

Eleventh Five Year Plan **2007-2012**

Information Technology Sector

Department of Information Technology
Ministry of Communications and Information Technology
New Delhi

Eleventh Five Year Plan
Information Technology Sector
2007 - 12

Department of Information Technology
New Delhi

Foreword

Information Technology has marked a turning point in the history of global trade in services, with growing acceptance of IT based global delivery model. With ever increasing availability of international bandwidth and powerful workflow management software, it is now possible to disaggregate any business process, execute the sub-processes in multiple centres around the world, and reassemble it, in near-real time, at another location. This is driving fundamental changes in the global IT services landscape, vendors and customers are redefining the levels of value creation in the industry. IT also makes significant contribution in increasing productivity in various sectors of the economy.

In the context of preparation of the Eleventh Five Year Plan (2007-12), the Government has constituted a Working Group on Information Technology sector to make recommendations on the various policy matters to enable to formulate the Eleventh Five Year Plan for Communication and Information sector.

This report is the result of efforts of the Members of the Working Group drawn from a cross section of the IT community and five specialized, subject specific Study Teams.

In the wake of changing global service landscape, Indian Information Technology (IT) and IT enabled services (ITES-BPO) continue to chart remarkable growth. The outstanding success of IT and IT-enabled services (ITES) has demonstrated what Indian skills and enterprise could do, given the right environment. India's remarkable success in IT enabled services has prompted some observers to conclude that China has a comparative advantage in manufacturing whereas India has an advantage in services and we should therefore concentrate on growth of high value services. India's performance in IT enabled services and other high end services is clearly a source of strength that we must build upon.

However, India cannot afford to neglect manufacturing. There is a pressing need to increase hardware manufacturing. We have a dynamic entrepreneurial class that has gained confidence in its ability to compete. We have skilled labour and excellent management capability. However, there are other constraints that limit our competitiveness, especially in labour intensive manufacturing, and the Eleventh Plan must address these on a priority basis.

I would like to thank all members of the Working Group and Study Teams for their valuable inputs and Shri Rajiv Rastogi and his team (S/Shri T. Santhosh, R.K. Manchanda, Raj Kumar, Virendra) for preparing this Report.



Jainder Singh

Chairman – Eleventh Plan Working Group
on Information Technology &
Secretary, Department of Information Technology

Preface

As a part of the exercise relating to the formulation of the Eleventh Five Year Plan (2007-12) for Communication and Information Sector, the Planning Commission had constituted a Working Group on Information Technology under the Chairmanship of Secretary, Department of Information Technology. The Working Group had 22 Members drawn from various Government Department and Organizations, State Governments, Industry Associations, R&D Institutions and Industry.

The Terms of Reference of the Working Group are given in the Appendices. For getting a wider participation from different industry sectors, industry associations, R&D laboratories, experts and other intellectuals, the following five Study Teams were constituted :

1. Electronics/IT Hardware Manufacturing Sector
- Chairman - Shri Ajai Chowdhry, HCL Infosystems Ltd.
2. Exports of Computer Software & Services
- Chairman - Shri Saurabh Srivastava, TIE
3. Domestic Computer Software and Services
- Chairman - Shri Kiran Karnik, NASSCOM
4. Human Resource Development
- Chairman - Shri Phiroz Vandrevalla, TCS
5. Research & Development
- Chairman - Shri Ashok Soota, MindTree Consulting

The Terms of Reference and Composition of various Study Teams are given in the Appendices of the Report. The reports of the Study Teams are included in this Report.

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Eleventh Five Year Plan for Electronics and Information Technology – A Perspective

Over the past few years several initiatives have helped demonstrate the potential to use ICT in working towards developmental goals such as poverty alleviation, increased access to education and health services, and reduce gender inequalities.

The outstanding success of IT and IT-enabled services (ITES) has demonstrated what Indian skills and enterprise could do, given the right environment. India's remarkable success in IT enabled services has prompted some observers to conclude that China has a comparative advantage in manufacturing whereas India has an advantage in services and we should therefore concentrate on growth of high value services. India's performance in IT enabled services and other high end services is clearly a source of strength that we must build upon. However, India cannot afford to neglect manufacturing. India meets most of the requirements for attaining double digit growth in manufacturing. We have a dynamic entrepreneurial class that has gained confidence in its ability to compete. We have skilled labour and excellent management capability. However there are other constraints that limit our competitiveness, especially in labour intensive manufacturing, and the Eleventh Plan must address these on a priority basis.

Poverty alleviation programs have leveraged ICT to increase opportunities for wage employment and micro-entrepreneurship. Use of technology has also helped raise the magnitude and reduce the vulnerability of returns earned by small producers from their economic activities by providing timely access to relevant information (e.g. details about the best prevailing prices for farmers, location of fish shoals for fishermen, weather reports, etc.). Further, direct effects of ICT on poverty reduction may also be achieved through a reorganization of economic activity that allows producers increase their returns.

Besides the direct contribution that ICT can make towards alleviating poverty, it can also contribute indirectly by facilitating and reducing the costs of delivery of services that either promote wage and self employment or help overcome structural constraints to poverty alleviation, and by improving the quality of delivery of employment generating and poverty alleviating projects being implemented by the government.

ICT can play a role in bridging gender disparities by directly benefiting the women who use technology as well as by improving the delivery of services to women. This is also reflected in the relatively higher proportion of women employees in the Indian IT-ITES sector – as compared to other sectors of the economy. The influence on gender equality is not restricted to the urban cities alone. There are also examples where ICT is being used to strengthen earning opportunities for women and to build productive skills among disadvantaged women as well as offer knowledge-based services that help improve the productivity of women's enterprises in smaller towns and cities.

Technology may also be applied towards building an equitable knowledge based society by facilitating better access to education to the people in remote locations or from underprivileged sections of the society in an economical manner. Potential gains from ICT in health have been highlighted through some grass-roots usage experiments in which ICT has been applied to increase the efficacy of social service delivery.

However, widespread diffusion usage of ICT is imperative for these gains to be realized on a large scale. Though still lagging behind global benchmarks, India has made steady progress on this front in recent years.

Manufacturing

"Manufacturing" has been recognized as the main engine for economic growth and creation of wealth. However the share of manufacturing has been stagnating at a low level of 17% of GDP for over two decades. One of the major reasons for the reduced level of contribution by Manufacturing has been the inability of the country to build and maintain competitiveness needed to meet the global challenges as well as to develop a larger domestic market through low cost production.

Manufacturing is crucial to the Indian economy. Manufacturing spurs demand for every thing from raw materials to intermediate components. It impinges on software to financial, health, accounting, transportation, and other services in the course of doing business.

Manufacturing sector has to carry the major burden of increasing employment opportunities, directly or

indirectly. This is particularly valid for rural and agricultural sectors. It also creates strong multiplier effects services.

India's manufacturing competitiveness is because of the factors such as Low-Cost Labour, Talent Pool of 3 million graduates passing out of universities every year. Raw-Material is one of the richest sources of iron ore and a strong edge in bauxite, aluminium and textile. Design-Strength of India has an edge in engineering and is a leader in hardware / software design.

Electronics is a booming industry worldwide. Apart from growth potential, the industry also holds promise of employment generation, capital creation, cascading effects both in increasing consumption-led growth and increasing other efficiencies, savings in foreign-exchange, increase in government revenue and overall long-term increase in India's global competitiveness.

Impact of electronics manufacturing on the Indian Economy

Electronics can impact the economy in the following ways:

- Raise long term growth potential (increased productivity, competitiveness)
- Create employment opportunities (both high skilled and low skilled)
- Spread of education and literacy
- Provide universal health services
- Deliver e-Governance.

We should aim at creating a 14 times growth in manufacturing sector in the Eleventh Plan to address the over 12-times growth in demand projected by Frost and Sullivan report. As per the report, the estimated potential of manufacturing is 155 billion USD by 2015 as against the current production of 12.7 billion USD. This is indeed a big challenge. Should the potential of the hardware industry be fully realised, it will lead to creation of 7 million direct and (x2) 14 million indirect jobs by 2015 and also leverage India's demographic dividend.

Convergence

ICT technologies are converging all across the spectrum. A mobile phone today gets used as a Voice device, an SMS device, for e-mail, as a PDA, a TV, a Radio, a Gaming device, a Disk Drive, for Internet Access, as a Camera, a Video Camera, a Calculator, a Watch

and an Mp3 player. PCs today get used for computing as well as a converged device for all these functions. A TV gets used as a PC, a Set-top-box, a Radio, Internet Access and Gaming device. Internet access, radio and TV broadcasting and telecom switching equipment are all digital and server-based today.

The Government fiscal policy provides special dispensation for IT policy (covered under ITA –1 of WTO). It is suggested that similar policies, taxation treatment should be accorded to all electronic products and their accessories.

Domestic Consumption

This sector is also the first to face the zero duty regime under the WTO. Manufacturing is thus under great pressure. The route to increase revenue collection for the government should be through increased domestic consumption base and the value addition rather than through increased taxation and duties on the existing small base.

Global value chain in electronics manufacturing

To make India part of the global value chain in electronics manufacturing, the focus should be on the following parameters.

- Developing R&D Capability and Academic Connect
- Supply Chain initiatives especially with reference to component manufacturing
- Encouragement to increase in Value-Addition by manufacturers
- Positioning India in the Global Value Chain (encouraging EMS companies etc)
- Flexibility in Labour Policy for Electronics Manufacturers
- Infrastructure (Supply Chain, E-Waste Management System, Power-Costs, Other input costs, Finance-Costs, R&D Costs (technology development fund)) etc.
- Testing Labs Infrastructure, to provide 'solutions' rather than go / no-go; (reference to the World Bank stress on metrology as a growth imperative)
- Compliance of safety and EMC standards and e-waste.

Constraints, problem areas and procedural issues

Electronic hardware industry has number of constraints, problem areas and procedural issues such

as small size/scale of operations, a fragmented market , standards & testing facilities, lack of component base, infrastructural issues, high cost of finance, high rate of technological obsolescence etc. These need to be addressed.

Trends

In 2005-06, 5.13 million computers were consumed in the country registering an annual growth of 32%. The growth in increased sales in computers can be attributed to significant consumption in telecom, banking and financial sectors, IT & ITES, education, SOHO, retail and e-governance.

Globally, television industry is expected to grow from 180 mn units in 2005 to 205 million units by 2009.

The \$235 billion worldwide semiconductor industry is the key driver for most advanced technologies in the world today. It forms the heart of the \$1,300 billion global electronics industry and is also the key enabler for the fast emerging nanotechnology and biotechnology markets, each of which will soon be a trillion dollar plus market.

India today ranks amongst the top 10 telecom networks in the world and the second largest in Asia. The current installed base of communication network in India comprises of about 47.5 million wire line phones, 106 million cellular phones, 7.5 million Internet subscribers, 110 million TV households, 18.0 million PCs, 500,000 route kms of optical fiber network and 25,000 VSATs, cable subscribers at more than 60 million.

Broadband has been a significant driver of economy for nations across the globe due to the benefits provided by the technology. Mobile Handsets have been a success story in the Indian electronics manufacturing space. Mobile Accessories with a huge potential for SMEs may provide further impetus to manufacturing.

Investments in most vertical industries including automotive, construction, chemical & petrochemical, electric power, food & beverage, metals, oil & gas, and pharmaceutical are growing at lightening speed. The increasing demand for a wide range of goods is driving the growth of these industries, and the future outlook for both process and discrete industries is expected to remain optimistic.

The Emerging Sectors which will add to the high tech manufacturing are Nanotechnology, Optical Communication, Electronics Materials, and Solar Photovoltaics.

The Government and the Industry should target to achieve the following by the end of XI plan

- Electronics production – USD 67 billion
- Investment of USD 44 billion
- Exports of USD 6.7 billion
- Employment of 21 million

Government will have to play an important role in not only demand generation but also facilitating the creation of a healthy ecosystem for electronics manufacturing in the country.

Software Exports

India's success in the export of Information Technology (IT) Software and Related Services over the past decade remains unparalleled. Total export revenues earned by this sector have grown from INR 6,723 crore (US\$ 1.8 billion) in 1997-98 to INR 104,500 crore (US\$ 23.6 billion) in 2005-06 and are forecast to reach INR 139,700 crore (US\$ 30.5 billion) in 2006-07. Today, India is regarded as the premier destination for the global sourcing of IT and IT-Enabled Services (IT-ITES). India now accounts for 65 per cent of the global market in offshore IT and 46 per cent of the ITES market.

With only 10 per cent of the US\$ 300 billion market potential addressed so far – there is significant headroom for growth. Further, with the global offshoring market continuing to grow rapidly, as the proven benefits of offshoring (also termed global sourcing or global delivery) induce more and more companies to adopt these practices and providers develop the capabilities to offer more sophisticated products and services – the size of the overall pie is also expanding. India is fundamentally advantaged and uniquely positioned to sustain its global leadership position, grow its offshore IT-ITES industries at an annual rate of 24-25 per cent, sustain nearly 10 million jobs, and generate export revenues of about US\$ 86 billion by 2012. Additionally, this export growth can be further accelerated through deep and enduring innovation by industry participants. Such extensive innovation could generate an additional US\$15-20 billion in export revenue over the next five to ten years.

Key service lines, vertical markets and new emerging areas identified include

1. Service lines

- a. R&D and engineering services
- b. Consulting services

- c. System integration
- d. Application development and maintenance
- e. Traditional IT outsourcing
- f. Horizontal services (finance accounting and administration, customer interaction services, human resource administration, research, etc.).

2. Verticals

- a. Banking
- b. Insurance
- c. Manufacturing
- d. Pharmaceuticals
- e. Travel and hospitality
- f. Animation, media and entertainment

3. Areas for focussed research

- a. Security
- b. Mobile and communications
- c. Health, biotechnology and life sciences
- d. Energy and Environmental protection
- e. Nanotechnology.

To that end, policy actions are required in five key areas: 1) Improving the supply of suitable talent; 2) Building adequate basic, business and social infrastructure; 3) Ensuring a favourable policy and regulatory environment, with a special focus on encouraging SMEs and new ventures; 4) Global trade development and promoting global free trade in services; and 5) Fostering a sustainable ecosystem for innovation and R&D.

Domestic Software

Several large e-governance initiatives under the National E-Governance Plan (NEGP) are expected to provide sustained growth in domestic demand for IT services over the next few years. Over the next five years, domestic spending on outsourced IT services is projected to more than double, from Rs. 103 billion in 2004 to over Rs. 238 billion in 2009.

Thrust Areas

1. Increase IT adoption in the Small and Medium Businesses (SMB) segment. Understand the

business needs of each cluster of SMB and create new suitable business models for adopting IT.

2. Increase efficiency of E-governance investments

- Encourage the Central and State governments to procure e-governance services
- Encourage the use of IP / products developed by Indian companies
- Encourage reusability in e-governance projects at both the infrastructure and application level.
- Fast replication of already successful e-governance programs.

3. Increase Digital Signature / Security issues awareness and acceptance

- Make digital signatures mandatory for e-commerce initiatives
- Fund/sponsor "Know Digital Signatures" campaigns
- Apply accredited digital signature to e-Government initiatives
- Banks to employ digital signatures in electronic banking
- Identify and Develop "Killer Applications" – Online auctions, e-Voting, Home Banking etc.

4. Education and Skill Development

- Expand capacities and the number of world-class institutions (e.g., IITs, IIMs, IISc)
- Re-orient the education system to make it demand-based through a joint academia-industry effort
- Decentralize the education sector governance model.

5. Effective Spectrum Management - Infrastructure Development

- Promotion of xDSL Technology
- Wireless in the Last Mile – using xDSL, Wi-Max Technologies
- Uniform spectrum pricing.

6. Increase PC & Internet Penetration

- All Government schools should have basic minimum IT infrastructure and connectivity
- Expand the Village Knowledge Centre (VKC) concept across the country to deliver citizen services
- Provide Incentive for production of multi lingual software.

7. Increase development and deployment of multi-lingual products

- The State and Central Governments must be mandated to deploy Local Language interfaces on the citizens front/citizen services.

8. Increase commercialization of domestic R&D

- Encourage creation of consortiums between vertical industry and research institutes
- Allow industry funding university research as direct R&D expenses
- Incentivise vertical industry to establish R&D centers within or in collaboration with academic/ research institutes
- Allow government scientists to incubate start-ups based on IP generated by them.

9. Enhancing usage of Free/Open Source Software (FOSS)

- Provide continued service support of FOSS at lower cost to Indian domestic software users.

10. Government Policy as an enabler

- Remove the excise on software announced in the current budget.
- Encourage the adoption of e-procurement model in all government procurement.
- Encourage State government to initiate major citizen centric mission projects under NeGP. Center may consider providing 75% of project cost. PPP model may be encouraged and revenue earned can be retained.

- Banks should be mandated to treat loans for IT procurement similar to loans for infrastructure funding.
- Government agencies responsible for seed funding (TDB, SIDBI Ventures etc) should re-orient themselves. Instead of directly investing in start-ups through loans/grants, these agencies should act as 'fund of funds' and invest in VC sponsored funds.
- High Net-worth NRI should be encouraged to invest in domestic VC funds.
- Domestic industry should be encouraged to contribute to Venture Capitalist (VC) funds aimed at seed funding.
- Government seed funding (TDB, SIDBI Ventures etc), Instead of directly investing in start-ups through loans/grants, 'fund of funds' can be considered that is for every X of GOI funds, the VC has to provide for 3X. The Yozma program in Israel and SBIC program in USA are good models to study.
- Create a dedicated fund to promote IT adoption in the SMB segment.

11. Legal frameworks

- There needs to be a distinct law on the legality of electronic payments.

Human Resource Development

The fast growing IT Sector has created a huge career opportunity in its wake. The profiles of the career opportunities keep dynamically changing as newer and newer technologies emerge and the global market requirements change.

All along at the initial stages of the growth of IT industry, the formal sector was predominantly meeting the manpower requirement of this sector. The formal sector education system focuses on the fundamentals, concepts in different subjects and bring-out engineers with excellent basics and strong foundation over which the super structure could be built. However, the need and demand placed by the fast technological changes and the emerging global market trends that are marking the growth of Indian IT industry brings out the demand for complementing and supplementing the formal sector through the non-formal sector of education and training. The need is in the form of continuing education for training the existing professionals and the teaching faculty to keep pace with

the demands of the industry as well as technological changes. The burgeoning demand for the IT professionals has marked the growth of non-formal education sector.

To retain our position as a major player in the IT arena over a period of time, there is a need to address the human resource requirement of the industry on a continuous basis.

Research and Development

India's expenditure on R&D at 0.8% of GDP is well below that of many nations and needs to be stepped up progressively. While India's success in software is a matter of pride, the trade deficit in Electronics hardware for a demand of \$22 billion has grown to reach \$ 10.4 billion and is projected to grow at alarming levels. There is a need for encouraging design led manufacturing which is also known to be an employment generator. Furthermore, the thrust on R&D activity has to be increased, together with applications and infrastructure, and be brought to the centre stage. For India to become a major player in knowledge economy, innovation promotion will play a major role. We have to respond to the changing needs and try out multiple models like Technology Innovation Promotion Scheme, Public Private Partnership models, Cluster approach and new ways to generate and protect IPR etc. To address the above issues and to bring R&D to centre stage, it is suggested that an E & IT Commission (Electronics and IT) be created and the department be renamed as Department of Electronics & IT.

To spread the R&D base, the faculty of tier II institutions needs to be brought into main-stream research. This could be achieved by supporting a large number of small projects at these institutions. In addition, DIT should also set up Centres for Excellence at premier institutes involving multiple specialties. In order to pay

focused attention for development of technologies in Indian languages, DIT should set-up a "Society" for Indian Languages, which is also supported by regional labs.

The processes for commercialization of technology needs to be accelerated by creating additional incubation centres and strengthening the existing ones, having a well-defined and liberal policy for Government funded IP, and strengthening the "Lab to market" process. In order to address the needs of IPR Generation and Protection, it is proposed to set up a Centre for Global Trading in E&ICT-IPRs, which will promote the IPR culture and provide specific services for Patent Mapping, IPR/ Technology Marketing and Legal Enforcements etc.

The shortage of talent is looming large and steps for attraction and retention of technical manpower in the Government and its institutions have to be taken.

For attraction of additional funds for R&D in E&IT, R&D Corporation of India (RDCI) be created which should be empowered to float tradeable bonds of Rs.1000 crore for the E&IT sector alone. This will help in increasing the contribution of non-Government funds towards R&D.

While prioritizing fund allocation, it would be imperative that no compromise is made in allocation of funds by Government in respect of the technology areas pertaining to National Security and Safety, Social Sector and next Strategic Sectors. Some prospective areas in this context could be Next Generation Wireless Networking and High Performance Computing, Open Systems, VLSI Design, Nano-Technology, and RFID.

It is important to have a grand vision whereby India selects a few areas for global leadership, and R&D is undertaken through a well coordinated geographically spread clusters of academics, labs, industry, and Government.

Electronics/ IT Hardware Manufacturing

Executive Summary

Advantages of Manufacturing

“Manufacturing has been recognized as the main engine for economic growth and creation of wealth and accordingly, emphasis was placed on growth of industry in most of our Five Year Plans. However the share of manufacturing has been stagnating at a low level of 17% of GDP for over two decades. One of the major reasons for the reduced level of contribution by Manufacturing has been the inability of the country to build and maintain competitiveness needed to meet the global challenges as well as to develop a larger domestic market through low cost production.

Manufacturing is crucial to the Indian economy. The effect of improvement in manufacturing sector goes far beyond the goods provided by it. Manufacturing sells goods to other sectors and in turn buys materials and services from them for its growth and development. Manufacturing spurs demand for every thing from raw materials to intermediate components. It impinges on software to financial, health, accounting, transportation, and other services in the course of doing business.

Needless to say that manufacturing sector has to carry the major burden of increasing employment opportunities in the coming decades directly or indirectly. This is particularly valid for the unemployed coming from rural and agricultural sectors. Growth of manufacturing sector lends greater support to Agriculture through more intensive efforts on agro-based Industries. It also creates strong multiplier effects in the services sector in areas like traditional trading, financial services, transport etc. Therefore, the overall employment effect of manufacturing would have to include the indirect generation of employment in the services sector. Besides, within the service sector those of the sub-sectors that are linked to the manufacturing directly need to be concentrated upon as they provide substantial job opportunities. It is, therefore, necessary that robust growth of the manufacturing sector is ensured for creating overall growth and employment possibilities in the economy.

Within industry, the employment in manufacturing was 40 million in 1999-2000. Between 1993-94 and 1999-2000, the employment elasticity in manufacturing dropped to 0.33 as compared to 0.59 during the period

1983 and 1988. It is estimated that a 12% growth rate will create 1.60 million employments with present employment elasticity. If the employment elasticity were to improve to the earlier higher level of 0.59, then 2.9 million new direct jobs per year would get created in manufacturing sector. These are figures on direct job creation. In addition, indirect jobs estimated at two to three times the direct employment figures would be created as a result of stet multiplier effects.

– *Extracts from the National Strategy for Manufacturing, NMCC, Government of India, March 2006*

Factors of India's Manufacturing Competitiveness

- **Low-Cost Labour:** Labour wage levels in India are among the lowest in the world. This advantage is likely to continue.
- **Talent Pool:** 3 million graduates pass out of universities every year; a large proof of talent, and cost advantage.
- **Raw-Material:** India has one of the richest sources of iron ore and a strong edge in bauxite, aluminum and textile.
- **Design-Strength:** India has an edge in engineering and is a leader in hardware / software design. A large number of Indian companies are engaged in this. This, along with manufacturing creates a full ecosystem that is hard to compete with.

Electronics Manufacturing

Electronics is a booming industry worldwide. Compared to a global GDP growth of 3%, it is growing at 7.5%. Apart from growth potential, the industry also holds promise of employment generation, capital creation, cascading effects both in increasing consumption-led growth and increasing other efficiencies, savings in foreign-exchange, increase in government revenue and overall long-term increase in India's global competitiveness.

The current splits in the electronics production globally are as follows:

Table 1 : Global Electronic Production

Country	GDP 2004-05	Electronic Prod'n (\$Bn)	Share of GDP	Share of Global
Germany	2100.0	174.0	8.3	12.1
China	1650.0	210.0	12.7	14.6
South	681.0	103.0	15.1	7.2
Taiwan	328.0	51.0	15.5	3.5
Israel	117.0	27.6	23.6	1.9
India	665.0	11.2	1.7	0.7
Thailand	177.2	22.0	12.4	1.4

Some points to note

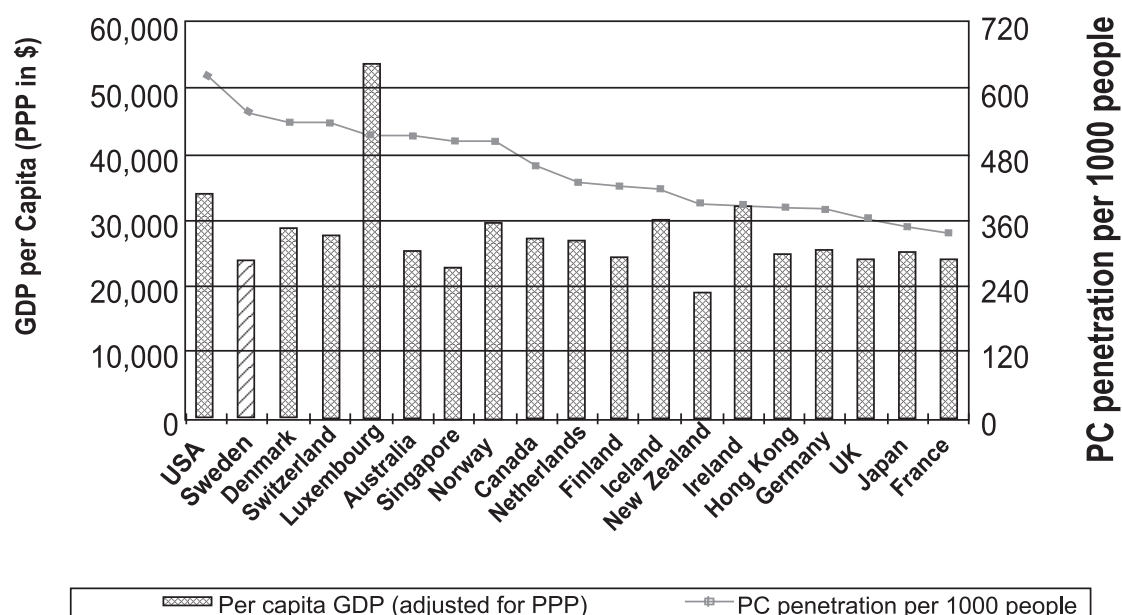
- In 1995, production in “high-cost” locations (such as the United States, Western Europe and Japan) accounted for 75 per cent of electronics output.
- By 2000, this figure had already fallen to 67 per cent
- In 2005, high-cost locations accounted for only 53 per cent of the total
- Between 1995 and 2005, Asia/Pacific's share of global electronics production increased from 20 per cent to 38 per cent.
- China's share of global electronics production increased from 3 per cent to 16 per cent
- Major indigenous companies emerged, primarily in South Korea and Taiwan

- Figures for Electronics Manufacturing in 2005: China \$210 Bn, S. Korea \$95 Bn, Singapore \$45 Bn compared to India \$12.7 Bn.

