semi-Conductor Laboratory SCL; and Indian Institute of Space Science and Technology IIST.

Indian Council of Agricultural Research (ICAR)

The Council is the apex body for co-ordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country. ICAR is one of the largest national agricultural systems in the world. It has played a pioneering role in ushering Green Revolution and subsequent developments in agriculture through its research and technology development enabling the country to increase the production of agricultural products. It has also played a major role in promoting excellence in higher education in agriculture. It has 100 institutions under its aegis.

The Indian Institutes of Technology (IITs)

These are autonomous “institutions of national importance” of higher education for quality education and research. These are located at Chennai, Delhi, Guwahati, Kanpur, Kharagpur, Mumbai, Roorkee, Bhubaneswar, Gandhinagar, Hyderabad, Indore, Jodhpur, Mandi, Patna, Ropar and Varanasi.

The Indian Institute of Science (IISc)

Over the 105 years since its establishment in 1909 at Bengaluru, IISc has become the premier institute for advanced scientific and technological research and education in India. Beginning with 2 departments and 21 students in 1911, today IISc has 39 departments, units or centres. In the recent years, with new centres such as CiSTUP (The Centre of Infrastructure, Sustainable Transportation, and Urban

Planning), the Divecha Centre for Climate Change, the Centre for Earth Sciences, the Centre for Neuro-Science, the Centre for Excellence in These are autonomous "institutions of national importance" of higher education for quality Nano Science and Engineering (CeNSE), and the Robert Bosch Centre for Cyber Physical Systems (RBCCPS), the Institute has vigorously promoted inter-disciplinary research

Indian Institutes of Science Education and Research (IISERs)

These are a group of most premier science education and research institutes in India. These institutions have been declared by Act of Parliament as institutions of national importance. Five IISERs have been established across the country in Kolkata, Pune, Bhopal, Mohali and Thiruvananthapuram. IISERs at Tirupati in Andhra Pradesh, in Odisha and Nagaland are to begin shortly.

Department of Bio Technology DBT, GOI

Attaining new heights in biotechnology research, shaping biotechnology into a premier precision tool of the future for creation of wealth and ensuring social justice, the DBT is instituted to promote large scale use of Biotechnology; to support RandD and manufacturing in biology, responsibility for autonomous Institutions; to promote university and industry interaction, to identify and set up Centres of Excellence for RandD, to have integrated programmes for human resource development, serve as nodal point for specific international collaborations; for establishment of infrastructure facilities to support RandD and production; to evolve bio-safety guidelines, manufacture and application of cell based vaccines, to serve as nodal point for the collection and to disseminate the information relating to biotechnology. DBT has some institutions under its aegis, such as the National Institute of Immunology, New Delhi; National Facility for Animal Tissue and Cell Culture (National Centre for Cell Science), Pune; National Institute for Plant Genome Research (NIPGR); the National Brain Research Centre (NBRC); the Centre for DNA Fingerprinting and Diagnostics; Institute of Bioresources and Sustainable Development; and the Institute of Life Sciences; Translational Health Science and Technology Institute (THISTI); Institute for Stem Cell Biology and Regenerative Medicine (INStem); National Agri-Food Biotechnology Institute (NABI) at Mohali; and National Institute of Biomedical Genomics (NIBMG) at Kalyani.

Other prominent scientific organisations in India include All India Institute of Medical Sciences, New Delhi; Indian Institute of Welding, Cochin; Science and Technology Park, Pune; SN Bose Institute for Basic Sciences, Kolkata; Indian Association for Cultivation of Science, Kolkata; Raman Research Institute, Bangalore; National Institute of Forge and Foundry Technology, Ranchi; Appropriate Rural technology Institute; Jawaharlal Nehru Centre for Advanced Scientific and Technological research, Bangalore; National Institute for Pharmaceutical Research, Chandigarh etc.

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Role of IT sector in Economic Development of India

- The National Association of Software and Services Companies (NASSCOM) – www.nasscom.in
- The Department of Electronics and Information Technology (DeitY), Ministry of Communications and IT, GOI – www.deity.gov.in
- The Department of Telecommunications, Ministry of Communications and IT, GOI – www.dot.gov.in
- International Data Corporation (IDC) – www.in.idc.asia
- The Associated Chambers of Commerce in India (ASSOCHAM) – www.assochem.org