It is clear from these figures that India has under-performed with respect to most other Asian countries and not just China. China's production is 18.75 times that of India and the share of global production is more than 20 times India's.

Electronics occupies a key position in modern science and technology. It has a vital role to play in the field of Atomic Energy, Space, Communication, Defence, Education, Agriculture, Manufacture, Services, Entertainment, Employment Generation and in tackling national priorities. Electronics has served in the modern age as the “backbone for development”. It is now

Figure 1 : PC Penetration



considered as much a part of infrastructure as are roads and power. This change in the role of electronics is based on the following rationale.

- a) Electronics infrastructure in a country has been found to be directly related to the GDP. The following illustration shows the correlation being talked about with an example of PCs.
- b) Electronics is now an 'enabler' that enables productivity increases in other industries like automobile, manufacturing, telecom etc.
- c) Electronics has cascading effects in increasing the Total Factor Productivity – which in turn has effects on increasing the GDP, and thus national revenues.

Electronics can impact the economy in the following five ways:

- Raise long term growth potential (increased productivity, competitiveness)
- Create employment opportunities (both high skilled and low skilled)
- Spread of education and literacy
- Provide universal health services
- Deliver e-Governance

Electronics and the Millennium Development Goals

The World Summit on the Information Society (WSIS) defined its challenge, as defined in the Draft Declaration of Principles, "is to harness the potential of information and communication technology to promote the development goals of the Millennium Declaration."

Some few developing nations have successfully built export-oriented electronics industries large enough to have significant macro-economic impacts. Costa Rica, for example, greatly stimulated its economy by attracting an Intel facility for the production of micro-chips. Electronics innovations have triggered complementary innovations from other technologies in many sectors. For example, microchips have been introduced into automobiles and other manufactured goods, potentiating mechanical other technological innovations in those goods, which together lead to still further technological innovations.

Goal 1: Eradicate extreme poverty and hunger

Technological improvements, driving increases in economic productivity, are important motors for long-term economic growth. Better organization and

technology are responsible for a significant portion of the growth in productivity. "Total Factor Productivity" growth is a keystone for those economists studying the effect of technology on economic development. Switching from animal to mechanical power was necessary for the industrial revolution, as the introduction of electrical and internal combustion engines was obviously linked to the increase in productivity in the early 20th century.

Goal 2: Achieve universal primary education

Electronics will have an important role to play in improving educational systems. The automation of information processing, storage and retrieval and the radical improvement of communications technology will transform the way we think, and in doing so will transform the way we learn.

People can use point-to-point communication media (e.g., telephone to save travel). They may use broadcast media to reach larger numbers of people for each presentation. They can use storage media (including movies, videos, tapes, and so on) to record information, allowing for future study and distribution. The educational process can be made more asynchronous, allowing people to learn when they choose; distance can be spanned, allowing people to learn where they choose. Learning may become more of an "on demand" process, and as such more motivated;

Appropriate, affordable technologies, such as interactive radio and TV, can help extend education to all, and to improve the quality of education for even the poorest schools in the next decade.

Goal 3: Promote gender equality and empower women

Communications technology offers possibilities to women to engage in e-commerce, distance education, and e-government, thereby overcoming barriers to women's economic advancement.

Especially in scenarios where face-to-face contact with other men is discouraged, women can find a route to the economy through the virtual marketplaces and workplaces that an electronics infrastructure may provide through e-commerce sites and virtual, hosted call-centres and the like. Brazil has had a successful experience with women's networks broadcasting over the radio which serves as an affordable communication media that reaches all homes.

India has a large number of highly educated women who can easily work from home. Just with a computer and an internet connection, they can dramatically add to the outsourcing momentum.

The Health Goals: 4, Reduce child mortality; 5, Improve maternal health; and 6, Combat HIV/AIDS, malaria, and other diseases

Electronics can be a powerful tool in the hands of those who would improve health. The use of low-cost, hand-held computers for collection of medical information, and the use of telephones by auxiliary health personnel can significantly improve the efficiency and quality of services. Other electronics, such as smart cards or electronics -based diagnostic devices, may well lead to significant innovations improving primary care in the future. Embedded computers and other electronics are to be found in much of the diagnostic and medical equipment in secondary and tertiary care facilities.

Providing health education through alternative means is especially important in poor countries. Important health concepts (e.g., how to use of oral rehydration therapy, or the need to use condoms) can be effectively communicated via radio in short messages. Electronics applications can also improve administrative efficiency and quality in the health sector. Medical records number in the millions and can be mined for detailed depiction of a community. The training of health professionals and paraprofessionals may also benefit.

Goal 7: Ensure environmental sustainability

A knowledge based economy generates products that are increasingly in the form of services, information, and “content”. In contrast to the resource intensive products of the industrial economy, the knowledge economy produces “weightless” services. And thus, countries moving toward knowledge economies may well find that development more environmentally sustainable.

In the U.S. economy, energy consumption stayed relatively constant from 1973 to 2000, while the GDP increased by 74 per cent in the same period.

Goal 8: Develop a global partnership for development

There is little need to establish a connect here as the indicators identified for this goal are very clearly electronics indicators.

I. Objectives

The recommendations of this study group are aimed

at creating a 14 times growth in manufacturing to address the over 12-times growth as outlined in the Frost and Sullivan report, January 2006. The report talks of a manufacturing potential of 160 billion USD by 2015 as against the current volume of 12.7 billion USD.

Indian production in 2005 was estimated at USD 11.6 billion, less than 1% of the global production. India runs a deficit of USD 12 billion and the figure is growing. More than 50% of the local requirements are being met through imports and the existing manufacturing concentrates on low-value-adding processes in line with the existing policies. This report takes a look at how these impediments may be rectified and a conducive environment created for bringing high-end manufacturing into India.

II. Vision

- Create 14X growth in electronics manufacturing to address over 12X growth in market projected to reach USD 320 Bn + Hardware Design USD 43 Bn; Total USD 363 Bn
- Manufacturing Potential of USD 67 Bn by 2012 and USD 155 Bn by 2015 (Source: ISA Frost and Sullivan, Jan 2006) compared to USD 12.7 Bn in 2005-06. Assuming 40% value for components, there is a potential for manufacturing electronic components worth US\$ 27 Bn by 2012 and US\$ 62 Bn by 2015. Presently India's output of electronic components is US\$ 2Bn.
- Sustain employment led growth in electronic hardware manufacturing. Potential to create 7 million direct and (x2) 14 million indirect employment by 2015 and leverage India's demographic dividend. 43% of India's population will be under 24 years and 60% under 34 years. The youngest country in the world which will need to provide employment opportunities for this huge workforce.
- Develop indigenous technology and competitive edge, particularly in segments where we are already having a strong presence such as passive and electromechanical components
- Expedite transfer of technology by Relocation of Manufacturing Plants from developed countries. This is the business model successfully facilitated by China and other Asian countries like Malaysia and Thailand to establish large and flourishing hardware industries.
- Grow electronic component industry from US\$ 2 Billion to US\$ 26 Bn by 2012 to meet local demand for components - at 40% of total projected production of US\$66 Bn in 2012.
- Catalyze investment of approx US\$ 20 Bn assuming an Investment Turnover Ratio of 1:1.5
- Role model for other industries for competitiveness under WTO commitments

- Create Fiscal Boom with Economic Boom
- Government Revenue to grow from USD 5 billion in 2005 to USD 56 billion by 2015 – compared to USD 21 billion under present scenario

III. Background

A Sectoral View

The study group strongly felt that there was a strong case for growing high-value-adding, global-quality electronics manufacturing in India. The report of the study group will seek to elaborate those points.

The following points shall elaborate on why this sector deserves a separate, 'sectoral' treatment.

Convergence and Overlap

The field of "electronics" has changed drastically since the last plan. While the term stood for a few isolated devices a decade back, it now stands for converging solutions all across the spectrum. Most of these devices were unheard of a few years back.

A mobile phone today gets used as a Voice device, an SMS device, for e-mail, as a PDA, a TV, a Radio, a Gaming device, a Disk Drive, for Internet Access, as a Camera, a Video Camera, a Calculator, a Watch and an Mp3 player. PCs today get used for Computing, as a TV, a Radio, an Mp3 Player, a DVD-player, for Gaming, as a VOIP device, an LCD and for Storage. PDAs are used as PC, Disk Drive, Calculator, Watch, Gaming device, for SMS, Voice, e-mail, as Navigators and for Internet Access. A TV gets used as a PC, a Set-top-box, a Radio, for Internet Access and for Gaming.

Internet access, radio and TV broadcasting and telecom switching equipment are all digital and server-based today.

The message is that it has become very difficult to isolate products based on usage. At the module level, the classification (say, into consumer electronics, IT or industrial electronics) becomes even more difficult. Finally at the component level (e.g. LCD for PC versus LCD for TV or phone); such a separation becomes virtually impossible.

The study group, therefore, would suggest similar treatment for all electronic products and their accessories by way of policies, duties etc. This is all the more important as most products are getting miniaturized (small-format) which leads to large scale illegal imports due to high duties. This has been highlighted in a later section in this

report. Mobile phones may continue to be treated differently, but for all the other categories, the treatment should be similar.

Electronics as "meta resource"

A meta-resource is a resource that can be used over a wide spectrum of applications. Electronics should be treated as a resource just like infrastructure is. As outlined earlier, this sector is not only a consumption category but an 'enabler' for other sectors from manufacturing to automobile. It leads to improvement in Total Factor Productivity and increases efficiencies in sectors where it is applied.

It is evident that nations with high electronics-deployment have a higher GDP, and returns in productivity have been demonstrated in various papers. This lends further credence to the Study Group's recommendation that electronics be now treated differently than it has been before in the light of the changing role for the same.

Electronics is a driver for the industry and the economy.

Electronics as an Employment Generator

In addition to being an enabler, electronics is also a huge employment generator for the nation – a fact that becomes more important in view of India's demographics and the impending employment crisis. Giving encouragement to manufacturing in India may be directly viewed as generating employment for Indians as against for other nations.

A potential of 21 million direct and indirect jobs by 2015 (7 million direct and 14 million indirect) in the industry is predicted if the domestic electronics demand is met through local production as against imports. Clearly, there are indirect benefits of demand creation, capital creation and cascading effects of increased spending and consumption which this job-led growth will lead to.

If India continues to import half or more of its demand, not only are these jobs not created, but there is considerable drain on the foreign-exchange reserves of the country.

It is appropriate to mention here that this industry has huge potential for the small and medium enterprise sector. If manufacturing shifts to India, there will be strong cases for the SME sector to set up manufacturing of certain components, accessories and other supplies. This will give a boost to the Government's plans of promoting this sector.

Tabel 2 : Impact of Disabilities in Indian Manufacturing

	Raw materials	Piece parts	Components	Sub-assembly	Finished equipment
Impact of disability (%)	10.31%	5%	4.41%	1.58%	0.75%
Share in value add (%)	31.43%	22.86%	28.57%	11.43%	5.71%
Share of disability (Assuming sale price of Rs. 1000)	41.25	30	37.5	15	7.5

First to face the Zero Duty Regime

This sector is also the first to face the zero duty regime under the WTO. In that light, the industry has been seen as a role model for the rest of the industries to follow. The last few years, however, have been difficult for the industry due to inverted duty structures and lack of incentives. Reducing duties on components as well as finished products was also seen as an incomplete solution by the industry in view of the significantly higher operating and input costs in India. The effective cost for power, for instance, adding the cost of erratic, supplemented power to the base cost, is many times higher than in other manufacturing countries.

The mid-term review of the Tenth Plan has confirmed the detrimental effect of inverted duties. The high finance costs and input costs in India add to the manufacturer's burden. While finished equipment faces a disability of 0.75%, importing raw materials suffers from a disability of 10.31%. This has led manufacturers to low-value addition that points towards an industry with weak fundamentals. India, therefore, is unable to use its demographic gains of having a young, large population for this sector.

Figure 2 : Mobile subscribers versus revenue



The Study Team felt that in the light of the disabilities posed by the impending zero-duty regime, it becomes even more important for the Government to prioritise electronics as a stress area for a separate treatment.

IV. Immediate Priorities

Demand Generation

To begin with, the electronics industry in India, with all its demonstrated benefits, is still in need of demand creation measures. Government purchases, if a minimum local-value-addition clause is incorporated, could fuel a shift of the value-chain to India, development of local capabilities, capital creation etc., apart from a saving in foreign exchange. Government projects and internal consumption has fuelled the growth of the industry in countries like China and Brazil.

In addition, an environment conducive to electronics consumption could be shaped around encouraging home, corporate and SME consumption using suitable policies on taxes, depreciation, finance rates etc.

The example of mobile telecommunication in figure 2 will show that when the government shifted focus from revenue to increasing tele-density, it resulted in an explosion in numbers post implementation of the NTP.

Manufacturing versus Imports 2004-2005

Table 3 : Export/Impact of Electronic Products

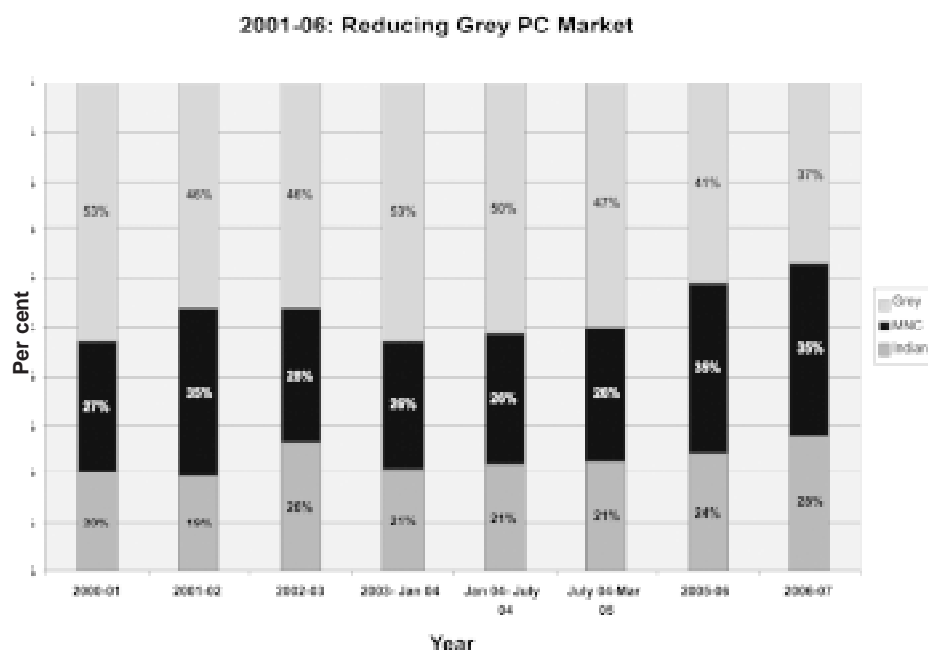
Country	Export (US\$Bn)	Import (US\$Bn)	Surplus/ Deficit (US\$Bn)
China	180	149	31
EU-15	139	226	- 87
USA	149	235	- 86
Japan	124	73	51
Taiwan	42	34	8
India	1.6 *	14	- 12.4

The illustration above will clearly show the draining of money that happens in an import-led market. Local manufacturing has certain benefits highlighted in the report, such as development of local knowledge and skills, development of long-term competitive capability, job-creation and cascading effects etc., but the most

important fall-out of a boom in local manufacturing would be a reduction in imports and thus in the drain on the government foreign-exchange reserves.

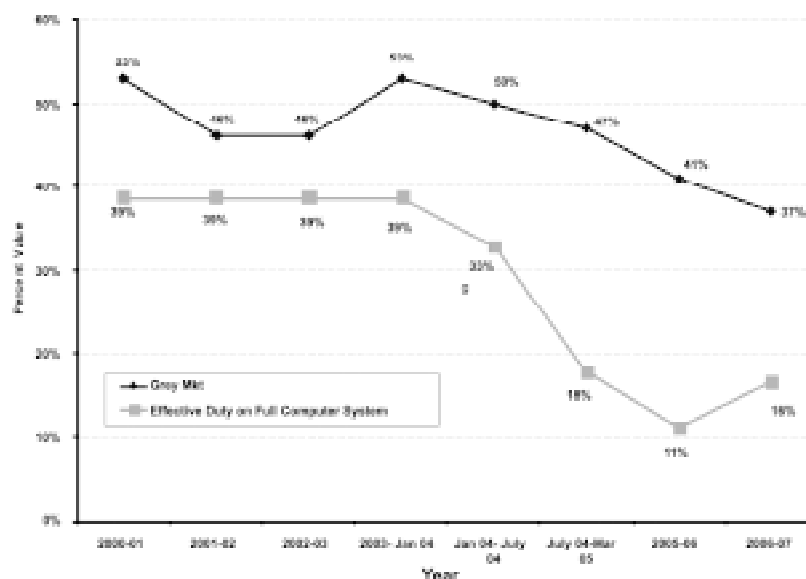
30% of India's trade deficit (USD 35Bn) is due to import of electronics-hardware that amounts to USD 12.4

Figure 3 : Impact of Reduction of Duties on Grey Market (PC)



Grey market has come down over the years as effective rate of taxation on PCs has reduced from 37.8% in 2000-01 to 11.2% in 2005-06

Figure 4 : Impact of Reduction of Duties on Grey Market (PCs)



**High Correlation between Falling Duties and Grey Market;
High elasticity below 20% Duty Level ! Small reduction in duty → Large Reduction in GreyMkt**

Figure 5 : Impact of Reduction of Duties on Grey Market (Cellphone)

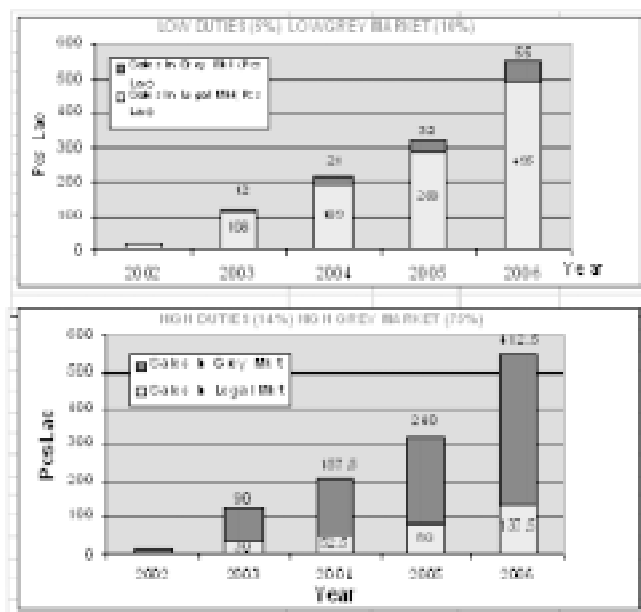
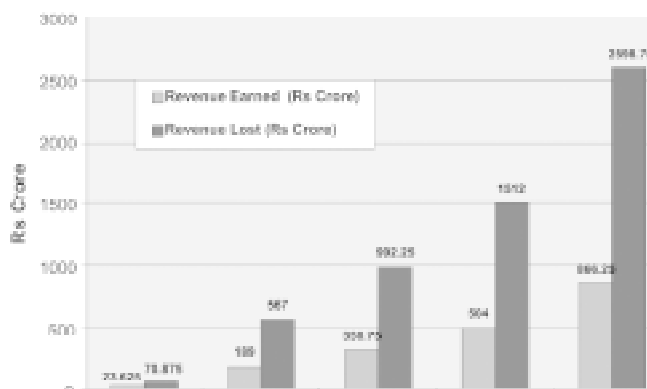
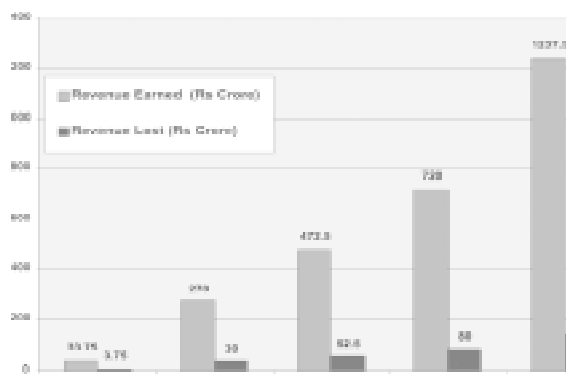


Figure 6 : Revenue Potential With Higher Duties



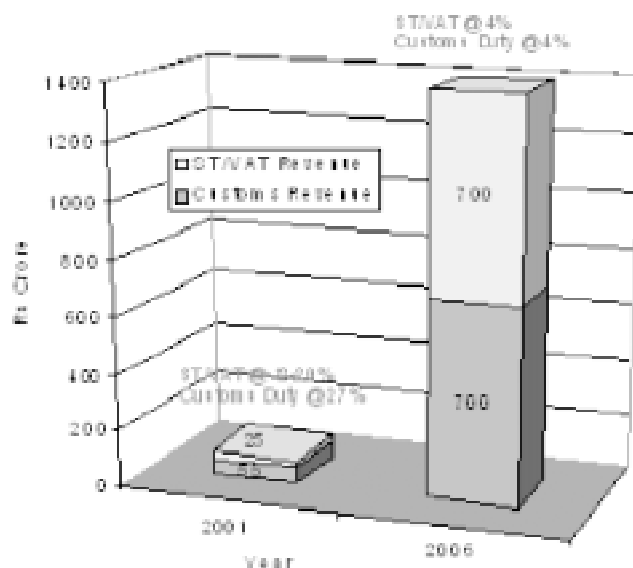
Import Duty 14% results in 75% Grey Mkt and Equal Loss of Potential Revenue!

Figure 7 : Revenue Potential With Lower Duties



Import Duty 5% results in 10% Grey Mkt and Equal Loss of Potential Revenue! Rise from Rs. 866 to 1237 Crs.

Figure 8 : Revenue From Cellphones



billion. Compared to China, where one-thirds of the total exports are electronic-items, this paints a sorry picture and also tells us the earning potential of the industry. Promotion of domestic manufacturing will not only earn foreign exchange and prevent drain on current resources, but might be a significant contributor to GDP. While electronics contribute to 1.7% of the Indian GDP, comparatives vary from 12.4% for Thailand to 12.7% for China to 23.6% for Israel.

To summarise, job-creation, competence-creation, IPR creation, wealth-generation, consumption growth and foreign-exchange earning versus spending are all imperatives for the government to look at initiatives on domestic manufacturing seriously.

Fiscal Opportunity

The measures outlined in this report will lead to a many-fold increase in the revenue collection of the government. The route to this increased fiscal collection shall be through an increase in domestic consumption and value-addition and a next-step larger collection of revenues from a larger base and not through increased taxation and duties on the existing small base. The calculations done by the group clearly indicate that the potential in the first case is much larger than anything that may be achieved through pure duties and taxation measures.

Government revenue is forecasted by us to grow from the present value of USD 5 billion to a potential of USD 56 billion by 2015. In case of as-is conditions, this value will only rise to about USD 21 billion by 2015.

Countering the Grey and Parallel Imports

India needs a policy of addressing all grey / illegal / refurbished / counterfeit products, especially those particularly prone to smuggling or mis-declaration due to small form-factors or modular nature. This policy shall be targeted towards customer protection. In addition, it will also benefit the industry, providing it more incentive to grow the market. Finally, it will also clearly mean an increase in the duty collections of the government.

Currently Grey Market estimates are around 30% for Digital Cameras, 50% for flash memory sticks and over 80% for portable Mp3 Players (Source Dataquest, July 15, 2006).

Inability to meet this challenge will mean customers unsuspectingly buy refurbished goods, with poor and altered specifications that brand-owners may not service. The Brand owner's reputation suffers; his markets are eroded by these, often cheaper products. Finally, the government loses out on all revenue collections from this channel.

A special mention needs to be made here of *small-format* goods. These, clearly lend themselves to easy smuggling, mis-declaration and disguise. Such articles, like mobile phones, gaming devices, Mp3 Players and most-important, accessories in all categories, actually constitute the bulk of illegal imports. If duties on such articles could be reduced, these could be brought under the revenue-net and also would render the current grey-market operations unattractive for most of the operators. This is a problem faced by all categories of electronics and is a high-priority item on the Study Group's agenda. The articles brought in through unofficial channels in these categories, constitute considerable revenue loss to the Government, and more-importantly, in some cases like accessories, stifle growth of Indian companies and SMEs in these categories.

According to CETMA, high magnitude of grey market is supported by assemblers in unorganized sector, which are using SSI excise exemption as an umbrella for unreported production. This not only results into huge revenue loss to Government, it creates unfair competition in the market, thereby discouraging investments in organized sector which can provide reliable products to domestic consumers and also can cater to export. Almost all product categories in Consumer Electronics except Colour TV have 50% to 90% share of products from grey market. Share of grey market in Colour TV is around 20% and is increasing.

The figures 3 to 8 show the impact of duties reduction on the grey market in case of PCs and cell phones.

It has been seen that with lower duties, because of the price elasticity, the demand has increased many folds thus increasing the revenue potential.

Framework for Development

Creating the Electronics "Ecosystem"

The Study Group felt the need for an entire ecosystem approach to creating an environment for growing the domestic electronics opportunity. These measures should be directed at growing the domestic manufacturing opportunity, increasing the percentage value addition in the country and making India part of the global value chain in electronics manufacturing. This approach must include a focus on the following components.

- Developing R&D Capability and Academic Connect
- Supply Chain initiatives especially with reference to component manufacturing
- Encouragement to increase in Value-Addition by manufacturers
- Positioning India in the Global Value Chain (encouraging EMS companies etc)
- Flexibility in Labour Policy for Electronics Manufacturers
- Infrastructure (Supply Chain, E-Waste Management System, Power-Costs, Other input costs, Finance-Costs, R&D Costs (technology development fund) etc.
- Testing Labs Infrastructure, to provide 'solutions' rather than go / no-go; (reference to the World Bank stress on metrology as a growth imperative)

In addition to the above, a few initiatives may require focussed attention by individual teams. The following are the other initiatives suggested by the Study Group.

Investment Cell

A unit should be put into place to simplify policy and procedures to encourage fresh and incremental investments in electronics manufacturing in the country. Incentives should be put into place that could be financial (exemption from certain taxes and duties) or non-financial (input costs e.g. power, flexible labour policy etc).

Export-Promotion Cell

A special impetus is required in the export-promotion area to make Indian manufactured electronic-goods competitive globally. This cell could look at technical collaborations and export incentives as well as hand-holding directed at bringing domestic enterprises and MNC enterprises manufacturing in India at a competitive-offering level in global markets.

Collaborative Efforts

The Group suggests that the DIT, the Industry and the Industry Associations could present a unified front on a common platform that will aid collaborative buying at competitive rates from global vendors, events of common interest e.g. a 'supplier's day' to host global component / technology providers, co-funding of domestic R&D, hand-holding for smaller players on the lines of a TUF etc.

Brand Building Initiatives

Efforts must be made to build the electronics brand for 'made in India' products, which currently do not have a competitive brand-perception in global markets. It is imperative to follow the software model and perhaps ride on the positive perception of the same to create desirability in international markets for products manufactured in India. These initiatives could happen on a co-funded, semi-sponsored basis.

Promoting Indian Standards

The Industry is the first to face the WTO zero-tariff regime, and it is a dual risk in the absence of any Indian standards that may serve as controls on e-dumping and e-waste (prevention of organisations from importing second-rate / refurbished / pre-owned / phased out goods). The other aspect is that in the event of Indian goods being blocked out of certain international markets, there may be scope the imposition of a non-tariff barrier from the Indian side.

Focus on e-waste

Electronic equipment that is no longer useful but may or may not be re-usable is called e-waste. It includes computers, household appliances like refrigerators, freezers, washing machines, electric stoves, microwaves, electric fans, vacuum cleaners, sewing machines, irons, toasters, grinders, clocks and watches, radio sets, televisions, audio amplifiers, computers, fluorescent lamps, sodium lamps and other lighting equipment except filament lamps. Cast-off electronic toys, sports equipment, medical devices, automatic dispensers and monitoring equipment also qualify as e-waste.

China Syndrome Cooling – An Opportunity for India?

In fact, many IT manufacturers are now are looking to hedge their bets in other regions or other countries for a variety of reasons. Among the reasons most often cited:

- *China's emphasis on allowing other cities besides Shanghai and Beijing to partake in the economic revolution is making it far more difficult for companies to manage logistics between their manufacturing sites inside of China;*
- *Rapidly rising labor costs are forcing some companies to consider comparable wage scales in places such as Vietnam, Malaysia and Eastern Europe;*
- *China's ineffective policing of intellectual property theft has made many companies reluctant to move design operations there;*
- *Continued U.S. government regulations about what technology can be shipped into China or developed there has kept the lid on many companies' plans;*
- *Manufacturers are looking to hedge their bets with backup strategies in case of a natural disaster or political issues that can affect regions.*

(Source – ElectronicNews, Reed Electronics Group, July 14, 2006)

Policies of Successful Asian Nations – Salient Features

(Thailand, Malaysia, Singapore, Taiwan, South Korea)

- Low indirect tax – 5 to 7% VAT/GST; 10% in some cases
- No cascading taxes like CST; no inverted duties
- Customs duties nil in most cases; except Thailand with high duty (20-30%) on White Goods; 5% for ASEAN
- Income Tax rates similar to India- benefits to investors
- Industry support infrastructure –for Training, Skills Development and R&D
- Cluster approach for creating supply chain
- Emphasis on infrastructure; efficiency in movement of goods
- Low cost of electricity, fuels and finance
- Malaysian government mandates local content for its purchases.

The Example of Mobile Industry

It shall be extremely useful, at this point, to refer to the successful example of mobile phones in India. The industry was caught in a similar juncture with a small industry with little or no value addition, huge proportions of grey imports, expensive services etc.

After suitable policy changes and a change in focus of the government from revenue to increase in tele-density, the industry witnessed demand growth, an explosion in volumes and a subsequent increase in revenue. More importantly, it resulted in the ultimate shift of manufacturing to India and a resulting increase in jobs for Indians.

VI. Constraints/problem areas/procedural issues

The study group has identified the following issues that have common interest in the Industry and if eased, will have large-scale and long-term impact on all the sections of the industry.

- **Small size/scale of operations:** The size and scale of operation of most manufacturing plants are very small compared to global market leaders. This leads to poor economies of scales for manufacturing, as well as for sourcing. Lower capacities translate to higher per-unit overheads. Even though the cost of labour in India is low, it fails to offset the adverse impact of poor economies of scale.
- The consumer electronics sector has peculiar problems of fragmentation of capacities due to aberration in tax structure; i.e., on one hand the taxes are high on consumer electronic products (more than 30%) and on the other hand tax exemptions given by the Central and State Governments for CENVAT and VAT, have resulted in most of the manufacturers setting up small units in different locations to avail of the exemptions, thereby resulting in poor economies of scale for manufacturing.
- **India - a Fragmented Market:** The country is fragmented into small markets. The electronic hardware sector is facing global competition due to the implementation of IT Agreement and Bilateral/Regional FTAs. While effort is being made to integrate country with global economies, India is divided into 28 separate markets, each State / Union Territory being a separate entity with different tax structure. While it is easy to get the products from abroad, it is difficult to move products from one state to another, as the transport has to wait at many check posts, resulting in avoidable delays.
- **Standards and Testing Facilities** – In electronic hardware the technology is changing rapidly. The product life cycle is getting shorter. Most of the countries in the world have laid down standards for the new products to ensure that low quality products are not dumped into the country. There is need to formulate standards. There is also a need to equip the labs such as ERTLs and SAMEER with the equipment to test 'State-of-Art' products.
- **Lack of component base:** The Indian components industry is restricted to passive components. Even here, the presence is in only a few sectors. The low domestic volumes and import and customs procedures and regulations do not encourage stock and trade of components. In the case of mechanical parts, suppliers do exist with technical capability. However, the industry has not experienced the needs of high-volume customers and would need substantial up-gradation of management skills. Also, to feed the emerging need of semi-conductors for all areas of manufacturing, government, defence, space etc., it is essential that this area be a major focus for government policy.
- **Infrastructural issues:** While inadequate infrastructure – roads, ports, high cost of electricity etc., is a cause for concern for all the sectors, the impact is more pronounced in case of the IT manufacturing industry due to very high rate of obsolescence. While significant progress has been made in improving the Turn-Around-Time (TAT), it yet needs to be streamlined to the international levels of 15-20 mins as compared to a day or two in India. Various studies have been conducted on the cost disadvantage of doing business in India and they indicate that the disadvantage is anywhere between 4% to 15%.
- **High cost of finance:** The average cost of finance available to Indian entrepreneurs is 11-12%; internationally the cost of finance is around 5%. This makes Indian enterprises non-competitive compared to their counterparts in other parts of the world.
- **High rate of technological obsolescence:** The low volume of production implies that any capital equipment of a certain technology procured by an Indian company is not fully utilised and its physical life lasts for a longer time. However, due to changes in technology, newer methods get introduced, calling for modern processes and equipment, which give a competitive advantage in terms of cost, speed and quality. Yet, Indian Companies find it unviable to upgrade before the investments in earlier equipment are recovered.

- **Frequent Policy changes:** Frequent policy changes have been cited as one of the primary reasons for the country in failing to attract sizeable investments. Without a stable policy regime, companies find it difficult to have a long-term business plan. Instead of making small changes constantly, the government should take a holistic view and create a long-term policy to encourage investments in manufacturing. Further, non-standard procedures of tax collections (e.g. introduction of MRP based VAT in Bihar) need to be corrected.

1. Computers and Peripherals Industry

1.1 Background

The Computer and related peripherals market in India is growing at a rapid pace and fast assuming global scales. In 2005-06, 5.13 million computers were consumed in the country registering an annual growth of 32%, a phenomenon consistent all through Tenth Five Year Plan. The growth in increased sales in computers

can be attributed to significant consumption in telecom, banking and financial sectors, IT and ITES, education, SOHO, retail and e-governance. The computer being the driver pulled the growth in all-round consumption of peripherals and networking products as well. With sound macro-economic conditions and signs of a robust growth in the domestic economy, the computer and related peripherals market is expected to grow at a comfortable pace of 25-30% for the next few years without any government intervention on the policies front. However, should the Government policies be made conducive towards creating a favourable eco-system for IT manufacturing and consumption, the annual growth may well exceed 40-50% in the ensuing years. On the policy front, the first few years of the Tenth Plan witnessed a certain degree of uncertainty in IT manufacturing, as the policy direction from the Government was not very clear. The policies appeared to be skewed in favour of imports rather than local manufacturing, further, the prevailing industry sentiment was that the Government meted a step-motherly treatment to the hardware industry compared to the software industry. Things have, however, significantly improved since then.

Table 4 : Computers and Peripherals Market: 2004-05 & 2005-06

	Total Market			Total Revenue (in Rs Crores)		
Product	2005-06	2004-05	% Growth	2005-06	2004-05	% Growth
Computers						
Desktop PCs	4,614,724	3,632,619	27%	8,884	7,520	18%
Notebooks	431,834	177,105	144%	2,027	978	107%
Servers	89,161	49,165	81%	1,545	916	69%
Printers						
Dot matrix	472,074	399,580	18%	430	379	13%
Inkjet	717,001	636,619	13%	241	223	8%
Laser	325,109	142,555	128%	554	286	94%
Line	4,914	4,675	5%	122	116	5%
Other Peripherals						
Key boards	4,639,156	3,669,441	33%	*	*	*
Monitors	4,637,787	3,642,204	34%	2,301	1,903	21%
UPS systems	1,208,413	954,260	27%	*	*	*
Networking Products						
NICs	3,646,145	1,801,854	117%	*	*	*
Hubs	144,117	113,894	27%	*	*	*

(Source: Manufacturers' Association for Information Technology) * wide variations in price in product categories

The Government of India had signed the IT Agreement of the WTO in early 1997 following the Singapore Ministerial Declaration in December 1996. It had assured the Industry that 'concomitant' to phase out of the duties on the finished products as identified in the ITA list, duties on input raw material, including that on dual usage items would also be phased out to nil prior to the terminal year i.e., 2005, unfortunately the case was not to be so. Further, the downturn in global consumption in 2001-02 adversely impacted the sales of IT products in the country too and adding to dampening of the manufacturing sentiment in the country. It was only in 2005 that the challenge for manufacturing in a zero-duty regime was addressed by the Government by permitting imports of non-IT inputs, raw material and dual-usage items at nil customs duty under end-use-certification.

The constant lowering of customs duty on one hand, kept the domestic manufacturing industry under severe pressure, a situation made worse by reduction of excise duty on computers in January 2004 with no simultaneous reduction on the excise duty on inputs and sub-assemblies leading to CENVAT overflow and disruption of business. The impasse was addressed by making the excise duty nil on some of the 'not made in India' components, however, the industry once again faced disruption and challenge in July 2004 when the excise duty on computers was brought down to nil, without once again, simultaneously lowering the excise duty on the input raw material and sub-assemblies. A "quick-fix" solution was administered to address the problem by introduction of additional duty on imports, as the situation had resulted in, apart from CENVAT overflow, imports being cheaper than locally manufactured computers. The industry continued to face adverse policy structure, which was finally addressed in the Union Budget of 2006-07 with the introduction of 12% excise duty on computers.

With consistent growth in consumption in computers and peripherals, and finally a streamlined duty structure on the excise front, confidence has now been restored in the IT manufacturing industry. Further, there is increased realisation in the government that a robust hardware sector is not only essential for reasons of national security considering the increasing dominance of China in this area, maintaining the competence of the software industry without a strong hardware base will also be a challenge. are now actively considering India as an alternative destination for IT manufacturing.

1.2 Current Status including production and exports

The global electronics (CE) industry clocked USD 1.27 trillion in CY 2005. The computer industry accounted

for USD 218 billion registering an annual growth of 9%. A total of 218 million computers were shipped worldwide registering a growth of 15%. China accounted for 19.3 million units of the PC consumption in 2005 registering a growth of 29%.

As manufacturers seek to reduce costs, there has been a marked shift in electronics output worldwide, including that of computers and peripherals, from high-cost to low-cost locations. Although Asia/Pacific-in particular, China-has been the main beneficiary, Central and Eastern Europe, Mexico and Brazil have also benefited from significant inward investment. In the longer term, many of today's low-cost locations will also offer significant market opportunities, creating the need for further investment in local manufacturing. The opportunity is knocking at India's door as well.

The size of the computers and peripherals market in India in 2005-06 (including printers, UPS and networking products) was around USD 5 billion (Rs. 22,000 crore). The consumption of computers was 5.13 million units with a growth of 32% over the previous fiscal. Desktops accounted for 4.6 million units growing 28%, while notebooks accounted for 0.5 million units growing 144%. In value terms, the computers and notebooks market was USD 2.5 billion (Rs. 11,000 crore) registering a growth of 28% over FY 2004-05, the growth in desktops being 18% and in notebooks 107%.

IT Products being manufactured in the country include personal computers, servers, workstations, supercomputers, data processing equipment, Dot-matrix printers, digitizers, networking products such as modems, hubs, etc., and add-on cards. The production in the PC segment is dominated by P-4 Processors. Other processors are gradually entering the market reflecting, perhaps, the need for low-cost computing solutions.

The IT products manufacturing industry in India is essentially an import intensive one. While the market size for IT products is estimated at USD 5 billion (Rs. 22,000 Crores), the production in the IT manufacturing industry (excluding PC assembly) is only USD 1.3 billion (Rs. 5,700 crore).

The industry has been essentially assembly oriented one with very low value addition. The impact of infrastructural related disabilities are significantly pronounced in the component and the sub-assembly and component manufacturing industry, as a result of which the component base in India is practically non-existent.

Of the total Desktops market in the country, almost eighty five per cent are assembled locally. All leading global brands including HP, Lenovo, ACER etc., have an assembly unit in India, Dell being an exception, but is expected to start its assembly unit soon. Multinational brands account for 35% of the PC market in India. Indian PC brands such as HCL, Zenith, Wipro, PCS etc account for 35% of the market. The reduction in customs and excise tariff over the years has had an adverse impact on the grey market, the proportion of which has steadily come down. Grey market accounted for over 60% of the market in 2003-04 and has been reduced to 37% in 2005-06.

In the peripherals industry, a very high degree of value addition (to the tune of 65%) has been achieved in the manufacturing of the Dot-matrix printers. TVS electronics and WeP peripherals, the top two leaders in Dot-matrix printers manufacturing in India account for close to seventy per cent of the Dot-matrix market. There is no indigenous manufacturing of laser or inkjet printers in the country.

In case of the UPS industry estimated to be Rs. 1,000 crore, 60% of the production by value is of large UPS (>300 VA) and the rest by small UPS. The large UPS have a very high indigenous content, at time as high as 100%; while the small UPS manufacturing is import oriented with little or no local value-addition.

The focus of the computers and the peripherals industry in India has been on the domestic market. The rapid growth in the domestic market has been the prime reason for this; however, it is not that the industry did not attempt exporting. In late eighties and mid-nineties, the industry had developed exports competence; however, with Indian infrastructure not keeping pace with the requirements of a quick turnaround as needed to be globally competitive, the industry gradually lost out on the exports front. Only a countable few in the IT manufacturing have been successful in exports. These include APC in UPS manufacturing, Moser Baer in computer media and Celetronix in components of hard disk drives and other components. The exports turnover of the IT manufacturing industry in 2005-06 was an estimated USD 1.25 billion.

Table 5 : Computer Penetration in India

	Computer Penetration in India
2001-02	6.3
2002-03	9
2003-04	11
2004-05	14
2005-06	18

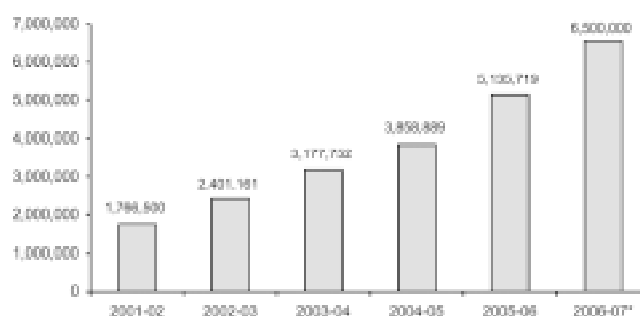
(Source: Manufacturers' Association for Information Technology)

1.3 Performance in the Tenth Plan

The Tenth five-year plan from 2002 onwards witnessed a significant growth in the computer consumption in the country, which grew from 1.76 million units in March 2002 to 5.13 million units in March 2006. Computer consumption is expected to exceed 6.5 million units by the end of the Tenth plan in March 2007. This reflects a cumulative average growth (CAGR) of 30%.

The computer penetration in the country has also witnessed rapid growth.

Figure 9 : Consumption of Computers in units: 2001-07



1.4 Technology Status

The Indian IT industry does not lag in technology in comparison to its global counterparts. Most products are launched simultaneously across the globe and so in the Indian market. However very few companies spend resources in designing products for the Indian market, while those who did take up the challenge have not been successful due to their inherent disabilities of scaling up and other deficiencies in the eco-system.

The Governments in India both at the centre and state levels have made several efforts to reach the benefits of IT to the Indian populace beyond the urban areas by launching several projects in regional language computing, however, very few have been successful. All this is in direct contrast to the fact that several MNC have set up their product design centres and technology labs in India to harness the inexpensive Indian engineering talent. Further several Indian entrepreneurs as also Indian companies are engaged in product and technology development meant for exports purposes only.

The linkages between the Industry and the academia in India are poor and there is no movement of personnel between the two thus limiting innovation and cross pollination of ideas. Lastly all nations with advancement in IT have scaled heights owing to the contribution of their Governments in R&D and technology development.

Unfortunately Government of India's spend in R&D in IT is very insignificant and not readily extended to the private sector.

1.5 Future Trends

The character of the IT industry is global and the industry in India also follows the global trends. With **convergence** of technologies, the distinction between technologies – IT, Consumer electronics and telecom is fast diminishing. Globally the consumption of mobile PCs (notebooks) exceeds that desktops, however in India the proportion of the notebooks is a little over 10% of the desktops, however, with over 100% growth in the notebooks, the proportion is fast expected to change to about 25-30% in the next three to four years.

Further, with mobile industry reading itself to roll out 3G, **the mobile phone will become the access as well as the computing device**. This will lead to a significant increase in population with internet access and with a critical mass of net user being available, several services could be rolled out increasing the value proposition of IT. The traditional definition of computing will thus under go a change.

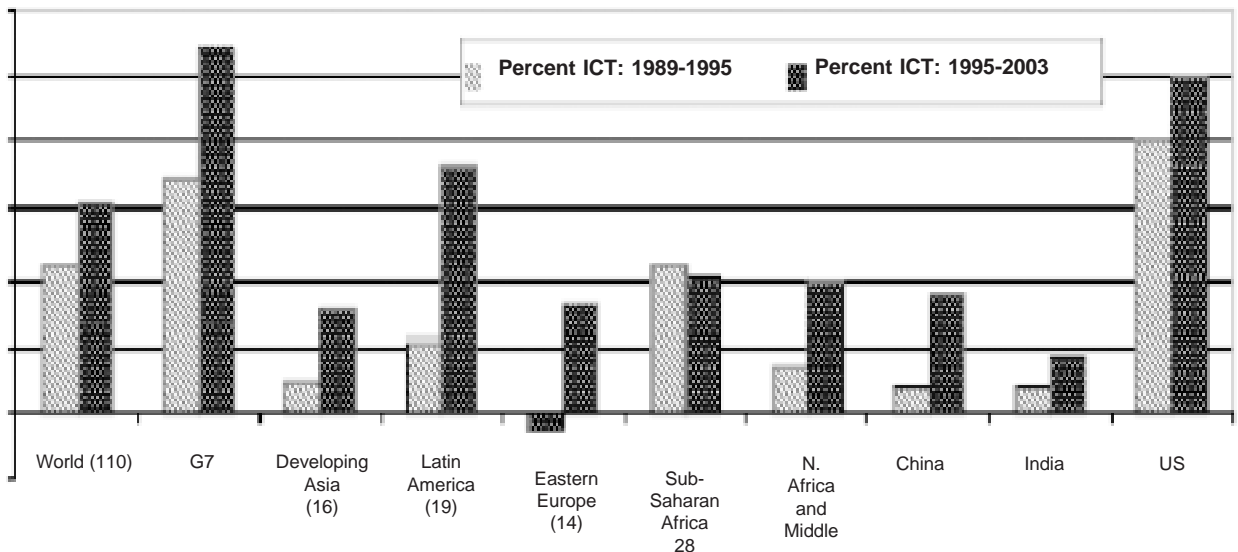
India will be the youngest nation in the world by 2025. A large population of people under thirty will drive the consumption of IT products, the Indian market is therefore going to expand rapidly, the challenge will be how to tap our own ready market for purposes of manufacturing in

India rather than creating jobs in other economies by meeting the demand through imports. Further, the import bill to meet the demand may well surpass the earnings through software exports. Should measures be adopted to convert the opportunity into domestic IT manufacturing, **India may well emerge as a strong manufacturing country**.

Thrust Areas: It is evident from the experience of the mobile industry in India that a vibrant market attracts investments. The lowering of first the customs duty and subsequently in 2001-02 the excise duty has enabled the organised sector to offer mobile products to the consumers at the same prices as that of the grey market. The grey market in the mobile phones, once over 90% is now totally eradicated. The mobile consumption in the country has risen to 5 million units a month. With the consumption attaining global scales, several global leaders and EMS companies are investing in mobile and related equipment manufacturing in the country. With convergence of technologies and with products mimicking each other's functions, the basic building blocks for all IT, Telecom and consumer electronics products are also converging. While most investments in the manufacturing value chain are concentrated towards assembly operations, the industry faces the challenge of deepening the manufacturing activity as the component and sub-assembly base is non-existent. This would require significant focus from the government and the industry, as component manufacturing is highly capital intensive.

Figure 10 : Market Projection for Computers: 2007-12

ICT Capital Contribution to economic growth, in percent, by region, 1989-1995 and 1995-2003
ICT Capital's Contribution to Economic Growth



Therefore the thrust in the Tenth plan should be the creation of a vibrant market through mission mode projects that would enable investments and simultaneous rolling out of measures that will help deepen manufacturing by incentivising investments in high capital-intensive components such as ICs, LCDs etc., and subassemblies. Attention will also be needed to streamline procedures of exports, imports and also that of movement of goods within the country, as it is

critical to achieve international levels of turn-around time. Delays lead to depreciation/loss in the value of goods, as the rate of obsolescence is very high in the IT industry. Further, thrust is also needed to create products specific to the requirements of the Indian market, suiting the Indian price points.

The figure 10 depicts the contribution of ICT deployment to the GDP of select nations.

1.6 Production and export targets for Eleventh Plan

Table 6 : Market Projection for Computers: 2007-12

	Current Trajectory Extrapolated			Trajectory with Govt. Intervention		
Year	Units (in million)	Growth (%)	PC penetration per 1,000	Units (in million)	Growth (%)	PC penetration per 1,000
2006-07	6.4	25	21.5	6.4	25	21.5
2007-08	8.0	25	24.8	8.9	40	25.6
2008-09	10	25	27.9	12.5	40	30.7
2009-10	12	20	30.5	16.9	35	36.6
2010-11	14.1	18	32.5	21.9	35	43
2011-12	16.6	18	41.7	28.5	30	60

(Source: Manufacturers' Association for Information Technology, reference Frost & Sullivan report)

Table 7 : Production Estimates for Computers and Peripherals: 2007-12

	Current Trajectory Extrapolated			Trajectory with Govt. Intervention		
Year	Market in USD billion	Production in USD billion	Avg. Value Add. In Local Production	Market in USD Billion	Production in USD Billion	Avg. Value Add. In Local Production
2006-07	6.0	3.77	31	6.00	3.77	31
2007-08	7.2	4.52	31	8.10	5.07	37
2008-09	8.6	5.43	31	10.94	6.87	42
2009-10	10.2	6.40	31	14.22	8.93	48
2010-11	11.7	7.36	31	17.77	11.16	54
2011-12	13.5	8.47	31	22.21	13.95	60

(Source: Manufacturers' Association for Information Technology)

1.7 Status of investments and investment needed to meet the targets

A poor investment climate, and a policy structure non-conducive to manufacturing, failed to attract any

significant investments in IT manufacturing. However, with rapid growth in consumption in the domestic market in the last few years, especially that of the mobile phones, seven of the top ten EMS players have set up their operations in India. These include

Table 8 : Employment Potential of Hardware Industry

	Current Trajectory Extrapolated			Trajectory with Govt. Intervention		
Year	Direct	Indirect	Total	Direct	Indirect	Total
2006-07	1.80	7.00	8.80	1.80	7.00	8.80
2007-08	2.16	8.40	10.56	2.43	13.64	16.07
2008-09	2.59	10.08	12.67	3.28	17.27	20.55
2009-10	3.06	11.89	14.95	4.26	21.37	25.63
2010-11	3.52	13.68	17.20	5.33	25.64	30.97
2011-12	4.04	15.73	19.78	6.66	30.82	37.48

(Source: Manufacturers' Association for Information Technology)

Flextronics, Honhai/Foxconn, Celestica, Jabil Circuits, Solectron Centum, etc. The core competence of EMS players is manufacturing and their investments in manufacturing will not remain relegated to mobile products alone. They are actively looking at diversifying their product profile as several of their international customers such as HP, Dell etc., have a strong market presence in India.

With recent changes in the excise duty structure of the PC, and also with the rapid growth in the PC market, HCL has set up a new assembly plant at Uttaranchal. Companies such as HP, Dell, ACER and Lenovo are expanding their existing capacities and/or setting up new plants as well.

Peripherals manufacturers such as TVS electronics, WeP Peripherals, Emerson have set up fresh manufacturing facilities at Himachal Pradesh. Tamil Nadu is also fast emerging as an attractive destination for hardware manufacturing; most of the fresh investments by the EMS players have been in Chennai. SEZs are emerging as the most preferred vehicles for driving manufacturing investments.

Going forward, semiconductor manufacturing is an area that needs focussed attention from the Government. SemInida, a consortium of companies from the US and June Min, a Korean entrepreneur, have announced setting up of semiconductor manufacturing plants in Hyderabad, however, a policy for attracting high capital IT manufacturing such as ICs, LCDS, OLEDs, solar panels, storage devices etc., is crucial for taking Indian to the next level of IT manufacturing.

1.8 Employment Generation

The hardware industry has the potential to create several employment opportunities for the semi-skilled and the blue collared.

The Computer and related peripherals market in India is growing at a rapid pace. The IT products manufacturing industry in India is essentially an import intensive one. With a non-conducive policy structure and several inherent infrastructural disabilities, the industry has been essentially assembly oriented one with very low value addition. The disability factors are significantly pronounced in the component and the sub-assembly and component manufacturing industry, as a result of which the component base in India is practically non-existent. A rapidly growing market provides an opportunity to the IT industry to scale up their manufacturing operations, however, the policy structure needs to be streamlined to uniform low taxation rates across the country. Being an industry operating in a zero duty regime, mitigation of disability factors such as high cost of capital, high rates of electricity, poor turn-around time are essential as these loom large when compared to our global competitors. It is essential for the government to give thrust to domestic consumption so that the market attains global volumes in consumption and enables industry to operate at global scales. Global scale of operation will lead to significant employment opportunities, not only direct but also indirect including those in research and new product development. Issues of revenue loss to the Government due to changes in the taxation structure are unfounded, as a vibrant industry and market will move that make up for the revenue shortfall in the short run. The Tenth plan provides an excellent opportunity for the Government to enable the hardware manufacturing industry in India and aim for a significant proportion of the global IT manufacturing industry.

2. Consumer Electronics Industry

2.1 Background

Consumer Electronics (CE) is the largest segment of the Electronics sector. It contributes 33% to the Electronics production in the country. Performance of some of the various segments of the industry are given below.

2.2 Current Scenario

B&W TV - This segment has been experiencing negative growth. The production has fallen from 4.0 million at end of ninth plan to 1.75 million in 2005-2006. This has resulted in premature death of B&W TV industry and many B&W TV units and their components such as Picture Tube manufacturing units have closed down. The production is mostly in grey market due to high level of taxes on this product.

Colour TV - This segment is the main driver of CE Sector in the country. It has registered a reasonable growth mainly due to the explosion of cable TV channel which cater to variety of tastes. The CTV production has grown to 10.50 million in 2005-06 from 5.2 million in 2001-2002. The total TV market including B&W has remained stagnant at around 10 million during tenth plan period. Considering that the penetration level of TV in the country, particularly in the rural areas, is low, the potential for growth in this segment is immense.

In last two years, it has been observed that the grey market operators have entered in the CTV segment and presently their share is about 20%. This may be due to the high level of taxation on consumer electronic products and TV at about 35%.

This segment is also affected due to fragmentation of capacities, as many TV manufacturers are setting up small plants at different places to avail the benefit of excise and state VAT exemptions.

Audios

1. Radio: Consists of standalone radio sets, combination of radios with Cassette players, CD/DVD players. Total production of stand alone radios is estimated to be around 6.0 million Nos. out of which organized sectors contributes only 2.5 million

numbers. Apart from above cheaper imported radios are being sold in large quantity.

2. Car Audios : Consist of Cassette players, FM radio, Cassette/CD/DVD players in combination with radios. Estimated market is around 2 million nos. This includes 0.5 million stand alone FM radios for automobiles (mainly 3 wheelers) out of remaining requirement of 1.5 million nos., production is around 1.0 million nos. Only 20% of the production is contributed by organized sector.
3. Portable Cassette Players - Out of total market of 2 million Nos. around 1 million is produced in the country. Organised Sector contributes about 50% of the production.
4. PA Systems and non-portable Stereo players - Organised sector caters to only 20% of production.
5. Music Systems and Home Theatres - Total market is around 1 million Nos. out of which only 0.5 million Nos. are produced in the country.
6. VCD Players - Around 5 million Nos. were produced out of which contribution from organized sector was around 10% only.
7. DVD Player – This segment of the industry has had an exponential growth in the last 2 to 3 years. The growth has been due to crash in the prices of Hardware and easy availability of cheap pirated software. Price of DVD Players of a reputed brand have dropped from Rs.25,000 in 1st year of Tenth Plan to Rs.3,500 in last year. The market for DVD players has increased from 50,000 to 4,000,000. The production of DVD Players in the country has been in substantial numbers for last one and half year.
8. MP3/MP4 Players - Market is estimated to be around 0.5 million Nos. Production has not started in this segment. This segment is growing very fast worldwide.
9. Satellite Digital Radio - Satellite radio receivers are being manufactured and marketed in the country, however quantity is still very insignificant.

Because of expansion of FM radio broadcasting, FM radio receivers manufacturing is increasing rapidly and replacing the diminishing market of conventional MW/SW radios. These are made standalone, as well as, in combination with all type of music players and systems, as well as TV channels.

Table 9 : Production during 2002-2003 to 2006-07 for Consumer Electronics

(Rs. in Crore)

Consumer Electronics	Target	Achievement
2002-03	15,400	13,800
2003-04	18,200	15,200
2004-05	21,500	16,800
2005-06	25,400	18,500
2006-07	30,000	21,000

Demand and manufacturing of Cassette related players has reduced substantially and is being replaced by VCD players, DVD players and MP3 players/MMC card readers/players.

Microwave Oven - has been growing at a healthy rate, though on a small base. Production grew from 1,75,000 units to 4,75,000 units. This product is being imported in large numbers, though some of the companies have started producing these here.

Set Top Box - STB segment had been non-existent till about two years back. There is a huge potential and if CAS is implemented in its right earnest, the production will commence. A number of manufactures are manufacturing STBs for DTH. Since all the channels were not available on DTH, till recently, the production was limited. It is likely that the production will pick up for STBs for DTH reception. As per CETMA, the reduction of Customs duty on STBs to 0% does not provide a level playing field to the indigenous industry and may not encourage manufacturing in India.

2.3 Performance under Tenth Plan

There were two scenarios indicated in Tenth Five Year Plan;

- (i) Realistic and
- (ii) Optimistic

The realistic scenario was a conservative projection of growth of the sector. In the final year, i.e., 2006-07, it was targeted to achieve a production of Rs.30,000 crore. Against this, we can expect production of Rs.21,000 crore, a short fall of around 30%. This shortfall can be made up in Eleventh Plan, by making suitable policies for the growth of this sector

2.4 Technology Status

The industry is making 'State of Art' products. Technology is changing very rapidly in this segment. The product life-cycle is getting shorter. Many new products are being introduced in the market. It is an unhappy situation that most of the new products in the market such as LCD and Plasma TVs, iPods / MP3 Players are imported and not made in the country.

This is primarily because of:

- a) Small market size of Indian market at present.
- b) Absence of Component manufacturers of these products in the country.
- c) Absence of Policies conducive to growth of industry.

2.5 Future Trends

Consumer Electronics sector, particularly Radio and TV are affected by the changes in the broadcasting sector. In India, broadcasting, specifically Terrestrial Transmission is totally under the Government control. The Government introduced a pilot project for Digital Terrestrial Transmission (DTT) in the four metros for TV, about 4 years back. But, since then, there has been little progress in the matter. Now the Government has formed a Sub-Group on "Going Digital", under the Chairmanship of Member Secretary, Planning Commission, to switchover to digital regime by 2010, when the Common Wealth Games are to be held in the country.

The Government had decided to introduce Conditional Access System (CAS) in the cable TV network in 2003. The introduction of CAS would have resulted in the cable TV network, switching over to digital. But this did not materialize. Implementation of CAS was put on hold and this caused delay in the cable TV network changing over to digital mode. A private operator had started Direct-to-Home (DTH) services about 3 years back. Also Doordarshan started Free-to-Air DTH service about 2 years back. However, the growth has been limited due to some of the popular content not been available on the DTH. Another operator has introduced DTH services very recently and it is expected that this would lead to a major growth in the sector.

Demand Enabler

All these developments in the broadcasting sector for both TV and Radio would act as demand enabler for the consumer electronics industry. It is expected that as more service providers start DTH operations, it will result in competition to the cable TV network. The cable TV networks will be forced to go digital and provide interactive value added services to the consumers. This will act as a catalyst for the growth of consumer electronics industry, particularly for the TV and STB segments.

Demand Creation

There is a need to bring down the prices of the consumer electronic products for creating a demand. This could be done by:

1. Creating economies of scale to reduce the cost of manufacturing.
2. Lower the general level of taxes on the consumer electronic products.

This will bring down the prices of all consumer electronic products by at least 30 to 35% and would result in the growth demand for these products. As the volumes build up, India will be able to export consumer electronic products to other countries, as is happening in China.

Thrust Areas

Thrust areas would continue to be CTV, particularly LCD and Plasma TVs, which are projected to register more than 50% yearly growth during the Eleventh Plan and Set Top Boxes (STBs), which will grow rapidly due to the introduction of DTH, value added pay services on cable TV network and DTT.

2.6 Targets for Eleventh Plan 2007-12

The production and export targets for the XIth Plan 2007-12 (year-wise) are given in Table 10 and Table 11.

Audio

Current demand in entire segment is estimated to be around 23 million Nos. and is growing @ 5% CAGR. Although substantial quantities are being manufactured/assembled in the country, contribution of unorganized segment/grey markets is substantially high.

2.7 Status of Investments and Investment needed to meet the Targets

Most of the investments by the domestic industry (small to medium scale) is in the excise exempted zone to take advantage of the excise and income tax exemptions. There has been some investment by Multinational Companies (MNCs) like LG and Samsung, who are investing in the country with the idea of making India an export hub. Some of the MNCs are expected to make India base for their exports. It is expected to be US\$ 4 to 5 billion in consumer electronics and its components during the Plan period.

In Audio sector, absence of investments in organized sector and high taxes results into products of unreliable quality and high cost to consumers. This sector has potential demand of around 50 million Nos. per year.

2.8 Employment Generation

Current status and expected Employment Generation – This sector is highly employment intensive and provides

Table 10 : Production Targets for Eleventh Plan

Products	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	Remarks
CTV	11.75	13.00	14.5	16.00	18.00	20.00	Rs. in Crores
STB	1.00	2.50	4.00	5.5	7.5	10.00	
DVD Players	5.00	6.50	7.50	8.25	9.00	9.50	
Home Theatre	0.35	0.42	0.50	0.60	0.70	0.85	
PA System	300	345	400	460	525	600	
Watches	31.5	33.0	34.5	36.0	38.0	40.0	
Clocks	29.0	30.5	33.0	34.5	36.0	38.0	
Microwave Ovens	0.475	0.60	0.75	0.90	1.10		
Total	21,000	24,000	27,500	31,500	36,000	41,500	In Rs. Crores

Nos. in Million Units

Tabel : 11 Exports Targets for Eleventh Plan**(In Million \$)**

Products	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
CTV	115.0	140.0	170.0	200.0	250.0	300.0
DVD Players	1.0	3.0	5.0	10.0	15.0	20.0
PA System	33.0	36.0	40.0	45.0	50.0	55.0
Total	300.0	350.0	425.0	500.0	600.0	700.0

Figs. in Million \$

jobs to professionals, skilled, semi-skilled and un-skilled workers. Women are employed in big numbers. The ratio of indirect and tertiary jobs to the direct jobs in this sector is very high, as any industrial output leads to immense logistic and trade activity.

Conclusion

Presently, the policy makers view consumer electronics as a sector which caters to the rich and hence is viewed as revenue generating. It would be important to see the developments taking place in China, where consumer electronics has become the major business of whole Chinese Electronics and IT sector. In the first half of 2006, China exported 22.8 million CTV sets, 35.5 million Digital Cameras and 156 million Mobile Phones. The fact that the Chinese Government sees the technological developments in the consumer electronic sector as an important area, is reflected in Mr. Lou's statement that initiating the developments on LCD TV is being given due emphasis, in the policies of the Government.

Digitalization and miniaturization has changed the market scenario to such an extent that even all type of broadcasting (a satellite based communication) are going to be mandatorily digital. This has increased the pace of convergence of multimedia in all type of products. Even handheld computers (Internet browsing Devices), mobile phones etc., has merged with consumer electronic products. India has lagged too much behind its competing nations in manufacturing of such devices as our tariff policies and infrastructural bottlenecks have kept us a high cost economy which does not gel with zero rate of customs duty, imposed on majority of electronic components and ICT products which are initiators of digital technologies. As a result of zero duty, real investments were not made in the country for last couple of years in digital technology products. Majority of investments in the current horizon are superficial to facilitate trading and services.

Investments made in Television industries are also threatened because of zero customs duty due to FTA/

PTAs. No investments are forthcoming in LCD technology which is replacing CRT technology worldwide.

Since developed countries are not fulfilling WTO obligations of providing free access to our agricultural produce in their countries by removing export subsidies and reducing import duties, India should also not allow free access of Electronic products at zero duty. A rationalized duty structure on entire consumer electronic products value chain at reasonable level on domestic manufacturing is necessary to provide level playing field.

Income tax relief and a strong infrastructural support should be provided to R&D.

Above measures will expand market, encourage large investments in organized sectors, discourage grey market, increase exports, employment as well as revenue to Government.

China wanted to become export led economy. For this they created SEZ like clusters of excellence and attracted FDI by providing tax relief (50% of income tax as long term measure and higher relief as short term measure). In order to make itself a low cost economy, China adopted countrywide VAT @17% (from nearly 35%) in 1994 and started rationalizing customs duties. They continuously went on reducing interest rates for manufacturing. Currently interest rates in China range from 3 to 6%.

India needs to take a leaf out of the approach of the Chinese Government and give due importance to the consumer electronics, as an important element in the economic activity in the country.

2.9 Technology trends in Displays

(CRT, LCD, PDP, CRT PRTV, MD, RTPV)

Global Scenario

Globally television industry is growing at a CAGR of

2% in volumes and 11% in revenue terms. Television market is expected to grow from 180 mn units in 2005 to 205 mn units by 2009, also in the same period the revenues are expected to grow from USD 85 billion to USD 125 billion.

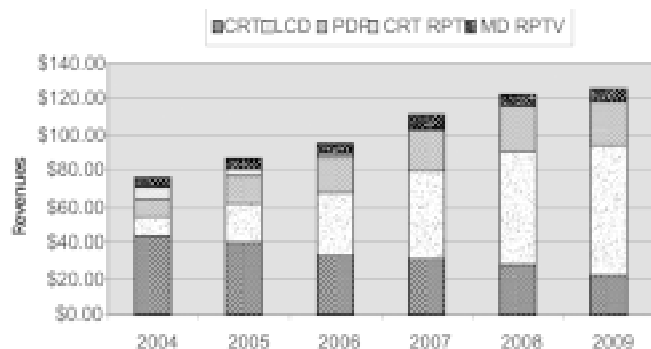


Figure 11 : Global TV Industry – Revenue Wise

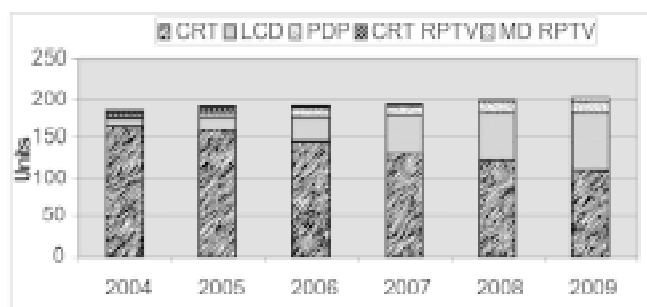
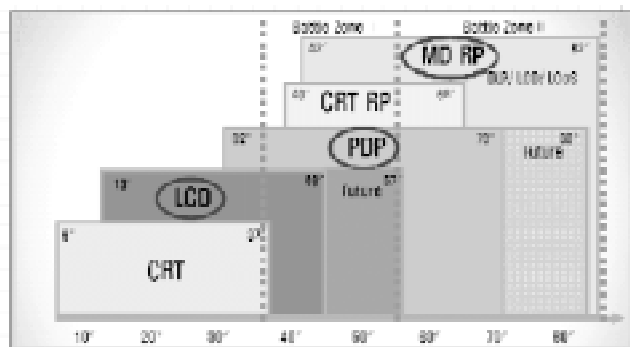


Figure 12 : Global TV Industry – Volumes in Millions

As new technologies emerge to take more percentage share of television industry, there is an ongoing fierce debate as to who is going to win this race. A commonly held view is presented below. This table shows existence of various technologies in different size segments.

Figure 13 : Display Size v/s Competing Technologies



If we analyze Q1 of 2006 then we observe TV revenues grew 36% Q/Q and 13% Y/Y to \$26.3B to the delight of retailers and TV manufacturers. Driving the growth was increased flat panel and HDTV penetration

resulting from their higher average selling prices (ASPs). Flat panel TV penetration jumped from 8% in Q1'05 to 19% in Q1'06 on a unit basis and from 36% to 58% on a revenue basis, causing the blended TV ASP to rise 18% Y/Y to \$451. Regionally, Europe enjoyed the highest revenue growth, up 40%, followed by North America, which was up 15%.

Flat panel TV penetration on a revenue basis was highest in Japan at 94%, followed by Europe at 77% and North America at 52%. HDTV sales also drove up the blended price; HDTV shipments as a percentage of total TV shipments more than doubled worldwide from 7% in Q1'05 to 17% in Q1'06. It was highest in Japan at 52% with North America at 35% and Europe at 28%. By technology, LCD TVs overtook CRT TVs for the first time on a revenue basis in Q1'06, holding a 38% to 31% advantage on 58% Y/Y growth.

- LCD TVs enjoyed the fastest growth, up 137% Y/Y, boosting their share from 6% to 15%. This enabled LCD TVs to overtake CRT TVs on a revenue basis. LCD TVs gained significant share in all regions except for ROW.
- Plasma TVs grew 109% Y/Y to more than double their share to 3.9%. Plasma TVs had record results and exceeded expectations, but lost share in key size categories and in certain regions on supply constraints.
- Micro-display rear projection TV (MD RPTV) shipments grew 52% Y/Y to boost their unit share to 1.6% with Sony accounting for more than one out of every two micro-display RPTVs sold. North America continued to dominate this market earning an 87% share on a unit basis.
- CRT RPTV shipments were down 60% Y/Y and fell from 68% of the Q1'05 RPTV market to 36% of the Q1'06 RPTV market for two reasons. MD RPTVs have narrowed the price gap, and consumers prefer the picture quality and form factor advantages of MD RPTVs. CRT RPTVs were down at least 58% Y/Y in each region.

Indian Scenario

India's TV and broadcasting markets are now facing a set of dramatic changes. With India's strong overall economic growth, the number of TV households is growing rapidly. DVD players also are enjoying brisk unit growth. Most significantly, India's large cable TV industry-after seeing years of double-digit growth-is now facing dramatic new competition from Direct-to-Home satellite services. Finally, even as Direct-to-Home (DTH) growth

accelerates, telecom carriers are testing Internet Protocol TV (IPTV) deployments, and cable MSOs are cautiously considering digital cable deployments to offset new competition.

India has more than 100 million homes with a TV, and it is the third largest country for cable subscribers, at more than 60 million. Advanced digital services and content are now finding interest among Indian consumers. With many emerging segments and yet with some significant uncertainty, India comprises a volatile market with both big opportunities and real risks. Among the key characteristics of India's TV market are the following:

- A large and growing TV market, with more than 11 million annual units of TV set sales, and \$2 billion in revenue expected in 2005.
- A large cable industry with 60 million-plus subscribers.
- A newly enabled Direct-to-Home satellite industry, projected to penetrate in excess of 2 million households in 2005, up from only 250,000 in 2004.
- A DVD player market emerging from sales of only 100,000 units in 2003, to nearly 4 million units in 2005.
- An overlap in ownership and partnerships among the broadcasters, cable operators and satellite operators.
- A highly fragmented cable industry, with a complex regulatory environment.

Additionally, trends in the advanced Indian TV and broadcasting market include the following:

- A colour TV market transitioning to flat-face CRT TV, and the initial emergence of LCD-TV and Plasma TVs.
- New DTH satellite providers preparing for market entry.
- Trials of digital cable services and IPTV services in major population centres.
- Emergence of digital set-top box markets supporting the growth and delivery of services in DTH, digital cable and IPTV.

In 2004, India had slightly more than 57 million homes receiving TV signals via cable and satellite, of which nearly all of them were cable subscribers. This is in addition to TV homes that receive free terrestrial TV broadcasts. Paid subscribers generated about \$3 billion in annual revenue. By 2009, it is forecasted (reference: isuppli) that the number of cable, satellite and IPTV homes will exceed 88 million, and this will drive subscription revenue to \$5.5 billion. This rapid growth in subscribers

and service revenue will drive similar growth in TVs and TV equipment, including DVD equipment, and cable, DTH and IPTV set-top boxes. iSuppli forecasts total equipment units to grow from 10.4 million units in 2004 to over 47 million units in 2009. Equipment revenue will grow from \$2 billion in 2004 to surpass \$5 billion in 2009.

Colour TV (CTV) Market

India's TV market is going through a high growth phase. This market is likely to see a compounded growth of 11% between 2005 and 2009. While CRT TV market will continue to grow at a 7% compounded rate, high growth with over 100% CAGR will be seen in LCD and plasma TV market. This high growth in flat panels will be driven by over 20% decline in their ASPs. The buying power of consumers is increasing. The key drivers for the TV market in India are:

1. Replacement of older TV sets-with the increase in disposable income, availability of financing schemes and declining prices of CRT TVs, increasing number of consumers are upgrading their existing black and white or much older and small size TVs with newer colour TV sets.
2. Increased adoption in rural and semi urban markets- due to declining prices of sets and increased availability of programming in local languages coupled with availability of financing, adoption on TVs in these markets is on the rise.
3. Increased affordability-number of families with two or more income generators is on the rise. With this, the disposable income of these families is on the rise and this leads to purchase of consumer electronics, specifically TVs as they are becoming a prime medium of entertainment.
4. Availability of flat panels-for the urban markets and the affluent in the other cities, declining prices of flat panels has been a key driver of replacement of their existing sets. Flat panels fulfill the consumer needs for a new technology, sleek TV set and because of their attractive form factor are capturing consumer attention. With declining prices they increasingly become affordable to the early adaptors and early majority of the market.
5. Increased local production-TV production in India is on the rise. Besides local players, Samsung Electronics and LG Electronics have manufacturing facilities in India to meet with the domestic demand as well as exports. Videocon has bought all of Thomson's colour picture tube production plants. Samtel is also working with emerging technologies like OLEDs and Plasma Display Panels (PDPs).

Local Production of CRT TVs

India produces not only complete CRT TV sets but also produces the key component - the colour picture tube (CPT). The two big CPT players in the Indian market are Samtel and Videocon. Samtel has a total CPT production capacity of 10 million tubes a year and has a line dedicated to 29-inch flat face tube production. Videocon boosted its existing capacity by acquiring the assets of Thomson. The company acquired Thomson's lines in Italy, Mexico, Poland, and China. Total tube production capacity in India is about 16 million tubes from about 8 existing lines. This accounts for 6% of global CPT production. Indeed, this market has enjoyed accelerating growth along with the increasing purchasing power of Indian consumers.

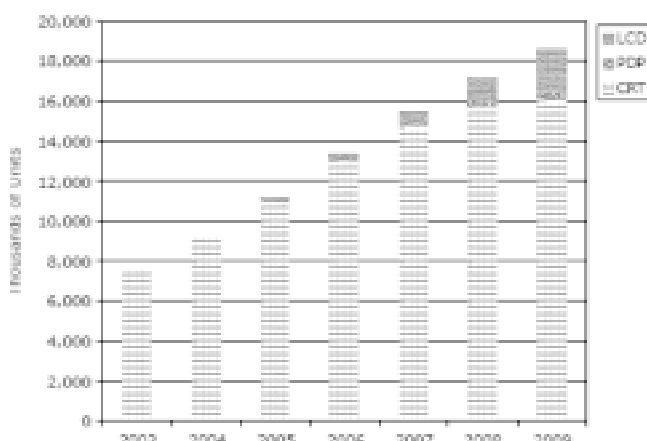


Figure 14 : Production of CRT TVs

TV products available in the market include analog colour TV, flat-face CRT TV, LCD and plasma TV. However, sales of plasma TVs have been very slow at 7,000-8,000 sets a year. A large majority of sets for India's TV market are produced locally, with increasing capacity and growth of exports as well. Flat-face CRT TV sales accounted for 25% of the overall CRT TV market sales of 9.25 million sets in 2004, and this segment is growing because the alternative choices of plasma and LCD TVs are still relatively expensive. Nevertheless, pricing for these flat-panel TVs is falling, which is resulting in increased consumer demand.

The table above shows iSuppli's forecast for TV sales in India. The market registered slightly more than 10 million units in 2005, and by 2009 it is projected that the market is likely to exceed 18 million units. This will drive strong revenue growth, despite gradual price reductions. Overall revenue will likely approach \$3.7 billion by 2009.

Future Trends in CTV Market in India

Currently Flat Panel Televisions in India constitute

only 4% of the total revenues. This is forecast to grow to 40% of the total revenues for the CTV market by the year 2011.

This growth will primarily be driven by PDP and LCD Technologies. PDP based displays are expected to grow to upwards of Rs. 4000 crore by 2011 from present levels of Rs. 165 crores. This growth is driven by:

- Rapid Innovation in Technology leading to enhanced performance and drastic cost reduction.
- Increase in Disposable incomes.
- Rising aspiration level of consumers.
- Aggressive distribution and promotion by Industry.

See data below:

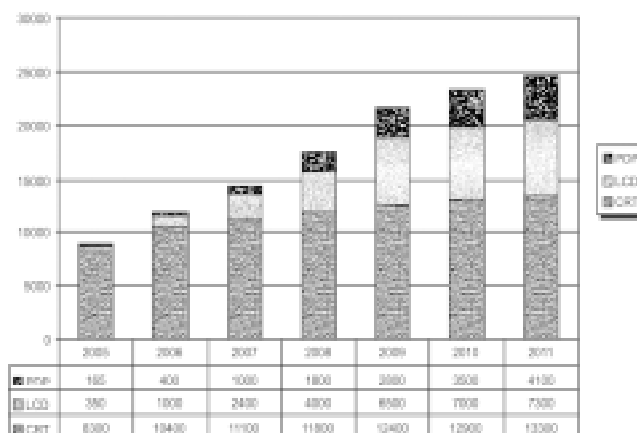


Figure 15 : Indian TV Market – Rs. (Crores)

In terms of units, the total CTV market in India is forecast to grow to 21.3 mn by 2011 PDP 1.1 mn, CRT based TVs: 16.7 mn, LCD TVs: 3.5 mn.

See data below:

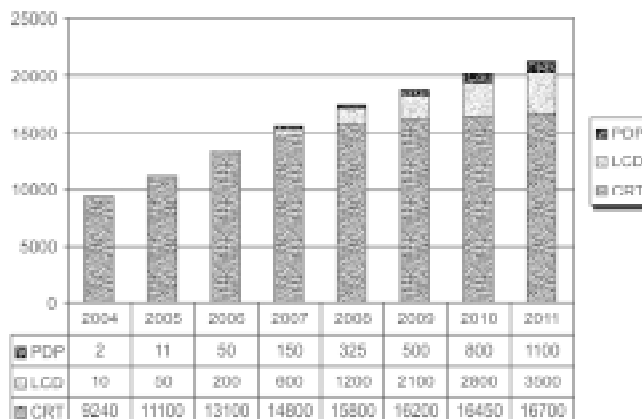


Figure 16 :Indian TV Market -Units (K)

3. Electronic Components

3.1 Background

The Electronic Components sector continues to face serious challenges to its growth and competitiveness due to severe disabilities it has to cope with. These disabilities are historical as well as caused by the present business environment.

Historically this sector has not kept pace with the rest of the world and is saddled with out dated technology, low volumes and high costs making it uncompetitive. The 'gap' has been increasing and in case of most manufacturers is very large, making it very difficult for them to catch up with the other electronic manufacturing nations.

3.2 Current Status including production and exports

The Current Business Environment is equally daunting and permits survival only of the fittest. With ITA-1 implemented last year most components are already at 'zero' customs duty and the remaining are fast converging to zero under FTAs. Convergence of technologies has further resulted in functions till now performed by Consumer Electronics equipment being performed by Telecom and IT products, eliminating whatever little difference remained between components used in these different segments of equipment. Thus practically all components today can be imported at zero customs duty.

This is indeed a unique situation, not comparable to any other industrial sector. The electronic component manufacturer competes with zero duty imports, manufactured in economies which have significantly lower input costs, huge capacities and economies of scale, better infrastructure and even lower internal taxation with larger domestic markets. China remains the biggest and most formidable competitor which Indian manufacturers are threatened by.

An interesting phenomenon about Indian electronic component industry is that while it is competitive in global markets, it is not able to compete with imports from Chinese and other Asian countries. Such imports are largely by assemblers in unorganized sector which flood

their products in the grey market hurting the organized revenue generating organized sector. The items of which a major share is sold in the grey market include Radios, DVD, CD Players, CFL lamps, Power Electronics, Auto electronics etc.

3.3 Performance under the Tenth Plan

Table 12 : Tenth Five Year Plan Projections vs Actual Performance

Year	Projection	Production	Exports
2001-02	6000	5700	2200
2002-03	6900	6600	2400
2003-04	7900	7600	3775
2004-05	9100	8800	3800
2005-06	10600	9100	4000
2006-07	12000		
GAGR	15		

3.4 Technology Status

India has been a strong player in the Picture Tube segment with large manufacturing facilities and new technologies. An Indian manufacturer has also developed Plasma Display technology indigenously. However there is a major shift in technology and preferences towards LCD, Plasma, LED technology where India has no presence.

Other products / segments in which we are strong include PCBs, Connectors, Passive Components and other electromechanical components such as relays, switches, contactors, fuses etc. Manufacturers of these products range from large MNCs who are focused on local as well as global markets and medium as well as small scale Indian companies. Investments in these products, though widespread are smaller compared to semiconductor manufacturing and thus we have some strong players who have expertise and have been around for long.

Trend in these products, such as capacitors and resistors is towards SMD technology (non-leaded) requiring a major shift in technology and huge investments.

However, large and sustained investments in R&D are rare to find. The will to invest for the long run has been weak due to lack of confidence in a supportive policy environment and other financial and infrastructural disabilities which make Indian manufacturers uncompetitive. This has kept India far behind the leading countries in Electronics Component technology, such as Japan, Taiwan, Korea and some EU nations. There are very few cases of Indian companies developing core technology, materials or components from scratch and owning patents.

The brighter side is that *India has an edge in Semiconductor Design, embedded systems and has the potential of becoming an engineering design house for the world.* Combining with its software strength, Indian Embedded technology is globally acclaimed and accredited. The growth rates in this segment are unparalleled by any other sector and this industry has the potential to corner a bigger slice of the \$80 billion global semiconductor design services market. This optimism is also backed by the strong legal system and IPR protection available in India which builds confidence in foreign investors.

More than 125 companies are involved in semiconductor design and testing and their numbers are growing fast. The existing ones, specially the MNCs are expanding their operations rapidly to keep pace with demand. Noted companies today in this sector include Arasan Chip, Bluefont Technologies, Sasken, e4e Labs, Moschip Semiconductor, Infosys Technologies, Satyam Computer Services, Tata Consultancy Services, Intel, Texas Instruments, IBM, Siemens, ST Microelectronics and Cisco, among many others.

The chip designing sector is growing very fast and according to estimates by NASSCOM has grown from about \$130 million in 2001 to \$800 million in 2005, and could well be the fastest growing segment over the next five years.

The key to success for India is to complement this design and R&D expertise with local manufacturing which would have a multiplier effect on the value addition for India. Global demand for semiconductors is growing, with the share of chips in the end product rising from 6 per cent in 1984 to 23 per cent today. If India can integrate its chip design services with fabrication facilities, it can result in growth in competitive manufacture of electronic products and success in the domestic as well as global markets. Unfortunately, most technology companies in India are either captive design centres of multinationals or third party service providers which results in the fruits

of value addition going to countries which have state of the art and large scale manufacturing facilities.

3.5 Future Trends

The future for all electronics including components and products is going to be impacted by the following trends in global markets and technologies:

Manufacturing and Business Trends

- Large volume production at competitive prices – high value for money
- Environmentally friendly products complying with strict rules and legislations – easily recyclable
- Reliable and robust design with quality for long life and safety
- Continuous innovation and R&D for developing new products which are smaller, cheaper and better
- Shorter product life cycles with high obsolescence
- Compressed time line from Design to Delivery.

Technology

- Embedded Systems and System on Chip
- Opportunities in new applications such as Blue Tooth, Digital Cameras, RFID, Auto Electronics, Thermal Management etc.
- New Display Technologies such as LCD, Plasma and OLED
- Shift to Optical Disks and Chip based Solid State storage from Magnetic tapes/ Disks
- Nanotechnology and its applications
- Micro ELectromechanics (MEMs)
- Environmentally friendly materials and products – complying with RoHS and WEEE - easily recyclable.

Thrust Areas

These are high potential product segments and technologies which need special attention by way of investments, technical and policy support –

- Energy saving devices – LED, CFL Lamps, Brushless DC motors
- Flat Panel display technology – required to complement our strength in CRT technology and upgrade industry to grow in future and meet changing demand patterns

- SMD Devices – miniaturization and facilitate expansion of EMS
- Wafer Fab and Chip manufacturing
- Embedded Technology and chip designing
- RFID Technology – expanding applications and market
- Automotive electronics – growing very rapidly with Drive by Wire technology
- Development of Environmentally friendly inputs / materials / components to ensure sustainability of electronics and meet global requirements
- Telecommunication equipment / Mobile Handsets value chain.

3.6 Production and export targets for Eleventh Plan 2007-12

With favorable policies, the following growth targets are achievable in the market and local production:

Table 13 : Demand and Components

(\$ Billion)

	EXPORT (growth 25%)	Demand for Components (40% of Total Electronics Prodn)
2005	2.39	4.6
2006	2.98	5.10
2007	3.73	6.52
2008	4.66	8.65
2009	5.83	11.45
2010	7.29	15.16
2011	9.11	20.10
2012	11.39	26.60

Components requirement would be 40% of projected production which we can expect to grow from US\$ 5 Bn at present to US\$ 27Bn by 2012.

3.7 Status of investments and investment needed to meet the targets

There have been many recent announcements by electronics majors such as Flextronics, BenQ, ST Micro, Samsung, LG, Videocon etc., for investments

in Design, R&D as well as manufacturing facilities in India. Most of these announcements are for R&D Labs, Test facilities, Design Centres while a few are for manufacturing in Consumer Electronics, Global EMS companies and Telecom majors. There are no announcements for large investments in electronic components and/or parts manufacturing. There should be focus on relocation of plants from Europe and Developed countries for quantum jump in manufacturing. This trend has benefited other Asian economies a great deal over the last 2 decades and India can gain by encouraging shifting of factories which are facing acute cost pressures in high cost economies

To meet a target of US\$ 27 billion in component manufacturing by 2012, with an Investment :Output Ratio of 2:3 approx., Investment required would be US\$ 17 billion by 2012.

Recent reports and RBI data show that 17% of total FDI inflows have come in from electronics due to huge demand for electronic products and rapid growth of MNCs in consumer electronics, EMS and Telecom companies. There have been cumulative inflows of FDI amounting to US\$ 23.7 Bn between 2002-2006 which far exceed the total FDI approvals in this sector (US\$ 19.2 Bn) over a 15 year period from 1991 – 2006.

However, it must be noted that from this amount of US\$ 23.7 Bn, the investments in electronic components has been negligible !

One area where investments in components and parts is likely to expand and needs to be encouraged and monitored is in SEZs where large MNCs are establishing Cellphone manufacturing and EMS production lines. These plants can create a huge demand pull for components and parts and should be encouraged to bring their global suppliers to set up base here, either as independent companies or in JVs with local manufacturers.

The areas where investments are likely to be injected are Solar cells, Plasmas/LCD displays, Semiconductors, electromechanical parts, PCBs etc.

R&D – Current Status and proposed

R&D provides strength and competitiveness to industry and is vital for its sustained growth and prosperity. India has not been strong in R&D in electronics hardware and has largely depended on acquisition of technology from developed countries.

Industry needs support from the government by providing financial, fiscal and infrastructural resources for strengthening local development efforts. This can be done by application of resources in Thrust Areas such as Energy Saving Devices, Flat Panel Display, RFID, IT/Storage Devices, Semiconductor Memories and Nanotechnology. India must focus on acquiring technology through mergers and acquisitions and by relocation of manufacturing plants from developed countries. This has been the route followed successfully by emerging Asian economies and is extremely cost effective as the technology flow follows a bottom up approach, commencing with assembly and moving on to manufacture of components and R&D for upgrading the products manufactured. It is a gradual learning process with commercial benefits accruing from day one.

Presently R&D is limited to individual efforts and partnerships between academia and industry remain scarce and tenuous. These need to be organized under programs sponsored by the government and industry with focus on emerging technologies with a 10-20 years time horizon.

It would be ideal for India to examine the example set by Taiwan where over the past 20 years, private and public sectors have joined hands to establish a highly efficient electronics manufacturing environment with global logistics capabilities. Taiwan remains an attractive place to invest, since many businesses have rapidly moved from being local labour-intensive manufacturers to global and knowledge-based creative enterprises. This movement up the value chain has happened due to a focused effort and investments in developing capability from design to delivery unmatched by any other nation. Taiwan has strengthened its industry and increased its lead by creating more silicon intellectual property (SIP) that has greater value and reusability, building its reputation as a well-placed centre for protection and distribution of SIP and hosting the world's fastest growing population of design firms, electronic engineers and electronic researchers.

Silicon Intellectual Property (SIP) is a key factor underlying the continued high rate of development for the semiconductor industry in the 21st century. At present, Taiwan's semiconductor industry enjoys a manufacturing advantage and strengthening its SIP is creating a great strength for it making it a global leader.

4. Semiconductor Manufacturing Industry

4.1 Background

The \$235 billion worldwide semiconductor industry is the key driver for most advanced technologies in the world today. It forms the heart of the \$1,300 billion global electronics industry and is also the key enabler for the fast emerging nanotechnology and biotechnology markets, each of which will soon be a trillion dollar plus market.

Given its crucial role in some of these large markets of the knowledge economy, and the tremendous strategic advantages it offers through the advanced technology involved, this industry has come to be regarded as the oil of the information age. Transition to this high technology industry has been an overriding goal of public policy in many countries, and industries have been planted and nurtured as an act of public policy to master this strategic sector at all costs for the wealth it could generate and the spin-off effects in rest of the economy.

4.2 Current Status

The domestic market for electronic products in India, which touched \$28.2 billion in 2005, though relatively small on the global scale, is on a roll and has become the fastest growing market in the world today, and is slated to grow at a CAGR of 29.8% to reach \$126.7 billion in 2010 and to \$363 billion by 2015, according to recently concluded country study by ISA-Frost & Sullivan. Correspondingly, the semiconductor consumption in the country is expected to grow to \$36.3 billion by 2015 from about \$2.82 billion in 2005.

4.3 Performance under Tenth Plan

India's total semiconductor consumption in 2005 is pegged at about US\$ 2.8 billion, which is substantially satisfied through imports. The semiconductor demand is likely to exceed US\$ 12 billion by year 2010 and US\$ 36 billion by the year 2015.

Additionally, there is a strong interplay between the growth of semiconductor and the electronic industries. Accordingly, the growth of the electronic industry plays a pivotal role in determining the demand for the semiconductor industry and vice versa since semiconductors may account for 25-40% in any equipment.

Table 14 : India Semiconductor Consumption

Year	Total Market (TM) Revenues (\$ Billion)	Growth Rate (%)	Total Available Market (TAM) Revenues (\$ Billion)	Growth Rate (%)
2005	2.82	37.1	1.14	25.3
2006	3.8	34.9	1.62	42.7
2010	12.67	132.8	5.8	155.8
2015	36.3	186.5	15.52	167.7

Source: ISA- Frost & Sullivan

In addition to the impact on the electronics industry, growth in the semiconductor industry would also have a significant multiplier impact on the growth of the software industry in the country. As the increase in semiconductor demand translates into a stronger chip design industry, it would result in a higher demand for software in the country.

Within the electronics industry, the main end user application of semiconductors is in telecommunications - cell phones, PCs, automobile ICs, and digital consumer electronics market segments. The consumption of semiconductors in PCs and in the telecom sector is much more as compared to other market segments. Therefore, within the electronics industry, increase in the demand for PCs and telecom would have a higher impact on the demand for semiconductors.

Performance and Future Trends of Indian Semiconductor Industry

Size and structure

With increasing demand for domestic electronic-goods and the availability of a pool of talented engineers, India is fast creating a footprint on the semiconductor roadmap. The Indian semiconductor industry is currently dominated by players engaged in chip designing activities.

The country today has almost 130 chip designing companies and market trends suggest that development of semiconductor industry is now taking centre stage. This is evidenced from the estimated revenues of the industry and the fact that almost all global semiconductor companies have set up designing operations in India. The key to the success of the Indian chip designing industry is the abundance of good talent and lower development costs.

4.4 Technology Status

With the strengthening trend of IC design activity moving to India, country is already seen as the top choice for complex IC design, with most top MNCs present in the country and several home grown design service and product start-ups on the horizon. As the semiconductor world transitions to 90/65 nanometer process technologies, semiconductor manufacturing and IC design are becoming increasingly interdependent as neither activity can be carried out without in-depth knowledge of the other. Coupled with this is the fact that embedded software forms a significant part in the design of today's System-on-Chips, where India is already seen as a leader.

Vision and Thrust Areas

In the new paradigm of strong interdependence of IC design, semiconductor manufacturing and embedded software capability, India is uniquely positioned to become one of the most ideal destinations in many ways for the future of semiconductor manufacturing but for the serious infrastructure related challenges. Geo-political factors also favor India as an alternate destination to minimize the risks associated with semiconductor manufacturing which has recently been getting concentrated in China and East Asian countries.

India is a late comer to the semiconductor manufacturing opportunity. Country seriously lacks in the infrastructure required for the industry. Lack of a supportive policy framework too creates a big viability gap. Large investments (\$3B for a state of the art plant, which doubles for every subsequent node of technology) required for the industry can only be attracted through serious commitment and policy level support from the Government. Hence, a careful strategy is needed to create the enabling infrastructure for achieving economies

of scale and develop a supportive policy framework that would help seed the industry and also support it in its stage of infancy.

4.5 Future Trends

Having reaped the benefits of the designing activities which India has been nurturing, the country has now realized the potential and opportunities offered by the semiconductor industry. Accordingly, more initiatives are being taken towards diversifying in the other areas of the value chain in the semiconductor industry.

Given that India is already a late comer into the industry, it must compete aggressively by building a coherent strategy and taking leaps towards setting up of a fabrication facility.

- *Pivotal role in the strategic development of wafer fabs*

The electronic goods manufacturers in the fabrication facility will create a substantial demand for ICs in the country, and thereby could offer an assured market to fabs setting up units in the fabrication facility.

In addition to facilitating setting up wafer fabs, the fabrication facility would also provide an impetus to the existing chip designing industry in the country by creating a sustained demand in the domestic market for their designs. Therefore, the fabrication facility will help in creating an end to end semiconductor value chain in India.

- *The fabrication facility will also lay the foundation for biotechnology and nanotechnology*

It would lay down the foundation for the biotechnology and nanotechnology industry in the country, each of which is expected to exceed almost a trillion dollar market globally within the coming decade.

- *Export potential*

For a country which imports almost 60% of its electronic goods consumption today, the fabrication facility could ensure that a substantial portion of this demand is satisfied through local manufacturers. Fab will also provide domestic manufacturers an opportunity to participate in the \$1300 billion worldwide market for electronic goods which is expected to grow at the rate of approximately 8%.

- *Sale by fabs in the domestic market*

This would result in self reliance and reduced dependence on the international market. The benefits

likely to arise from such self reliance would be more or less equivalent to those generated from export activities. One such benefit would be an increase in the foreign exchange reserves of the country due to reduced outflow.

Fabs would cater not only to the domestic market, but the country would also be able to reach out to the global semiconductor market in specific product categories.

- *Infrastructure development*

Fabrication facility will act as a catalyst in scaling the country's infrastructure to world standards. Scaling up of the infrastructure would improve India's image on the global map. Infrastructure will also translate into greater foreign investments in the manufacturing industry as a whole.

- *Generation of talent pool*

Fabrication facility would provide the infrastructure and environment for research activities to ensure development of cutting edge technologies in the country. This in turn would play a vital role in generation of a talent pool in the country which would provide a competitive edge to our people.

- *Quantum of Investment required for setting up fabs*

A single 300mm Fab requires investment of more than US\$3 billion. Further, given that the industry faces a high level of obsolescence, the level of capital expenditure required on an ongoing basis to keep pace with the industry is also substantial. As per CLSA Asia Pacific Markets data, in the year 2004, a company in the semiconductor industry on an average incurred capex to the extent of almost 14% of its top line in a year.

Proactive role of Government in establishing Fabs

The semiconductor industry has come to be regarded as the oil of the information age. Transition to this high technology industry has been an overriding goal of public policy in many countries, and industries have been planted and nurtured as an act of public policy to master this strategic sector at all costs for the wealth it could generate and the spin-off effects in rest of the economy.

Based on the experience of other countries, it is evident that Government initiative played an integral part in the seeding of semiconductor manufacturing related industries in countries like Taiwan, China, Singapore, Korea, Malaysia, Israel and Germany.

Government support in these countries came in the form of equity capital, research grants, or biased tariff

structures that supported the formation of local manufacturing industry.

Government grants to the IC manufacturing industry: A comparative Scenario

Country	Grants
Taiwan	Large seed capital, tax breaks, research grants
Singapore	Government equity, tax concessions, cheap funds, research grants etc
China	Government equity, subsidised funds, favourable tariff structure, tax breaks etc

Steps needed to be taken on high priority basis according to ISA:

- Measures to encourage investment in the Fabrication facility
- Measures to encourage capacity commitments
- Incentivise use of indigenously manufactured semiconductors
- Make available the best infrastructure
- Finally, it is believed that given the multiplier effect of the semiconductor industry, growth in the industry is likely to provide substantial benefits to the economy which will far outweigh the costs of providing these benefits.
- In fact, it is believed that kick starting the semiconductor industry would result in the creation of a domestic semiconductor and electronics industry of over US\$200 billion in the next 10 years and will contribute to more that 12 to 15% of the GDP on an ongoing basis.

5. Telecommunications & Broadcast Industry

5.1 Telecommunications Industry

5.1.1 Background:

The Communications sector covers the areas of Network Infrastructure, Services, Technology and Equipment production and thrust was on improving

accessibility, reliability and provision of basic and value added services to address the growing needs of the urban and rural areas alike. With the deregulation and privatization of basic telephone and value added services the growth of both mobile communication and broadband services touched unprecedented levels. The FDI in the telecom services sector was increased to 74%* from the earlier limit of 49% and up to 100% in telecom manufacturing sector. The policies in telecom have brought significant net gains to the country. These have led to drastic reduction in tariffs. New and innovative services with better quality and reliability are now available to every user. Foreign Direct Investment in this sector has been significant and encouraging with more than US \$ 2 billion already invested in the sector. It has led to increased user access and the country is now fully geared to deploy more affordable universal access. The country today has an independent, strong and effective telecom regulator with the relevant Act passed by Indian Parliament. A separate dispute settlement mechanism in the form of an Appellate Tribunal is also in place.

India today ranks amongst the top 10 telecom networks in the world and the second largest in Asia. It has more than 150 million telephone network with a tele-density of around 13.09. Telecom sector has been declared as one of the key infrastructure sectors for the country and this will lead to rapid growth of Indian economy. The current installed base of communication network in India comprises of about 47.5 million wire line phones, 106 million cellular phones, 7.5 million Internet subscribers, 110 million TV households, 18.0 million PCs, 500,000* route kms of optical fiber network and 25,000* VSATs.

Communication products manufactured presently include telephone instruments, teleprinters, facsimile, electronic/digital switching equipment, electronic PAXs, RAXs and PABXs, electronics telex exchanges, transmission equipment such as open wire systems, coaxial systems, optical fibre cables and optical fibre communication equipment, microwave systems, troposcatter equipment, PCM multiplexing equipment, two-way radio communication equipment in HF, VHF, UHF and microwave ranges, power line carrier communication equipment, radio paging equipment and data communication equipment,. The production of communication equipment as well as the basic telephone services which were reserved for the public sector have been opened to private sector as per the New Telecom Policy. A number of multinational companies have joined hands with Indian partners to

cater to Indian needs in the field of basic telephone services, radio paging, and cellular mobile phones. The boom in the cellular services market is all too visible with about 5 million mobiles being added every month. Consequently, the subscriber base reached 90 million by end of March 2006. The annual growth (April 2005 to March 2006) for this segment was of the order of 73%.

Convergence of various communication equipments and technologies is the hallmark of present information age. The convergence of Computer, Communication, Consumer electronics, Broadcasting and Contents; Voice, data, video and computing, fixed and mobile telephony and telecom and IT networks is creating new businesses giving flexibility in doing business and taking collaborative processes to a new level. It makes it possible to communicate almost anything to anyone at any time. The growing communication needs and business processes demand for faster Internet access and innovative interactive content have ushered in the broadband. At the same time, globally efforts are to

ensure that the benefits of ICT reach the largest section of the population. R&D is the driving force in harnessing the technologies and facilitating cost effective deployment of ICTE for the benefit of economy and society.

5.1.2 Telecommunication Equipment

Details of production and export of telecom equipment during Tenth Plan are given in Table 15.

Imports, on the other hand had steep rise during the last 5 years, as per estimates shown in Table 16.

5.1.3 The targets for Telecom Sector will be benchmark for the potential investors in telecom equipment manufacturing. (Table 17 and Table 17a)

5.1.4 Demand of telecom equipment

It is expected that there will be requirement of telecom equipment worth US \$ 73 billion during the Eleventh Plan in India. (Table 18).

Table 15 : Production Export of Telecom Equipment

	Production		Export	
	Rs. in crore	US \$ In million	Rs. in crore	US \$ In million
2002-03	14,400	3,200	402	89.3
2003-04	14,000	3,111	250	55.5
2004-05	16,090*	3,575	400	88.8
2005-06	17,833*	3,963	1,500**	333
2006-07 (estimates)	20,000	4,444	1,800	400

* include Rs. 2,800 crore (2004-05) and 3000 (2005-06) crores for turnkey services

** include Rs. 950 (2005-06) crore for turnkey services

Table 16 : Imports of Telecom Equipment

Year (In Rs. Crore)	Import of Telecom Equipment	US \$ In million
2001-02	1, 672	372
2002-03	7,694	1,710
2003-04	20,000	4,444
2004-05	20,560	4,569
2005-06	26,166	5815

Table 17 : Targets for Telecom Sector

	March 2007 in millions	March 2012 in millions	Net Addition in 11th Plan
Telephone connections			
Wire line	41	66	25
Mobile	154	584	430
Total	195	650	455
Broadband connections			
Wire line	10	50	40
Wire less	0	100	100
Total	10	135	140

Table 17 (a) : Targets for Telecom Sector

	Year 1 Mn	Year 2 Mn	Year 3 Mn	Year 4 Mn	Year 5 Mn	Total Mn
Wire line Telephone	3	4	5	6	7	25
Mobile Telephone	70	80	90	95	95	430
Wire line Broadband	7	7	8	9	9	40
Wire less Broadband	10	15	20	25	30	100

5.1.5 Export Targets

The Asia Pacific region offers a huge export opportunity since it is one of the fastest growing regions for telecom services. The proposed targets for exports of telecom equipments are given in Table 19.

The present production level of telecom equipment is around US\$ 2.8 Bn with a value addition of about US\$ 0.3 Bn . India has to position itself as a 'Regional Hub' for telecom equipment manufacturing as domestic and export volumes offers a tremendous potential. Considering 75% of the Indian demand of telecom equipment & handsets worth US \$ 73 billion to be met through indigenous manufacturing and an export potential of US \$ 12 billion, the total telecom equipment production target could be US\$ 67 billion for Eleventh Five Year Plan and 40% value addition in the high value telecom equipment to be achieved at the end of Eleventh Five Year Plan.

5.1.6 Important factors for growth of indigenous manufacturing of telecom equipments in India

- Potential 650Mn telecom subscriber base in India by March 2012.
- Encouraging Government policies.
- Competent and Experienced management workforce with experience in production management, supply chain management, working capital management, Flexible Manufacturing systems, etc., available in the country.
- Strong auxiliary component manufacturing base like cables, electronic packaging like cabinets, shelves, power electronics, tooling, bare PCBs up to 8 layers, etc.
- Skilled and trained shop floor workforce for electronics circuit assembly, testing and integration from widely available resources from Industrial Training Institutes and Polytechnics.
- Competitiveness in labour costs.
- MNCs willingness to invest in India driven by demand of regional SAARC countries as well as moderately developed ASEAN countries like Indonesia, Philippines, etc.
- Indian Telecom Operators market base with huge investment plans.
- Lower Manufacturing plant establishment cost in India.
- Current major drivers of National Economy – ITeS and BPO – totally rely on Telecom Infrastructure.

Table 18 : Domestic Requirement of Telecom Products

	Year 1 Mn US\$	Year 2 Mn US\$	Year 3 Mn US\$	Year 4 Mn US\$	Year 5 Mn US\$	Total Mn US\$
Wire line Telephone						
CPE	30	40	50	60	70	250
Active Infrastructure	300	400	500	600	700	2500
Mobile Telephone						
Handset (New Connection)	2800	3200	3600	3800	3800	17200
Handset (Replacement)	2000	2800	3600	4800	6000	7200
Active Infrastructure	2250	2550	2850	3000	3000	13650
Wire line Broadband						
CPE (Modems)	2100	2100	2400	2700	2700	12000
Active Infrastructure	1400	1400	1600	1800	1800	8000
Wire less Broadband						
PC Card	300	450	600	750	900	3000
Active Infrastructure	500	750	1000	1250	1500	5000
Optical Fiber Cable	120	140	160	180	200	800
E-Governance initiatives						
Defense - Telecom	400	400	600	800	1000	3200
Total Requirement	12200	14300	16960	19740	21670	72800

Table 19 : Exports Targets for Eleventh Plan

Year 1 Mn US\$	Year 2 Mn US\$	Year 3 Mn US\$	Year 4 Mn US\$	Year 5 Mn US\$	Total Mn US\$
400	1000	2000	3600	5000	12000

5.2 Broadcast Equipment Sector

The Broadcast sector covers digital broadcasting of audio and video, broadband access devices, Digital Video Broadcasting (Terrestrial, Satellite and Cable TV) and Optical technologies. Emerging technologies, and growing convergence between diverse technologies (telecommunications, broadcasting, information technology), are creating new challenges as well as new opportunities for broadcasting sector such as Direct-to-home (DTH) systems, Digitalization and digital compression technology, Digital Audio

Broadcasting and satellite delivered radio, Digital Terrestrial Television, new developments for uplinking TV/radio programmes to satellites, Internet and broadband multi-media, Streaming audio and video, Interactive TV, combining features of traditional broadcast technology with those of the net. New technologies in programme production and especially in the “post-production” stage, involving use of computers, new digital equipment and techniques are also on the anvil.

Trends

The scenario of wireless infrastructure equipment manufacturing changed in early 2005 when Ericsson started the assembling of BTS equipment at its Jaipur plant. Later in the year, ITI in collaboration with Alcatel, started BTS manufacturing at its Mankapur factory in Uttar Pradesh. This has given the necessary fillip to the wireless equipment manufacturing in the country. Manufacturing

in access networks has been relatively higher as Indian firms have indigenously developed the technology. Midas communication has specialized in corDECT technology for WLL applications while Tejas Networks has specialized in the STM products. DLC products have been developed by MAC India. All the companies have developed technology and licensed it to contract manufactures.

Tremendous growth was seen in communication networks, optical line transmissions, radio and satellite transmission, value added services, switching and mobile communication.

Wireless is expected to have a wider reach among the masses, thereby, enabling a variety of information delivery services relevant to the diverse needs, also addressing the last mile connectivity problem.

Broadband has been a significant driver of economy for nations across the globe due to the benefits provided by the technology. Development and growth of economy in many industrialized nations have been testimony to the benefits of broadband. The various benefits provided to various users are: for telecommunication companies it is a route to sustenance and growth while for the consumers it is a reach and wider range of information and services. Broadband has also integrated the whole society with the global information ecosystem, thereby, leading to the overall economic growth. In the Indian context, this has a potential to serve rural as also busy urban areas alike.

- Next Generation Communication, Broadcast and Convergence technologies (e.g. 4G Wireless Communication, Software Defined Radio/Software Radio, Ultra Wide Band transceiver and antenna, Data Compression Technology, Smart antennas)
- Wireless sensor networks (e.g. Communication algorithms, protocols, RFID applications)
- Convergence of wired/wireless networks, consumer premises equipment (CPE) and converged access devices.
- Wireless Technology deployments for urban-rural connectivity (e.g.: Broadband on Power Line (BPL), WiFi, WiMax).
- Development of IP based products/ services (e.g VoIP/IPTV, SIP based IP telephone)

The targets set by DOT are 250 million telephone connections 10 million broadband subscribers and 20 million Internet subscribers by end of 2007.

Production and export targets for Eleventh Plan 2007-12

Unprecedented growth of telecom subscribers have occurred during the year 2005-06. A teledensity of 13.09 per 100 persons in the country has consequently been achieved by March 2006. An interesting observation is that, during the year, about 20 million mobile subscribers were added taking the total of this category to 90 million, and thus wireless phones overtook fixed wireline connections. India has emerged as the second largest market for mobile handsets. Following the fast growth in the mobile market, a number of companies have announced setting up production base for mobile hand sets in the country for meeting domestic as well as export markets.

Direct to Home (DTH) broadcast service in Ku-Band through satellite was also started by the National Broadcaster, in addition to one private DTH service provider. Good quality digital broadcast reception is available almost everywhere in the country to the citizens, on their television sets through the use of dish antenna and a Set Top Box (STB).

Growing demand for a wide range of telecom equipment due to increased infrastructure creation provides excellent opportunities. India has been recognized as a key supplier of products and technologies for rural telecommunications by International Telecommunications Union.

Production of telephone answering machines, cordless phones, cell phones, fax machines, line jack units, modems etc., also provide opportunities for manufacture and trade.

6. Mobile Handsets and Accessories

6.1 Background

Mobile Handsets have been referred to earlier as a success story in the Indian electronics manufacturing space. This sector has traversed the journey that has been proposed for the rest of the electronics industry in this report i.e. demands generation initiatives and domestic value-addition requirements leading to manufacturing growth leading to an export growth. The following illustration shall attempt to throw more light on the same.

6.2 Current Status including production, export and market

- a) Over 10 times jump in production in 2006-2007:
 - Negligible domestic production during 2005-2006 – Estimated production 2 million valued at Rs.600 crore.

- Production jumps by 10 times over 2005-2006 to 20 million valued at Rs.4000 crore.
- b) Exports start in 2006-2007
- Estimated exports during 2006-2007 > 3 million handsets valued at Rs.600 crore.
- c) Market
- The market in 2010 will be 100 million handsets valued at 7 billion dollars (Rs.27,000/- crore). This is 5 times the 2006-2007 estimated production.

The above figures show that the domestic production in 2006-2007 has taken off and is up by 10 times over the previous year. The current production level of 20 million handsets is substituting the imports. Within the next five years, i.e., in 2010, the market will grow to reach 100 million handsets. A beginning in exports has been made in 2006-2007, where it has reached a modest figure of 3 million handsets, which is about 13% of the domestic production.

Mobile Accessories

Product Coverage

- Batteries
- Charger/Adapter
- Car Charger
- Desktop Stand (Connector)
- Loopset
- Hands free (Handset kit)
- Cover
- Memory card
- Connectivity cable
- Car kit
- Belt Clip
- Carry case (leather)
- Music Player
- Bluetooth sales pack
- Fashion Accessories

Current Status & Future Projections of production and exports

- Negligible production basically battery packs and charger packs being assembled.
- Less than 5% of India's demand is being met by local production.
- Very negligible export (essentially in the passive components like leather pouches.)
- Difficult to estimate quantity of other accessories.

Product	Current Market	Market in 2010
Battery Pack	40 million pieces valued at Rs.12000 million	250 million pieces valued at Rs.65000 million
Charger Pack	80 million pieces valued at Rs.4800 million	350 million pieces valued at Rs.17500 million

6.3 Performance under the Tenth Plan

This sector has over-performed as is evident from the data given above.

6.4 Technology Status

- Mostly GSM products manufactured in India. CDMA still based on imports.
- Design, IPR, patents etc. not held in India. The products were being imported in fully assembled condition. Assembly operations have begun only now.
- R&D almost entirely outside India. Since imports were the only source of meeting domestic demand of late, assembly has started. The R&D and design eco system has yet to be catalysed in India.
- Component industry expected to establish base in this period.

6.5 Future Trends

- Global market expected to reach 1300 million handsets (by 2012 valued at 150 billion dollars).
- The Indian market expected to reach 100 million by 2010 valued at 7 billion dollars.
- Mobile services will cover 80% of India's population by 2012. Subscriber base expected to cross 400 million (by 2010!).
- Mobility will pervade all spheres of life – eg:

Mobile Governance
Mobile Payments
Mobile Commerce
Mobile Medicine etc.

- a) In other words, the penetration level will be as much as 35%. The bulk of this huge market will comprise of standard low priced handsets in developing countries where the major part of the world population resides. This means that high volume low priced production, variety in production, quick response time to changes in demand and low cost will be a

competitive advantage. India is the best place to cater to this type of demand and can compete very well with China and other Asian countries in this segment.

- b) India is one of the laggards in mobile penetration with the lowest penetration level in the region of less than 10% while China is at 30%. The developed regions have exceeded 100%. However, this situation be changed considerably by 2010 and Indian market will reach 400 million subscribers and 100 million handsets. We will account for nearly 8% of the world market in 2010. Thus, Indian industry can become a global HUB on the strengths that it would have acquired in various segments of manufacturing, service and other associated activities like growth of companies, marketing skills and design capability.
- c) The sheer volume of numbers in 2012 will create its own velocities, which can cover the nooks and corners of the global market.
- d) The changes will be in terms of both with the design of the handsets which will become smaller and possibly multiple sets will be used by the same person. On the other hand, the usage in terms of application will expand to take over the functions of the traditionally P.C., internet, television and, of course, the landline. This will throw up huge opportunities in the field of software, which can be aimed at both the domestic and world market.

6.6 Targets under the Eleventh plan

The targets for mobile handsets and mobile assessaries are given in Table 20 and 21.

6.7 Status of investments and investment needed to meet the targets

- Current status of investment - approximately 150 million USD.
- Investment needed to meet the target ≥ 1.00 billion dollars.

A deployment of the magnitude of USD 1.00 billion is well within the reach of the private sector since the industry is based on high volume and quick returns with high cash flows. However, significant outlays in public investment are required for:

- a) Design Development, R&D
- b) Training of work force
- c) Development of value added services industry
- d) Monitoring the trends and developments in the industry
- e) Infrastructure development
- f) Interest subsidization of 5% on the lines of TUF (in textiles).

6.8 R&D – Current Status and proposed

The Indian handset industry has just crossed the infancy stage, a few years ago. The market was totally dependent on imports under the official and

Table 20 : Targets for Mobile Handsets

Year		2007	2008	2009	2010	2011
Production Target	Volume Value	25 mln 5000 cr.	34 mln 7500 cr.	52 mln 12000 cr.	61 mln 14000 cr.	72 mln 16500 cr.
Export Target	Volume Value	5 mln 1000 cr.	6.8 mln 1300 cr.	13.3 mln 2400 cr.	17 mln 3000 cr.	22 mln 3700 cr.
Likely India Market	Volume Value	70 mln 24500	80 mln 27200	90 mln 30600	100 mln 34000	120 mln 39600

Table 21 : Targets for Mobile Accessories

Production Target	2007 500 cr.	2008 1500 cr.	2009 4000 cr.	2010 6000 cr.	2011 10000 cr.
Export Target	2007 50 cr.	2008 300 cr.	2009 1500 cr.	2010 3000 cr.	2011 5000 cr.

grey market import. The industry is shifting to domestic production with the expected manufacture of 20 million handsets in year 2006-2007. With this, the industry is ready to support R&D in both the public and private domain for the handset as well as accessory segments.

6.9 Employment Generation

Mobile sets

- Current status – Employment is approximately 3500 people
- Potential – Employment for $\geq 1,00,000$ people (including component sector).

Accessories

- Current status – Employment is approximately 5000 people
- Potential – Employment for 2,50,000 people

The Vision statement envisages growth of the industry to reach the market size of 100 million handsets by year 2010. Given the right policies for fuelling the growth forces in the component and accessories sector, One can expect the development processes to travel down the line. The sector will become a major employment generator to absorb one lakh persons a year by 2010. This has implications in terms of training, curriculum development, skill standardization and testing.

6.10 Thrust Areas

- Battery packs and Charger packs are main areas of demand where high volume low cost assembly operations can make a difference. The small and medium sector can make a difference here.
- Memory Cards, SIM Cards etc., are the second area where competencies can develop. However, these areas will need attention from large size companies.
- Fashion Accessories – The small and medium sector can emerge as the leader in this section. Variety design and relatively small volumes can make the difference here.

7. Industrial Electronics

7.1 Background

Distributed control system (DCS) and discrete control systems, also known as the programmable logics controllers systems are the two end of the Automation Continuum. However the gap between the two technologies is diminishing fast, thanks to the microelectronics and software technologies. The time may not be far when both these technologies will be able to provide total automation solution. This will be helpful to integrate the entire automation system across the plant floor. The market for both these technologies is growing almost at same rate 5.9 to 6% through to 2009 according to the ARC study.

Contributing to overall DCS market growth is increased manufacturing capacity utilization in North America and Japan, while developing economies in China and India continue to add significant amounts of capacity. Capacity utilization in the US, for example, is coming closer and closer to breaking the 80 per cent mark, which, as a rule of thumb, should signal a capacity expansion mode, resulting in increased investment in automation. In the US, productivity (measured as output per hour of all persons) increased by over 4 percent for manufacturing in the second quarter compared to the same period last year.

Europe, meanwhile, is experiencing a downturn in capacity utilization, which for manufacturing is normally much higher than utilization rates in North America. The reason for this is unclear, but may be affected by increased manufacturing growth in Eastern Europe. The EU 25 New Orders Index for manufacturing has also fallen in recent months.

Japan is experiencing a recovery in capacity utilization, with rates over 2 percentage points higher than average levels for the year 2000, marking five consecutive quarters of increase. The near term prospects for Japan continue to look favorable in light of this increased utilization as well as continued supplier reports concerning increased investment for Japanese manufacturers.

Industrial Electronics is a very high technology area needing very high R&D investments. Therefore, there are limited no of global players as far as R&D is concerned. The leading Indian suppliers of the industrial electronics and controls are Siemens, Rockwell Automation (Allen-Bradley), Asea Brown Boveri, Schneider, L&T, Honeywell, Mitshubishi, Emerson etc. A number of small

scale units have also come up in the recent past owned by technocrats having expertise in integrated solutions for automation and control instrumentation and software.

7.2 Current Status including production and exports

As the world economy rebounded to a strong year in 2004, the heightening demand from various emerging markets created robust growth for the Automation market. The worldwide market for PLCs is expected to grow at a Compounded Annual Growth Rate (CAGR) of 5.9 per cent over the next five years. The PLC market was nearly \$7 billion in 2004 and is forecasted to grow to over \$9 billion in 2009, according to a new ARC Advisory Group study.

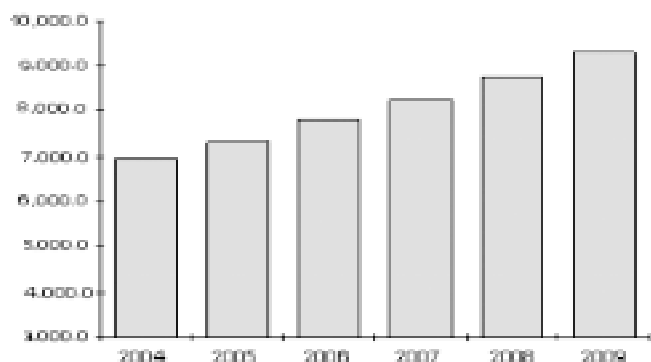


Figure 17 : The Worldwide PLC Market (\$ Million)
2005 ARC Ad in Sony Group

Many elements of modern information technology (IT) are being incorporated into PLCs, raising their attractiveness as a center stage plant floor controller among worldwide manufacturers. Global manufacturers are challenged to seek automation equipment that supports their business objectives such as improving return on assets (ROA), enhancing overall equipment effectiveness (OEE), and providing real-time performance management (RPM). The PLC, being primarily an automation controller designed with modern IT features, plays a key role in supporting these objectives.

With the globalization of Indian business environment most of these companies have their 100% owned subsidiaries in India. They bring their hardware from overseas principals / parent companies and undertake the integration, software development, installation and commissioning work in India. The engineering skills of Indian engineers have developed very highly and now services are being outsourced by their parent companies. Like in IT Industry, the engineering outsourcing is taking roots. Siemens for example has opened an engineering division for outsourcing. Rockwell Automation too has a system architecture validating group to support their regional

customers in Asia Pacific. Some of the companies are in advanced stages of collaborating for engineering outsourcing and next two years, India may become a major source of Engineering and technical manpower outsourcing.

Outsourcing for development of ASIC chips for automation products from India by major Automation manufacturers has already started. Some of the leading IT companies like Wipro, Patni computers, TCS, HCL etc have a numbers of development projects in hand for development of ASIC chips.

Outsourcing of Engineering from India is also gaining momentum. Some of the leading Motor control centers (MCC) and Power Control Centers (PCC) has started at least on trial basis and some of the Indian Panel manufacturers are taking it very seriously. If pursued well and commitments are maintained, this could be another major source for growth for the Indian Electrical and Automation Industry.

Providing 24X7 technical support is one of the major need of the manufacturing plants. Therefore, call centers with 24X7 backup support are likely to be another major growth area for Indian automation industry. At present, the Indian automation industry is growing @ 19.5% approx and is likely to go up with more foreign investment coming to India in future..

7.3 Performance under Tenth Plan

Table 22 : Production of Industrial electronics in Tenth Plan

(Rs. Crore)

Year	Production
2001-02	4500
2002-03	5500
2003-04	6100
2004-05	8300
2005-06	9300

Table 23 : Production of Industrial Electronics in Tenth Plan

(Rs. Crore)

Year	Exports
2001-02	950
2002-03	1400
2003-04	1515
2004-05	1500
2005-06	-

7.4 Technology Status

Manufacturing in various industries has become more challenging due to expanding product variations, increasing production speeds, and growing quality requirements at every stage of the production process. Automation equipment, therefore, is continually improving in the areas of functionality, communication capability, size, software, implementation tools, and diagnostics to meet these rising challenges. The study addresses emerging automation trends as manufacturers increasingly demand the use of open standards for interoperability, multi-control discipline functionality to reduce cost of integration, Ethernet-based network technology, and modular architecture for scalability.

7.5 Future Trends

The Distributed Control System (DCS) market, primarily buoyed by growth in developing countries such as China and India and a slowdown in hardware price declines, has experienced healthy growth between 2003 and 2004. This growth is expected to continue through at least the 2006-2007 time frame, resulting in overall market growth of 6 per cent between 2004 and 2009,

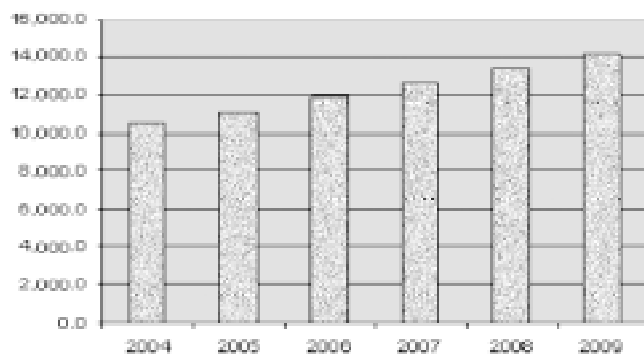


Figure 18 : Worldwide DCS Market 2004-09 (\$ million)

Growth in China and India is compounded by the fact that significant restructuring efforts will need to be made in the North American oil and gas and refining infrastructure in the wake of an unprecedented hurricane season, as well as a return to stronger, albeit moderate growth, in the previously depressed Japanese DCS market.

After years of decline in the hardware business, increased demand and overall market growth have resulted in resurgence in hardware growth. Hardware revenues for suppliers are expected to grow at the average annual rate of just over 4 per cent through 2009, which is a big departure from the declines witnessed in the hardware business in recent years. Most DCS suppliers have retained key business elements of manufacturing and/or design of control hardware.

The automation in all the three areas (Process, Packaging and Warehouse) is driving growth. The emerging markets are driving growth in traditional hardware based products such as PLCs and AC drives during the forecast period. Production Management software is growing very rapidly due to their early product lifecycle phase and market demand for enterprise integration and real-time information from plant equipment regarding material location and tracking remain strong. System integration services are also providing modest growth in the worldwide discrete automation market.

According to the ARC study, the worldwide automation market for the discrete industries experienced robust growth as the global economy enjoyed a strong year of expansion with heightened demand from various emerging markets. The worldwide automation market for the discrete industries is expected to grow at a Compounded Annual Growth Rate (CAGR) of 7.0 per cent over the next five years. The market was over \$27 billion in 2004 and is forecasted to grow over \$38 billion in 2009, according to a new ARC Advisory Group study.

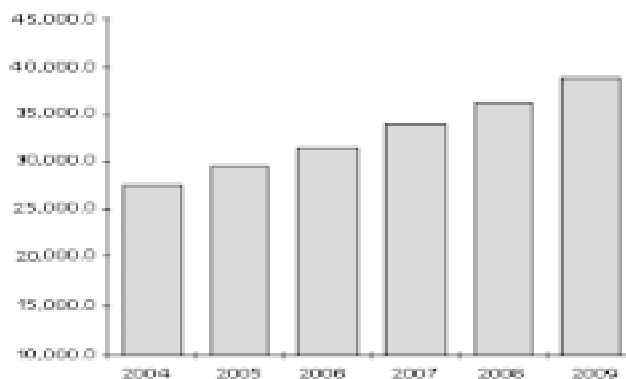


Figure 19 : Total Automation Business for the Discrete Industries Worldwide (\$Millions) © 2005 ARC Advisory Group

Manufacturing companies increased expenditures for automation equipment to set up new plants in Asia and expand production capacities globally. A primary factor contributing to market growth during the next five years is the continued infusion of capital for automation in many industries and regions driven by globalization. Although overall capital expenditures have remained flat in previous years, globalization is causing manufacturers to allocate increased investments in automation in order to drive down costs and raise the quality of their manufactured products.

7.6 Production and export targets for the Eleventh Plan

Investments in most vertical industries including

automotive, construction, chemical and petrochemical, electric power, food & beverage, metals, oil & gas, and pharmaceutical are growing at lightening speed. The increasing demand for a wide range of goods is driving the growth of these industries, and the future outlook for both process and discrete industries is expected to remain optimistic. With PLCs remaining the key automation solution for discrete industries, and their application in process industries expanding, investments in these sectors are powerfully boosting the PLC market in India.

India's economic expansion, accompanied by its rising consumer demand, is propelling the country's manufacturing sector, which in turn is driving the programmable logic controller (PLC) market in India. India's PLC market reached close to \$150 million in 2005 and is expected to grow at an astounding compounded annual growth rate (CAGR) of 19.2% over the next five years, according to a new ARC Advisory Group study, "Programmable Logic Controller Outlook for India".

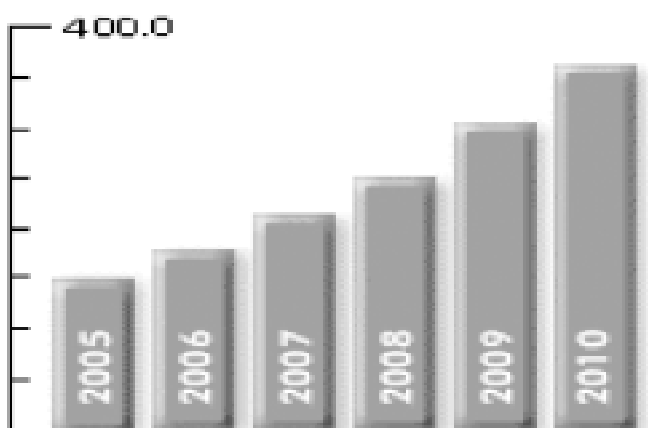


Figure 19 : Programmable Logic Controller (PLC) Business in India (\$Millions)

The country's growing middle class segment, which has more disposable income to spend, is creating a huge demand for a broad range of manufactured goods, fueling the growth of a variety of process and discrete industries in India. The manufacturing sector, which has been registering strong growth over the last five years, is thriving and intensely competitive. This makes manufacturers rely on automation to help them gain a competitive edge and improve profitability. With manufacturers increasing their automation spending, the outlook for the PLC market is extremely bright.

7.7 Status of Investments and Investment needed to meet the targets

Opportunities in infrastructure development, government incentives and stable & growing domestic

market size are factors driving FDI inflows in the Industrial automation sector. USA, Netherlands, Japan and UK account for approximately 70% of FDI inflows in India.

8. Emerging Sectors

8.1 Nanotechnology

Information Technology (IT) is changing the way we work, communicate, organize, conduct business, gather and process information, and even how we play and entertain. In the last 10-15 years, Information Technology has enabled us to have Internet, global economy, ATM, Cell Phones etc., at affordable cost. Broadly, the Internet traffic doubled every six months, wireless capacity doubled every nine months, optical capacity doubled every twelve months, storage doubled every fifteen months and chip performance (as per Moore's Law) doubled every eighteen months. One can get an idea of the impact of this change on the economy from the fact that about one third of the GDP of United States is contributed by Information Technology. Recently, we have witnessed the success of 'Human Genome Project', cloning and stem cell research. Also, scientists have discovered ways to see and manipulate atoms and have met with success in developing some materials with novel properties. Today, we stand at the dawn of a new industrial revolution, much more powerful and profound than the previous ones viz., the industrial revolution few centuries ago and the ongoing information technology revolution. This new revolution is expected to be ushered and dominated by the convergence i.e., synergetic combination, of the following four sciences/technologies:

- Nano: Nanotechnology including Nanoscience
- Bio: Biotechnology and biomedicine including genetic engineering
- Info: Information Technology including advanced computing and communications
- Cogno: Cognitive Science including cognitive neuroscience

Each of these is currently progressing at a rapid rate. These four technologies will learn from each other and contribute in the synergistic development of each other.

Nanotechnology refers to research and technology development at the atomic, molecular or macromolecular level, in the length scale of approximately 1-100 nanometer (nm) range, to provide a fundamental understanding of phenomena and materials at the nanoscale and to create and use structures, devices and

systems that have novel properties and functions because of their small and/or intermediate size. The novel and differentiating properties and functions are developed at a critical length scale of matter typically under 100 nanometer. Nanotechnology research and development includes manipulation under control of nanoscale structures and their integration into larger material components, systems and architectures. Within these larger scale assemblies, the control and construction remains at the nanometer scale. In some particular cases, the critical length scale for novel properties and phenomena may be under 1 nm (e.g. manipulation of atoms at ~ 0.1 nm) or be larger than 100 nm (e.g. manipulation of reinforced polymers have the unique features at ~200-300 nm as a function of the local bridges or bonds between two nanoparticles and the polymer). **Nanoelctronics** is concerned with nanotechnology as applied to the area of electronics and information technology. An example of a commercial product is GMR (Giant Magneto Resistance) heads, introduced in the market in 1997 have served as enabling technology for multi billion dollar (US\$ 30-35 billion/yr) computer hard disk market. The basic principle is: sandwiching several non-magnetic layers, one of which is less than a nanometer thick, between magnetic layers can produce sensors for disk drives with many times sensitivity of previous devices, allowing more data (bits) to be stored on the surface of each disk.

Global Scenario

Nanotechnology, an emerging, disruptive and interdisciplinary technology involving development of nanomaterials, devices and systems, finds revolutionary applications in almost all fields of science and engineering. Nanotechnology, widely regarded as the

next technological revolution, has attracted the attention of scientists, researchers and technologists all over the world and is likely to have a profound effect on almost all industry sectors and application areas. It is expected that this emerging field and manufacturing technology will allow us to arrange atoms and molecules layer by layer as per the physical laws to create desired functionalities of devices. Cognizant of the potential of nanotechnology, Governments in the countries like USA, Japan, Europe, China etc. have been funding R&D in this area for quite some time. In fact, the work in this area in the USA started in 1959 as a follow up of now famous lecture "There is Plenty of Room at the Bottom" by Nobel Laureate Physicist Richard Feynman.

Nanotechnology funding by governments of leading countries is given in Table 24.

About 65% of the research funding in USA has gone to the universities. It is also noteworthy that in addition to Government funding; about US\$ 4.5 billion has been invested by organized corporations in the year 2005. Further the market for products incorporating nanotechnology is growing rapidly. National Science Foundation (NSF), USA estimated that the global market for nanotechnology products would be \$1 trillion by the year 2015. NSF has also projected that the global workforce in nanotechnology industries would be about 2 million by the year 2018. Plunkett Research, USA has estimated that about 1000 companies are working in this field.

India started R&D funding in the area of Nanotechnology during the Tenth Plan and projects with a total outlay of about Rs. 200 crores have been initiated.

Table 24 : Nanotechnology Funding of Leading Countries

Million US\$

Region	1997	1998	1999	2000	2001	2002	2003	2004	2005
W. Europe	126	151	179	200	225	400	650	950	1050
Japan	120	135	157	245	465	720	800	900	950
USA	116	190	255	270	465	697	862	989	1081
Others*	70	83	96	110	380	550	800	900	1000
Total	432	559	687	825	1535	2350	3100	3700	4100
(% of 1997)	100%	129%	159%	191%	355%	547%	720%	866%	945%

(Source : M Roco, National Science Foundation, USA)

* Others include Australia, Canada, China, Israel, Korea, Eastern Europe, Former USSR, Singapore, Taiwan and other countries

Indian Scenario

Recognising importance of Nanotechnology, DIT initiated Nanotechnology Development Programme in the year 2004 with an objective to create infrastructure for research in Nanoelectronics and nanometrology at the national level and also to fund small and medium level research projects in specific areas such as nanomaterials, nanodevices, carbon nano tubes (CNT), nanosystems etc.

Ten projects with a total budget outlay of over Rs. 126 crore have been initiated. These include two major research infrastructure projects at national level : (i) Nanoelectronics Centres – a joint project at IISc Bangalore and IIT Bombay with an outlay of Rs.99.80 crore for a duration of 5 years; and (ii) Nanometrology Centre at NPL, New Delhi with an outlay of Rs.11.308 crore for a duration of 4 years. The Nanoelectronics Centres at IIT Bombay and IISc Bangalore is a unique experience of two leading academic institutions involving 55 multidisciplinary faculty working together on different components of the project. The project also includes teaching and research at PhD, M.Tech and B.Tech level. The Nanometrology Centre at NPL, New Delhi will provide calibration and traceability for line width, step height, surface texture measurement; and calibration of low voltage (nV), low current (pA) and electric charge(fC). The centre will participate in international inter-comparisons and round-robin tests. The facilities available at these Centres would also be available to other researchers, institutions and industry.

Future Plan

Comparing the efforts of India with the developed countries as brought out above, and also considering the multidisciplinary nature of the field involving all branches of Science, Engineering and Mathematics, it is obvious that we have made only a beginning. By and large, nanotechnology is evolving mainly on three axes converging at nanoscale : (a) Progress in Physio-Technical methods have been principal drivers in creating smaller structures in microelectronics – enabling IT revolution; (b) Progress in Chemistry has led to various compounds with potential for applications in catalysis, membrane technology, sensing technology and thin film technology; and (c) The understanding of Biological processes of cellular and molecular levels such as information flow from gene to protein, self organization of molecules and photosynthesis is providing new goals to be achieved by technological means. The challenge is in applying methods and insights of one discipline usefully to others.

Nanotechnology value chain can be profiled as : (i) Nanomaterials, i.e., nanoscale structures in unprocessed form such as nanoparticles, nanotubes, quantum dots, fullerenes, dendrimers, nanoporous materials, speciality polymers etc., (ii) Nanointermediates, i.e., intermediate products with nanoscale features such as memory and logic chips, coatings, fabrics, contrast media, optical components, orthopedic materials, etc.; and (iii) Nano-enabled products i.e., finished goods incorporating nanotechnology such as computers, consumer electronics devices, cars, clothing, airplanes, pharmaceuticals, processed food, plastic containers, appliances etc.. To work on the value chain, we need Nanotools i.e., capital equipment and software used to visualize, manipulate, and model matter at the nanoscale such as atomic force microscopes, scanning tunneling microscopes, nanoimprint lithography equipment, molecular modeling software etc.

In view of the above, it is necessary to set up many more networked multidisciplinary centres of excellence at leading academic institutions for conducting research and developing trained manpower at all levels. Further it is proposed to continue funding small and medium level research projects in specific areas such as nanoelectromechanical systems, thin films, nanosensors, nanodevices, spintronics, nanocomputing, nanophotonics, etc. In addition to creating infrastructure, the best young scientist and engineers also need to be attracted towards higher education and research by way of offering long-term research career and competitive salaries.

Outcome: The programme would enable India to launch major initiatives at global scale in selected area of this disruptive technology which would impact everything man made.

8.2 Optical Communication

Introduction

1. To sustain the growth of I.T. in the country it is now well recognized that the provision of sufficient bandwidth is essential. These bandwidth requirements can only be met through Fiber Optic communication. With the opening up of the telecom area, fiber has been laid across the country by public and private companies. The capacity requirements for the connectivity visualized have been possible and can be substantially increased only through innovative use of optical communication technologies supported by Wavelength Division Multiplexing, Optical Amplification etc.

2. Recognizing the need for bandwidth many companies are putting up High bandwidth networks, however there is not much clarity on the essential needs and on the methodology for this. Each of this is a vendor driven activity and each vendor tries to ensure his own systems and related (proprietary) components are used so that the service provider is bound to the vendor. This also leads to a difficulty of the different Optical systems "Talking to each other". At times this can only be overcome at the Electronic interfaces.
3. Today there is considerable fibre laid in the backbone network and optical technology such as WDM and Optical Amplification have led to large bandwidth availability. The picture is not as good in the access and the access network (The part of the network closest to the individual user) is acting as a bottleneck for real growth of high data connectivity. Penetration can only increase through increased bandwidth for access and low access charges. Supply of large bandwidth upto each computer will need to precede demand.
4. With this large growth of bandwidth and the plans for deployment of new network to satisfy, this need the demand for optical fibre and Photonic-based systems will be very large. A major part of the expenditure by the service providers goes into the Photonics systems, which in turn consist of the sub systems, components and technology. Except for some of the fibres the other equipment, sub systems components are being imported.
5. It is important that a thrust should be provided in the Eleventh Plan to to use this opportunity so that India has a presence as an Optical Communication Technology Developer rather than just a Market.

Thrust Areas for Optical Development

1. Development of 40/100 Gbps systems for Datacom.
2. WDM & DWDM Network and its Protection Aspects as well as the various technological routes for **OADM** (Optical Add Drop Multiplexing). This is an area which is upcoming and have very huge future potential.
3. FLL (Fiber in the Local Loop)
4. Fibre For Cable TV/ ISP On Cable TV
5. Material Growth Technology: The Technology Base for Receiver material, LED material, laser material, Tunable sources as well as pumps, SOA, High power

pumps for Raman etc is III-V Semiconductor technology.

Other Materials required include Dielectric materials, Lithium Niobate, Glass, silica on silicone Raw Material for Optical Fibre and Cables.

Besides, this Novel Materials, Organic and Polymeric material for Optoelectronics could be the workhorse for innovative devices in the long term and justify exploratory work immediately.

6. New Fiber designs : Newer Designs in the conventional type fibres and in the Emerging Area of PCF (Photonic Crystal Fibres-Earlier called Holey Fibres), LEAF fiber, fibers for LASERS, special purpose fibers for amplification, sensing, Polarization maintaining.

8.3 Electronics Materials

Overview

In today's highly competitive electronic and IT industry, manufacturers are constantly challenged to find ways to cost-effectively make faster and smaller electronic devices. One of the most important aspect of achieving these challenges is dependent on the *development of advanced materials and technology*. Nowhere is the ability to produce new materials more crucial than in the electronics and IT industry. Electronic and IT materials are the key elements of continued scientific and technological advances in the 21st century. Electronics Materials are the core for the components production. It constitutes approximately 50% of the total components cost. The electronic and IT materials include;

- Semiconductors
- Superconductors
- Ferroelectrics
- Liquid crystals
- Conducting polymers
- Organic and superconductors
- Conductors
- Nonlinear optical and opto-electronic materials
- Electro-chromic materials
- Laser materials
- Photoconductors
- Photovoltaic

- Electro-luminescent materials
- Dielectric materials
- Nano-structured materials
- Silicon and glasses,
- Photosynthetic and respiratory proteins.

Some of these materials have already been used and will be the most important components of the semiconductors and photonics industries, computers, internet, information processing and storage, telecommunications, satellite communications, integrated circuits, photocopiers, solar cells, batteries, light-emitting diodes, liquid crystal displays, magneto-optic memories, audio and video systems, recordable compact discs, video cameras, colour imaging, printing, flat-panel displays, optical waveguides, cable televisions, computer chips, molecular-sized transistors and switches, as well as other emerging cutting edge technologies. Electronics and photonics materials are expected to grow to a trillion-dollar industry in the new millennium and will be the most dominating forces in the emerging new technologies in the fields of science and engineering.

The rapid progress in the area of development of materials has entered an era of designed materials. The combination of sophisticated and accurate processing equipment and fundamental understanding of materials enable synthesis of materials especially created to have properties required by the design engineer. Moreover, recent developments in materials science and engineering have not only made it evident that the traditional division to metals, ceramics, polymers etc., is

becoming obsolete, but also that the ties of physics, chemistry and process engineering are becoming stronger than ever. The development of multi-functional and adaptable material's new technologies is finding ways to reduce energy, and material inputs.

Effective advanced semiconductor and printing circuit board manufacturing requires a long list of specialized and high purity materials. New materials such as superconducting ceramics and diamond films are likely to shape the electronics industry in the coming decade. As these improved materials are synthesized atom by atom, there will be multiple combinations of atomic assemblies. This will create the possibility of achieving several new structures and properties, enabling new electronic applications. Nanostructures based on inorganic and organic semiconductors, coupled with other complex materials such as polymers, will form the building blocks for many future devices and systems. Researchers are working on a wide range of technologies and sorting out difficulties, which will have a positive impact on the industry. These include elaboration and characterization of very thin dielectrics for gate control, reliance on fewer electron memories, lithographic techniques, and the possibility of optical interconnects. New developments such as holographic data storage and doped conjugated polymers are poised to revolutionize the industry.

Thrust Areas in Electronic Materials for Research

1. OLEDs, high density Optical Storage Discs, high density hard disc materials, photo-resist materials and photoimable and photodefinable.

Table 25 : Global Outlook for Solar power Sector

	2003	2004CL	2005CL	2006CL	2007CL	2008CL	0209CL	2010CL
Production (GW)	0.75	1.15	1.50	2.02	2.62	3.53	4.6	6.00
Production growth (% increase in GW)	50	30	35	30	35	30	30	30
Average installed price (US\$/Watt)	7.00	7.25	7.42	7.44	7.10	6.77	6.39	6.02
Revenue pool (US\$bn)	5.0	8.3	11.1	15.0	18.6	23.9	29.4	36.1
Industry average pre-tax margin (%)	8	15	21	25	25	21	19	18
Pre-tax profit pool (USD bn)	0.4	1.2	2.3	3.8	4.6	5.1	5.6	6.4

Source: CLSA Asia-Pacific Markets

2. Research in futuristic materials areas leading to innovation and technology up-gradation such as;

- Semiconductor packaging materials
- Materials for CRT's and various displays
- Advanced ceramic materials
- Holographic data storage materials and devices
- Superconducting ceramics
- Nano-structured materials and devices
- Nonlinear optical and opto-electronic materials
- Electro-chromic materials.
- Ferroelectric Materials.
- Specialized polymers.

Electronics Materials and Components is investment and knowledge intensive industry and require special attention. For this purpose it is necessary to create an "Electronics Components and Materials Development Fund" with a corpus of about Rs 500 crore to start with. Depending on the seriousness/credibility of the entrepreneur an appropriate quantum of capital should be made available at the subsidized rate of interest. The moratorium period as well as the pay back period could be decided on case to case basis.

8.4 Solar Photovoltaics

Investment opportunities in solar power

The solar power sector has had a very good 2005, with strong stock price appreciation driven by production growing from 1.15GW to 1.5GW, revenue growing from US\$8.3bn to US\$11.1bn and profit growing from US\$1.2bn to US\$2.3bn.

There is a strong conviction that well-positioned players are likely to see enormous growth through at least 2008 and likely 2010 and revenue will grow to at least US\$15bn in 2006 and US\$36bn in 2010, and pre-tax profit will increase to US\$3.8bn in 2006 and at least US\$6.4bn in 2010. This expansion is driven by demand growth that outstrips capacity, limited pricing competition and impressive cost reductions.

Outlook for the solar power sector (Global)

With the energy crises in the world, Solar Photovoltaics sector has become very important. This is an area where large investments are foreseen in the near future. Federal Governments like Japan, Germany, Korea, USA and other EU countries have prepared plans

to encourage production of solar power through Photovoltaics. It is uneconomical and costly and therefore all these countries provide subsidies and viability gap funding in investments.

Table 26 : Indian PV Road Map

Year	2006 (MW)	2008 (MW)	2010 (MW)	2012 (MW)
INDIA	80	200	500	800
WORLD	2000	3500	6000	10000

Table 27 : List of Indian PV Manufacturers

		Present	Expansion (2008)	2012
1	Tata BP Solar, Bangalore	16MW	30MW	100 MW
2.	BHEL ,Bangalore	3MW	30MW	50MW
3.	BEL ,Bangalore	5 MW	10MW	30MW
4	CEL, Sahibabad	5MW	10MW	30MW
5	Maharishi	6MW	-	30MW
6.	Webel, Calcutta	5MW	30MW	60MW
7.	Udai Semiconductor,	1MW	2MW	5MW
8.	Microsol, Hyderabad	2.5MW	8MW	15MW
9.	Moserbaer Photo Voltaic	40MW	80MW	250MW
10.	New Players	-	-	30MW
		83.5MW	200MW	800MW

Investment per MW of solar power is around \$ 2-3 million. Therefore, the estimated investment in this sector to generate 800 MW in 2012 would be of the order of \$ 2 billion.

Additional Support

- All PV implementation schemes are supported by IREDA and banks
- Rate Of interest: 5%-for individual and 7% for commercial users
- Loan Period: 5 years
- Moratorium: 1 year
- Total loan Amount: Up to 80-85% of total Cost
- Upper Limit Of loan: IREDA-No limit, but in bank-Rs 5.0 Lakhs.

Table 28 : IREDA Support

Sr No	PV items	Subsidy Amount (Rs)	Remarks
1.	Solar Lantern (10 Watts)	Rs 1300 or 50 % of ex- works cost, which ever is less	North East & special areas Rs. 3000 or 90% of Ex-works cost, which ever is less
2	Solar Home Systems (18-74 Watts)	Rs 5500 or 50 % of ex-works cost, which ever is less	North East & special area Rs. 10,000 or 90% of Ex-works cost, which ever is less
3	Street Lighting (74 Watts)	Rs 11000or 50 % of ex-works cost, which ever is less	North East & special areas Rs. 20,000or 90% of Ex-works cost, which ever is less
4	Power Plant (1KW-10KW)	Rs 1,80,000 or 50 % of ex-works cost, which ever is less	North East & special areas Rs 3,50,000 or 90% of approved ex-works cost of the system
5	Water Pumping	Rs. 110 per Wp of PV array used, subject to a maximum of Rs. 2,50,000 per system	90% of approved ex-works cost of the system

9. Issues of Concern

9.1 Parallel Imports

Parallel Import – Definitions and Characteristics

A parallel import is visible when brand name imported in the normal course of trade (ostensibly seems to be a legitimate transaction), but is actually carried out by unauthorized distributors.

Typically, this trade has the following characteristics:

- A large proportion is refurbished or the integrity of the goods is altered / compromised. Internal configuration and software may not be as per Indian conditions.
- There is usually a serious element of VAT washing (EU terminology), under invoicing, non payment of State ST/VAT etc. The model details and quantity may be misdeclared at Customs.
- Instruction manuals are either non existent or in foreign language and can be beyond the comprehension of the Indian consumer, who follow English or Hindi.
- There is no list of authorized agents or dealers, who will provide after sales service or replacement warranty/guarantee.
- In some cases, the trade mark of goods produced

for a particular market with special characteristics are diverted into the Indian market at low prices to undermine authorized producers or distributors in the Indian market.

Adverse Impact of parallel imports:

- To the consumer:
 - Consumer, unsuspectingly, buy refurbished, altered, poor specification products without recourse to After Sales Service.
 - Consumer pays the same price as the genuine imports.
- To the Industry/Brand Owners/Trade:
 - Brand owner's reputation suffers because the trade cannot comply with the necessary standards in case of parallel imports. Consequently, the brand reputation suffered.
 - The manufacturing sector suffers because his legitimate market is eroded. Refurbished products are available at approximately 35-50% of the cost of the original.
 - The genuine and ethical trade suffers because of the parallel/grey channel avoids/evades taxes/duties, thereby undercutting the genuine trade margin on ethical retailers and distributors.

Recommendations

- Parallel imports should be banned/severely curbed in the interest of the industry, trade and consumer.

- The Customs Act, 1962 and Foreign Trade (Development & Regulations) Act, 1993 should be amended to recognize parallel imports upfront and declare them as improper. The legitimate brand owner/operator in India and the authorized distributor should have priority over parallel importer in the interest of long term development of the industry.

9.2 Compliance Framework for Safety and EMC Standards

With the proliferation of electrical and electronics goods into all walks of life, the risk and dangers of safety and emissions of electromagnetic radiations have also come into play. Growing dependence on electrical and electronic equipment has made it necessary to ensure that these are safe and electro-magnetically compatible.

Safety and EMC compliance is of utmost importance to any nation since an unsafe good could cause hazards to human beings, property and environment around. EMC involves a larger issue of in-direct risks to society from unwanted radiation and false communications. Being a signatory to WTO, India is obliged to treat Indian manufacturers at par with the foreign manufacturer's. The absence of any framework for seeking compliance of Electro-technical goods to standards of Safety and EMC is creating an unbalanced playing field for the Indian industry. Sub-standard goods are being dumped into the country at throwaway prices putting the Indian industry to the risk of getting wiped out by this un-fair competition.

With diminishing distances and collapsing commercial borders, global trade has become a current day phenomenon. It has been realized that there is a need for supporting Indian electronics on issues related to technical compliance of goods. To begin with Safety and EMC (Electromagnetic compatibility) have gained utmost importance all around the world. Whereas it is impossible to export any non-complying goods to any of the advanced / developing nations, the Indian market is still open and has been left to fend for itself.

Technical compliance to standards in the current scenario would benefit India especially on the following fronts:

1. Enable Indian goods to come up to the international standards and thereby compete in global markets.
2. Put an end to the unfair competition since the foreign manufacturers would also have to supply compliant goods in India.

3. Provide Indian consumers with the opportunity to enjoy world class goods
4. Act as anti dumping measure against of non-compliant goods.
5. Save business interest of entrepreneurs for effective negotiation at International trade agreements.
6. Project a positive image internationally as a country with quality production of IT goods.

Being a signatory to WTO, India is obliged to ensure that products imported from another WTO member are accorded the same treatment as products produced locally. Whereas WTO is against any barriers to trade, it provides flexibility for member countries to specify the requirements in interest of national security requirements, prevention of deceptive practice, protection of human health or safety, animal or plant life or health, or the environment but are not to implement technical requirements that create unnecessary obstacles to international trade and it is in this context that Safety and EMC requirements have been made mandatory by most of the advanced/developing nations. WTO calls for harmonizing relevant technical requirements by member countries to international standards.

Indian manufacturers today have the capability to produce compliant goods and India has the necessary infrastructure to prove this compliance but the efforts are still largely disintegrated. The resources available within the country for certifying compliance of Indian hardware needs to be channelised by bringing out a policy framework. While calling for compliance to Safety and EMC standards, Government need to support Indian industry for upgrading their test facilities and hence the product quality.

Thus, Safety and EMC are the priority areas for electrical and electronics sector. The technical requirements shall be at par with international requirements and compliance mechanism compatible to the world so that the trade is facilitated. While asking for compliance, there is need to provide liberal methodology for compliance in line with global trends and WTO guidelines. The products should be brought under mandatory regime in a phased manner. The prioritization could be done on the basis of the hazards involved. The enforcement shall be strict and any non-compliance observed shall ask for more stringent methodology to be followed for the defaulters. A policy along with the industry associations is to be framed by identifying products, standards and resources to test/certify compliance for the products. We need to bring in a system whereby all available conformity assessment resources in the country

could be pooled in to take the call of large testing and assessment requirements that would be generated. In this regards, the test and certification infrastructure may need to be upgraded. At a later stage issues like RoHS, WEEE, Energy efficiency, Green labelling etc., can also be brought under the scope of compliance.

To implement the scheme of compliance of safety and EMC, Department of IT has initiated the process and set up a Working Group, which will identify the electronics/ IT products to be brought under the compliance mechanism, upgrade the existing facilities in the laboratories so as to meet the international standards. All the stake holders are being involved in the exercise.

9.3 e-Waste

What is electronic waste?

Electronic equipment that is no longer useful but can be reused or recycled. It is often toxic waste. It includes computers, household appliances like refrigerators, freezers, washing machines, electric stoves, microwaves, electric fans, vacuum cleaner, sewing machines, irons, toasters, grinders, clocks and watches, Radio sets, televisions, audio amplifiers, fluorescent lamps, sodium lamps and other lighting equipment – except filament bulbs- are also included. Cost off toys, sports equipment, medical devices, automatic dispensers and monitoring equipment also qualify as e-waste.

Table 29 : Budget for Ensuring Compliance of Consumer, IT and other Electro-technical Goods to Standards of Safety and EMC In Rupees (crore)

S.No.	Heads	1st Year	2nd Year	3rd Year	4th Year	5th Year	Total Budget
1	Upgradation & Set-up of Test Labs						
	To Set-up New Emc Labs (1 Lab Per Year)	25	25	25	25	25	125
	Upgradation of Existing EMC Labs	4	4	4	4	4	20
	To Set-up New Safety Labs (1 Lab Per Year)	10	10	10	10	10	50
	Upgradation of Existing Safety Labs	3	3	3	3	3	15
2	Accreditation Cost, Mutual Recognition Schemes And Participation In International Meetings Etc.	1	1	1	1	1	5
3	Creation of Registration Mechanism	50	20	20	10	10	110
4	Introduction of Promotional Schemes For Industries	10	10	10	5	5	40
5	BIS For Upgradation of Standards and Participation in Technical Committees	2	2	2	2	2	10
6	Advertisements. Campaign Etc.	2	2	2	2	2	10
7	Gap Set-ups for Local Cabs	5	5	5	5	5	25
8	Creation A Data- Base for Registering Mechanism	2	2	1	1	1	7
	Total Budget	114	84	83	68	68	417

How much e-waste do Indian cities produce?

Mumbai topped in 2006 with 11,017 tonnes, Delhi (9730 tonnes) followed. Bangalore and Chennai produced 4,648 and 4,132 tonnes respectively, Kolkata and Ahmedabad for 4,025 and 3,287 tonnes.

As the consumption of IT and electronics products is increasing in the country, the issue of e-waste is gaining in significance. The European Union has issued two directives effective July 01, 2006, one on ROHS (Restriction on Hazardous Substances) and the other on WEEE (Waste Electronics and Electrical equipment). The ROHS directive aims at restrictions on the use of hazardous substances in electrical and electronic equipment and to contribute to the protection of human health and the environmentally sound recovery and disposal of waste electrical and electronic equipment. It aims at limiting the quantity of certain hazardous chemicals such as lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenylethers etc. The WEEE aims at management of electronics waste, especially the reuse, recycling and other forms of recovery of such wastes so as to reduce the disposal of waste. It also seeks to improve the environmental performance of all operators involved in the life cycle of electrical and electronic equipment, e.g. producers, distributors and consumers and in particular those operators directly involved in the treatment of electronics waste.

In India, the issue of e-waste management is in a nascent stage, however Ministry of Environment and Forest and the Central Pollution Control board are gearing up to address the imminent challenges. Unlike the European Union and other developed nations, India does not face environmental degradation due to usage of e-waste as land fill etc., however the challenges are those of combating non-environmental friendly processes of

recycling especially in extracting precious metals from PCBs, burning of cables etc. This is as most of the recycling happens in the unorganised sector.

A pilot project on e-waste management has been initiated in Bangalore with the formation of the Electronic Waste Agency (EWA). Several of the industry associations – MAIT, ELCINA, TEMA, CETMA, NASSCOM along with the Karnataka Pollution Control Board, Ministry of Environment and Forests, NGOs, International research institutions such as EMPA, citizens representatives and the recyclers are active participants in the initiative. The EWA has undertaken several initiatives including drafting a legislation on e-Waste, providing training to unorganized recyclers and conducting several awareness programmes on e-waste management.

Going forward, the challenges are as to how to scale up the EWA initiative in Bangalore and also replicate such an initiative in other parts of the country. Further, being a geographically dispersed nation several organised recycling facilities will be required to be set up at multiple locations across the country, as transporting e-waste for processing to a central location may be prohibitively expensive due to high transportations and logistics costs. Since there are no proven business models of recycling, it will be necessary to subsidise the capital for recycling facilities by the Government. Lastly, there being no legislature or policy on disposal or management of e-waste, the industry and the Government work need to work towards regulation/guidelines for effective electronic waste management in the country.

A number of pilot projects are being developed at different locations in India in a decentralized manner. However, it would be appropriate to develop a National plan with complete infrastructure to deal with the entire variety of e-wastes.

Table 30 : Recommended Budgetary Allocation for e-Waste Project

(in Rs. crore)

		1 st Year	2 nd Year	3 rd year	4 th Year	5 th Year	Total
1	Develop operational framework	4.1	6.3	8.6	9.6	9.1	37.3
2	Develop legal framework	.6	6.1	4.0	2.0	4.0	16.7
3	Develop technology framework	8.0	8.0	6.0	6.0	6.0	34.0
4	develop monitoring framework	6.0	8.0	8.0	6.0	4.0	32.0
5	develop political framework	2.0	2.0	2.0	2.0	2.0	10.0
	Total	20.7	30.4	28.6	25.6	25.1	1,304

10. Recommendations

Therefore, the Group recommends the following Policy initiatives to promote the growth of Electronics / IT Hardware Manufacturing Industry:

Promotional Measures

1. Electronics/IT Hardware manufacturing industry is one of “**Thrust Areas**” of the Government of India. Therefore, this sector needs special attention to address simplification of procedures, self declaration, post audit for import & export facilitation by customs and central excise authorities, infrastructure support, single window clearances mechanism for all state/ municipal approvals, continuous and adequate supply of power and water etc.
2. **Classification of Electronic/IT goods:** There is need to have list of identified products which could be considered under the category of “Electronic/IT Hardware products”. The list must be aligned with Harmonized System (HS) which is followed internationally. These products are to be treated as a single category for all purposes because technologically these are multifunctional and termed as “Infotainment” products. The list of Electronic/IT goods as per HS classification is given in Annexure – I. This is not an exhaustive list and may need to be modified from time to time as the industry is characterised by innovation and fast obsolescence.
3. **Hardware Manufacturing Clusters/ Parks:** GOI should support setting up of Hardware Manufacturing Clusters/ Parks in private sector or public sector or public-private partnership to co-locate the inter dependent units in the same complex. This will help to create virtually integrated units meeting the requirements of each other to the extent possible. This will help the core/mother unit to meet its most input needs from the next door neighbour. These can be created within or outside the proposed SEZs or Manufacturing Investment Regions (MIR) being promoted in the States. These Hardware Clusters/Parks outside the SEZs should be declared as SEZs provided they meet the criteria as specified under the SEZ Rules.
4. **Unification of Manufacturing:** With rapid convergence of consumer electronics, IT and telecom and fast introduction of newer products in the market new vistas for the manufacture of accessories to support the new gadgets are emerging.

Therefore, unification of product categories has to be attempted for manufacturing. Moreover, for mass

production, economies of scales have to be kept in mind. Fragmented manufacturing capacities will fail to produce the desired result. One therefore cannot differentiate production for domestic market and export markets. It is therefore, proposed to amend para 6.9 (g) of the FTP 2004-09 and para 53(I), Chapter VI of the SEZ Rules to allow supplies of all Electronics/ IT Hardware manufactured in the EOU/EHTP/SEZ units when sold in DTA to be counted towards fulfilment of positive NFE condition.

5. **Building Brand India:** Government of India (DIT) may provide financial support to the Industry and Associations as under:
 - i. For participation of SMEs in international exhibitions/trade fairs (limited to space rental).
 - ii. For conducting sectoral studies, impact assessment, growth prospects and other measures for attracting investments/relocation of the industry to India.

Research and Development

6. **Expenditure in Scientific Research:** Deduction @ 150% is allowed under Section 35 (2AB) of the Income Tax Act on expenditure in scientific research in the area of Electronics/IT sector. India has not been considered as R&D hub by the world standards. Investments in R&D by the private sector are miniscule. R&D institutions involved in the basic research lack resources and industry’s support. R&D institutions need to be strengthened not only by the governments support but mainly by industry’s participation in sponsoring the projects. Therefore, it is proposed that deduction @ 250% is allowed under Section 35 (2AB) of the Income Tax Act on expenditure in scientific research in the area of Electronics/IT hardware sector made by the industry in an academic/research institution. Amendments to the Income Tax Act {Section 35(2AB)} may be introduced in the Budget 2007-08. This initiative would help in creating an eco-system in an educational institution which is closely linked with industrial R&D.
7. **International Patents:** Government of India through DIT may consider to provide support in the form of grant-in-aid or reimbursement for registering international patents to the level of 150% of the fee for filing patents and to meet part of the expenses incurred thereof.
8. **Sponsored Research and Development Projects:** Government of India through DIT and other Ministries/Departments may take up special research

and technology development projects in the high tech areas such as flat panel displays, OLED, super specialty electronic materials, optical devices, solar cells, nano technology etc.

For the purposes of funding of activities through DIT, it is proposed to set up an **Empowered Committee under Secretary, DIT** to consider the requests from the industry/associations /institutions. DIT budget allocation may be suitably supplemented by the Department of Expenditure in consultation with the Planning Commission.

Non-Tariff Barriers

9. **Standards for Safety and EMC:** Standards have become very important with the world trade opening up. India does not have mandatory compliance of safety and EMC standards. As a result, non-standard and spurious products are being dumped in the market. Many countries are using standards as non tariff barriers also to restrict the imports. Dumping is also creating grey market and thus the local manufacturing industry is hurt. Therefore, there is an urgent need to have Indian standards for all Electronics/IT products and should be mandated to be followed for manufacture, import and exports. For this purpose, we must build our own capacity to provide testing labs with international level of testing facilities spread throughout the country. For this purpose, Department of IT has set up a Committee under the Chairmanship of Additional Secretary to formulate and recommend measures to implement standards for Safety and EMC compliance. The Committee should complete the work at an earliest.
10. **E-Waste:** With the increase in consumption of Electronic/IT goods, the problem of e-waste is becoming unmanageable in India. Currently, there are no rules and regulations for collecting and treating e-waste. The developed countries are finding different mechanisms for handling e-waste. GOI may provide grant-in-aid upto 50% of the capital expenditure to set up processing unit for e-waste in the country. The Empowered Committee under Secretary DIT may process such requests.

A number of computers and telecom equipments are lying unused for years, occupying space and ready for disposal, especially by EOU/EHTP/STPI/SEZ units. These are not being debonded due to procedural hassles and duty payment on debonding. These units should be permitted to recycle defunct IT products through authorized e-waste treatment plants without the hassle of payment of duty for debonding of such IT products that are being recycled.

Demand Creation Measures

11. Government may consider value addition criteria on all local purchase of Electronic/IT goods by Government Departments and their PSUs. Government Departments and PSUs could lay their own guidelines to provide preference to local manufacturers for supply if technical specifications and prices are matching. This is also being done by numerous other governments.
12. **Depreciation on computers:** Computers are depreciated @ 60% . These are required to be up graded after every 2-3 years and even faster in some cases. It is therefore, proposed that computers should be allowed to be depreciated 100% in 3 years or earlier.
13. Government should take up issues with RBI to consider providing special low rates of interest for purchase of computers by students and Government employees.
14. Government must enforce IT spending of 3% of the allocated budget by the Government Departments/ Ministries.
15. Government should take IT applications as mission mode in e-governance, computerization, telemedicine, IT based education, creating IT infrastructure like internet and broadband. In this context, a detailed report was prepared by the Department of IT, Ministry of Communications & IT titled 'Roadmap for Domestic IT in India', March 2005. Salient recommendations of the report are given in **Annexure – II.**

Fiscal Measures

16. **Total Taxation Level:** A long-term stable policy should be made on taxation. To make the industry competitive and to provide level playing field, the total taxation level for this industry should be brought down to a level of 12-15%. Many of these electronic products like phone, PCs, PDAs, Mp3 Players etc., have a large number of accessories. These needs to be brought to a low taxation level to bring it all into the revenue-generation ambit. Most of these accessories are currently being illegally imported. Also due attention needs to be paid to ensure that the duty on inputs, components and sub-assemblies is not higher than that on the finished goods. Earlier, the computer industry was disadvantaged due to average excise duty on inputs being 7-8% while it was nil on the finished computer. This anomaly was subsequently corrected.

17. Inverted Tariff Structure: Customs duty on all capital goods and inputs for manufacture of all Electronics / IT products may be reduced to 0% on actual user basis. The issue of inverted tariff structure arising out of FTAs need to be corrected.
18. Some of the electronic products have been reclassified under new HSN codes w.e.f. 01/01/07. It is necessary to ensure that the existing duty structure continues to apply to these items with minimal disruption when the change comes into effect.
19. Some of the electronic products are covered under Section 4(a) of Central Excise Act. As per the law Excise duty/ CVD is payable on MRP with prescribed abatement. However, since Excise duty / CVD is paid on MRP minus abatement, the effective rate of duty works out more than the actual rate of duty payable on transaction value. Government should take appropriate steps to rectify the situation.
20. Additional customs duty of 4% under Section 3(5) was introduced to create a level playing field for locally manufactured goods on which 4% sales tax is paid. However, since no distinction has been made between raw material and finished goods, therefore tax incidence on locally manufactured goods have gone up. It is therefore recommended that the Additional customs duty be restricted to finished goods alone.
21. In case of educational and research institutes approved by DSIR, import duty applicable is limited to 5% whereas locally manufactured goods when supplied to such units attract 10% excise duty in the form of Cenvat reversal. This anomaly needs to be addressed to provide equal opportunity to products manufactured in India.
22. There is an urgent need to create a suitable 'single agency' for addressing classification issues and disputes under all indirect taxes. This is as IT and electronic industry is fast evolving and is prone to classification disputes.
23. Exports from domestic tariff area or EOU/EHTP/SEZ must be treated at par. DTA units have to work hard to create export products. Because of lack of proper incentives, they remain in pilot stage and do not get repeat orders. Therefore, Income from export profits of units in the domestic tariff area manufacturing Electronics / IT hardware goods should be exempt from income tax.
24. Sun-set clause in respect of the tax holiday under Section 10A/10B of the IT Act would put undertakings that have registered under the EHTP/EOU at an economic disadvantage, vis-à-vis similar undertakings which have been set up under the Special Economic Zones. It is therefore recommended that the sun-set clause in Section 10A/10B of the IT Act to be extended and realigned for EHTP/EOU with the sun-set clause under Section 10AA of the Act available to SEZs.
25. (i) The supplies to EOU/EHTP units from the DTA should be treated as physical exports.
(ii) DTA sales may be allowed at 50% of the applicable duty without any conditions for EOU/EHTP units.
26. **Interest Subsidy:** Government may consider providing 5% interest subsidy (on project cost and working capital) as viability gap funding for projects in Electronics / IT Hardware sector.
27. **Abolition of CST-**This sector is the first to face zero customs duty due to implementation of ITAs & FTAs, with various countries. The CST is a handicap to the indigenous supplies of raw materials, components, sub-assemblies and finished products, since it is not cenvat. The additional CVD of 4% levied on imports is cenvatable. Therefore, the CST should be immediately abolished.
28. Exemption of State VAT on Diesel for captive power plants Or State VAT on Diesel should be made Vatable for Captive Power Plants.
29. **Simplification of Process for Imports – Periodic Processing:**

The current system of import clearance requires a customs bill of entry to be filed for every shipment. This adds to the transaction processing cost for the importers and the government.

Regular, recognized importers generally have a clean track record in imports and there is not much value add in scrutinizing every single transaction of such importers and this becomes more so when the imports are repetitive.

The Kyoto Convention on Trade Facilitation and as also the Kelkar Committee on tax reforms have stressed on the need to move to periodic processing of imports for recognized importers.

In this process, imports are processed on a periodic basis at an agreed time period interval say once a week or once in two weeks depending on the volume of transactions.

Goods are released on preliminary information either against a secured pre-deposit of duty or payment on a deferred basis and adjusted in a single transaction

filed for the agreed period.

It would reduce the number of transactions to a maximum of 52 per year if processed every week and to a maximum of 26 per year if processed fortnightly. This is irrespective of the volume of imports.

This reduces the transaction costs for both importer and government by 90 % and is major productivity boost in the system by cutting pipe line inventory by 2 to 3 days. **(Annexure III)**

Role of State Governments

State governments equally play an important role in the manufacturing revolution and creation of islands of excellence in the Electronics/IT hardware sector. States create infrastructure, arrange for supply of good quality of power and water, make suitable labour laws, create clusters of high tech manufacturing and provide fiscal incentives such as exemptions from stamp duty, octroi, entry tax, electricity duty and uniform VAT etc., to attract investments in the state.

30. Therefore, State Governments are requested to remodel their IT Policies to consider providing the following so as to create eco system for the investments being made by the Electronic/IT Hardware manufacturers in their states:

Fiscal

- 100% Stamp Duty exemption or
- 100% exemption from payment of Electricity Duty

- Exemption from payment of Octroi / Entry Taxes
- Double FSI (FAR) for units built in IT Parks/Clusters/ HW Parks
- Lower Property Taxes – same as Residential rates
- Minimal Sales Tax rates on locally procured Capital goods
- Power supply at 'Industrial rates'
- VAT at 4% on all electronic goods produced and sold.

Non-Fiscal

- Permission for 24x7 working hours
- No restrictions on employing women workers at late hours
- Relaxation of Labour laws and statutory returns thereon
- Electronic/IT hardware manufacturing units like BPO units treated as 'Essential Services' and 'Continuous Process' units
- Unlimited captive and backup power generation permitted
- Permission for IT units in IT Parks to be 'Independent Power Producers'

Human Resources Development

- Permission for IT units to use school /college infrastructure for manpower training
- University – Industry partnering to develop required skills and curriculum

11. Targets for the Eleventh Plan

Table 31 : Production Targets

(All values in USD Billion)

	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Hardware Market @18% Growth (existing)	27	31.86	37.59	44.36	52.35	61.77	72.89
Hardware Market @30% Growth (proposed)	27	35.10	45.63	59.32	77.11	100.25	130.32
Hardware Production @12% Growth (existing)	12.7	14.22	15.93	17.84	19.98	22.38	25.07
Hardware Production @ 32% Growth (proposed)	12.7	16.76	22.13	29.21	38.56	50.89	67.18

Table 32: % Investment and Exports

(All values in USD Billion)

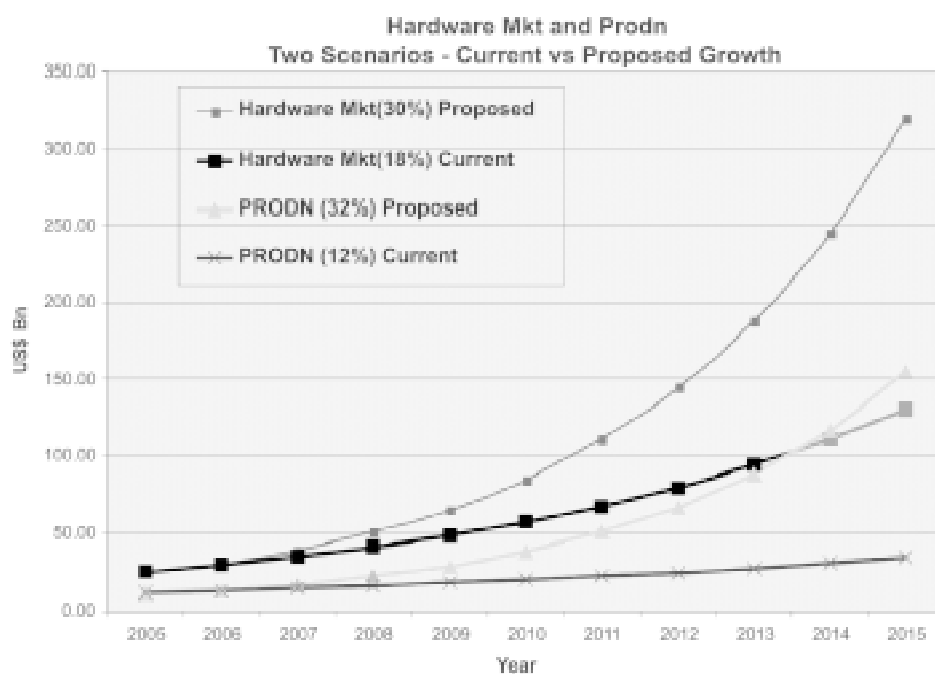
	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Investment	11	15	19	25	34	44
Exports	2.6	3.4	4.3	5.1	5.9	6.7

Tabel 34 : Employment Generation

(Lakhs)

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Direct	5	18	31	44	57	70
Indirect	10	36	62	88	114	140
Total	15	54	93	132	171	210

Figure 20 : Future Projections



Tabel 34 : Proposed Budget for Electronics/IT Hardware Manufacturing

(Rs. Crore)

S.No	Item\Year	2007-08	2008-09	2009-10	2010-11	2011-12	Total
1.	Electronics Components and Materials Development Fund	100	100	100	100	100	500
2.	Safety & EMC Standards	114	84	83	68	68	419
3.	e-Waste Infrastructure	21	30	29	26	25	131
4.	Patent Facilitation	5	10	15	20	25	75
5.	Hardware Promotion Programs	100	150	150	150	150	700
	Total	340	374	377	364	368	1,825

Table 35 : Proposed Budget for Mission Mode Projects by concerned Government Agencies (2007-2012)*

(Rs. Crores)

S.No	Item\Year	2007-12
1.	Installation of PCs in schools across the country (excluding Internet & content)	12,085
2.	Nationwide Telemedicine Grid (with spirometers)	9,931
3.	Development Fund for creation of multilingual software and application	100
	Total	22,116

* Refer DIT report on 'Roadmap for Domestic IT in India', March 2006

12. Conclusions

- World Scale electronics production – US\$ 155 Bn plus US\$ 43 Bn Electronic Design Industry
- Domestic Electronics will make other sectors efficient and competitive
- Revenue Generation will multiply from US\$ 5 Bn to \$52 Bn
- Electronics Hardware production will contribute 12% of GDP
- Employment Potential : 21Mn (7 Mn-Direct, 14 Mn-indirect)
- Inclusive growth for all with substantial opportunities for socially and financially backward sections
- Will enable capability and Capacity for R&D, economies of scale leading to sustainable growth

HS Classifications of Electronic/IT Goods

280461/69, 3818, 701120, 846911, 8470, 8471, 847290, 847310, 847321, 847329, 8473.30, 84734090, 850110/11/12, 85030021, 850431, 850440/50/90, 8505, 850720, 850680, 8517, 8518, 8519, 8520, 8521, 8522, 8523, 8524, 8525, 8527, 8528, 8529, 8531, 8532, 8533, 8534, 8636, 85354030, 8538, 8540, 8541, 8542, 854441/49/51/70, 900110, 90132000, 90138010, 901390, 9030, 9031, 9101/02/03/05/08/09/10, 95041000.

Annexure – II

Key recommendations that can lead to spurt in domestic consumption of IT and lead to significant improvement in IT penetration:

1. Education: IT enabled teaching and IT teaching in education

- Use “catch them young” as the motto to encourage IT learning early in school curriculum. Utilise IT in education as a capability building tool for the population and encourage the development of the country as a knowledge economy
- Encourage both IT enabled learning and ICT training
- Utilise IT to target both primary education and eradication of illiteracy
- Fast track school computerisation programmes that provides IT infrastructure across all government schools in the country along with connectivity and local language software. Mission Mode deployment and Monitoring of the fast track computerization programme
- Create local language “train the trainer” programmes and involve private bodies, government bodies and NGOs in implementing these programmes
- Device a national technology education programme that encourages the creation of content by reputed institutions like the IIT’s and IISC and enable the sharing of the content between institutions of higher education for increasing the quality of higher education
- Provide Content and bandwidth to schools and other educational institutions at a subsidized rate
- Encourage all the government and approved engineering colleges in having a minimum IT infrastructure following the international norms

2. IT Enabled Energising of Rural India

- Government should expand the Village Knowledge Centre concept to all villages and provide computers, software and connectivity
- Use the IT infrastructure not only for the delivery of panchayati raj institutions and e-governance programmes but also for monitoring of crucial development work and increasing transparency and accountability in development work
- The e-panchayati raj and e-governance efforts must be aligned
- Other services that can be offered along with the governance efforts to the villages through the village knowledge centres are – telemedicine, education, weather information, expert advice, e-judiciary, entertainment and news
- The committee recommends the creation of robust infrastructure that can handle the Indian terrain and conditions
- The deployment should consider the ability of the partners to create a service support network which becomes crucial for the actual functioning of the infrastructure laid out
- The power availability in deep interiors can be handled by a combination of battery, solar, human and other renewable sources of energy
- The committee recommends the expansion of the SWAN to cover all villages using different connectivity options like WiMax, Cordect, VSAT etc
- Multi-lingual content and Multilingual Software is essential for deep usage by the villagers and these need to be developed in partnership with NIC and private sector players
- The committee recommends a revenue structure from the villagers on the utilisation of the resources for future up gradation, maintenance and warranty cover

- Training of all the stakeholders is recognized as a critical success factor
- The deployment of IT in the rural areas creates jobs for the local youth. The employment of the village information officers who report into the existing district information officers employed by the NIC creates 6 lakh jobs as there are 6 lakh villages in the country. Maintenance needs creates another 4-6 lakh jobs
- Usage of alternative methods of power generation in running the infrastructure created using human power is a source of additional employment to the tune 12 -13 lakh opportunities.

3. Telemedicine

- It is essential to consider a fast track, mission mode implementation of the National Telemedicine Grid
- The committee recommends the architecture and plan for a functional and quickly deployable National Telemedicine Grid
- The committee feels that a fast track implementation beginning 2006 can be completed by 2008 covering 90% of all village health care centres, primary health care centres, primary health care sub centres, community health care centres, district hospitals and the state capital level institutions.

4. Towards Affordable Computing for Home

- The committee recommends the adoption of a concerted national programme for increasing the penetration of PC in Indian homes on the lines of efforts in developed nations like the UK and Sweden and those done by neighbours close at hand like Korea and Malaysia
- It is felt by the committee that PC remains the primary technology and access device. However it is essential to consider other alternatives like the Personal Internet Communicator, Set top Box, Thin Clients, Mobile Phones, PDAs and smart phones as options of access devices
- Design of a no frills PC in conjunction with MAIT/ IIT's/IISC/C-DAC is a mid term option for the country
- The committee after detailed deliberation has concluded that the fastest and most efficient option to increase the affordability of a PC would be to create multiple financing options like

- i. Easy financing with minimal paper work through public sector banks
 - ii. Mandating of PC finance as a priority sector lending (as was done in agriculture) for increasing the no of banks serving the customers
 - iii. Special interest rates and low paper work in PC financing
- Government servants and public sector employees must be offered loan schemes (at all employee levels) for encouraging PC adoption amongst this easily reachable group
 - Post office, employee provident fund, pension funds and other savings funds would be alternative ways of funding PC adoption as was done in Korea, Malaysia, Indonesia and Thailand
 - Public sector telecom companies can tie up with PC manufacturers in creating a subscription model that combines PC with internet connectivity and thereby bringing the cost of PC down while making it more useful to the household by being connected.

5. IT for SMB and Social Sector

- The committee finds that only 17% of SMB's in India are computerized and a concerted effort in this direction is needed to increase the productivity in this segment and to create greater PC penetration in the country
- 100% depreciation offered on IT investments by SMB's reduce the cost of the PC for smaller organizations encouraging them to computerize
- Encourage the flow of retired assets to the social sector. The depreciated assets when directed into the social sector can be used for driving adult literacy, which will be the cornerstone for development in the country. Literacy drives can be taken up with software created by various private sector firms like TCS for this purpose. This can result in 12-14 lakh people being made literate in a year. In a 4 year time frame this is equivalent to training 15-20 crore adults in the country.
- A fund must be created in which can be used to encourage local ISV's and other software developers in creating software and content in various Indian languages
- The committee feels that there is a need for creating affordable broadband connectivity to this sector

- Appropriate applications software is another priority. In particular, applications of direct relevance to the SME's (small scale manufacturing, small retail outlets and other small businesses like restaurants, etc) have been neglected and need attention.

6. Campaign Promoting Domestic Hardware: Government– industry Partnership

- It is recommended that a multimedia campaign be launched that will communicate the value-proposition and the benefits of having a PC, which will in-turn positively impact its desirability and thus create a demand-pull
- The broad objectives that this campaign should address are:
 - i. To increase the awareness of “PC”
 - ii. To showcase the importance of PC in our lives/businesses
- It is recommended that this campaign be run for around 6-7 months. A campaign of this nature could need a budget of about 20 crore.
- The Department of IT should facilitate arranging of special rate for the print media (say DAVP) and also special rates from Prasad Bharti/DD.

7. E-governance

- The committee is of the opinion that E-governance plays a very important role in developing domestic IT infrastructure. A compelling reason for use of PC and internet in India will be largely driven by e-governance and citizen centric services offered by the government
- The committee feels that the National Citizen Database with the National ID card will prove to be the corner stone for the e-governance drive in India
- The State Wide Area network is an excellent initiative in creating an IT infrastructure backbone on which all the other projects can be based on. However deepening the reach of the SWAN is essential. The SWAN must penetrate to the village level
- As a part of e governance delivery the connectivity of SWAN to village can be achieved in addition to leased lines and dial ups, through
 - i. WiMax

- ii. Satellite (ISRO/NIC work in this direction in other sectors have been successful)

- iii. Tenet like solution from IIT Chennai

- There are a number of other e-governance initiatives being undertaken by various states; with many more are still on the planning board. However though there have been a no of successful programmes, these have remained state level initiatives or at the pilot level. It is essential to upscale these programmes. These also have to be taken up on a mission mode at the central level for faster implementation by 2008.
- Alternative routes of delivering e-services to the villages must be considered like
 - i. Post offices
 - ii. Village STD booths
 - iii. Village telephone exchanges
- Currently there are no standards by which government removes hardware from the departments. It is recommended that the government clearly define this to be four years of usage as the technology life is not more than 3-4 years. Also the redundant computers must be collected and sent to the social / NGO sector.
- Due incentive must be provided for citizens who interact on-line.
- It is suggested that the Income Tax Act may be amended to include deduction of Home PC purchase price, under the recently created section 80c, till 2010.
- There is a need for development of IT Hardware Parks. Industries promoted in these parks should be seen in relation to each other – forward and backward linkages in the value chain.

8. Internet penetration: A key to PC penetration and domestic IT growth

- In order to motivate all users and service providers to use more and more bandwidth and considering that the incremental cost of providing multiplexed bandwidth is marginal, the price multipliers for E1:DS-3:STM-1 should be kept around 1:4:10 in line with the international trends rather than 1:8:23, as notified by TRAI
- The Public Sector Telco's have the highest level of wire line penetration into homes across the country. This infrastructure must be shared on a

win-win basis with companies with Internet services delivery experience, and the technological capability of ushering in a broadband revolution

- National Frequency Allocation Plan (NFAP) was due for revision w.e.f. 1st January 2004 but this should not be delayed any longer. Adequate provisions must be made for 4G type technologies like Wimax
- ASMS (Automatic Spectrum Management System) set up in WPC under the World Bank project must become operational latest by 1st April 2005
- There exist numerous alternate technologies for internet access like cable, DTH and local initiatives like the Tenet from IIT Chennai. The committee feels that there is an urgent need to promote such alternative technologies which create choice for consumers and encourage greater usage
- It is strongly recommended that all the incumbent broadband operators like BSNL/MTNL are encouraged to move towards a subscription model for broadband and PC as a package
- Besides local context and local language, local hosting is very important so that the benefits accrue to all stakeholders. This can be incentivised by treating the revenue from web hosting within India as deemed export under appropriate scheme.
- Besides, all ISPs must be mandated to route the traffic to and fro other Indian ISPs within the country and here, NIXI can play its true role.
- Use of Digital Signatures must be incentivised to promote online transactions of all sorts (G2C, G2B, B2B, B2C & C2C).

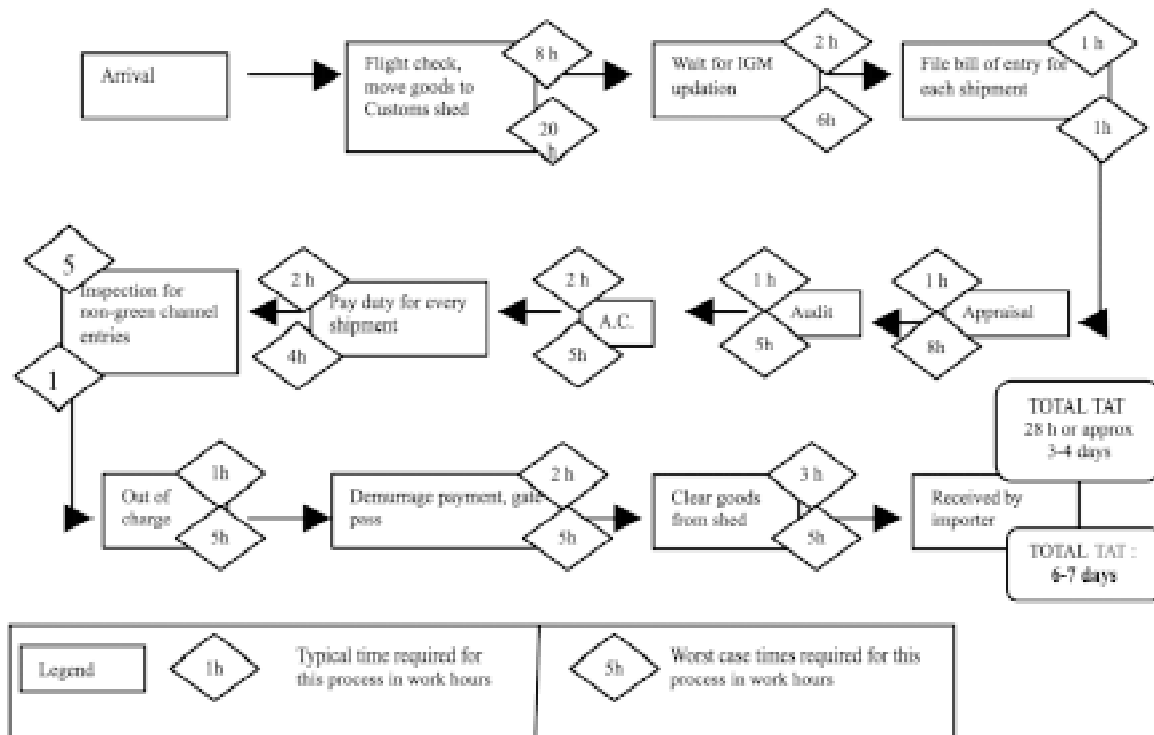
9. Multilingual Software, Applications and Content

- The committee feels that that indisputable fact is that the market for PCs in India will go up dramatically when the applications running on them are useable by more than 50% of the population rather than by restricting them to a mere 5% of the English speaking population
- In the medium and long-term, multiple (Indian) language software and content is essential, so that penetration extends beyond the limited English-knowing population. In the short term too, content in various Indian languages is essential, but software could be in English since the extent of English-language knowledge required for this purpose does exist. As noted,

further (long-term) growth will require multi-lingual software.

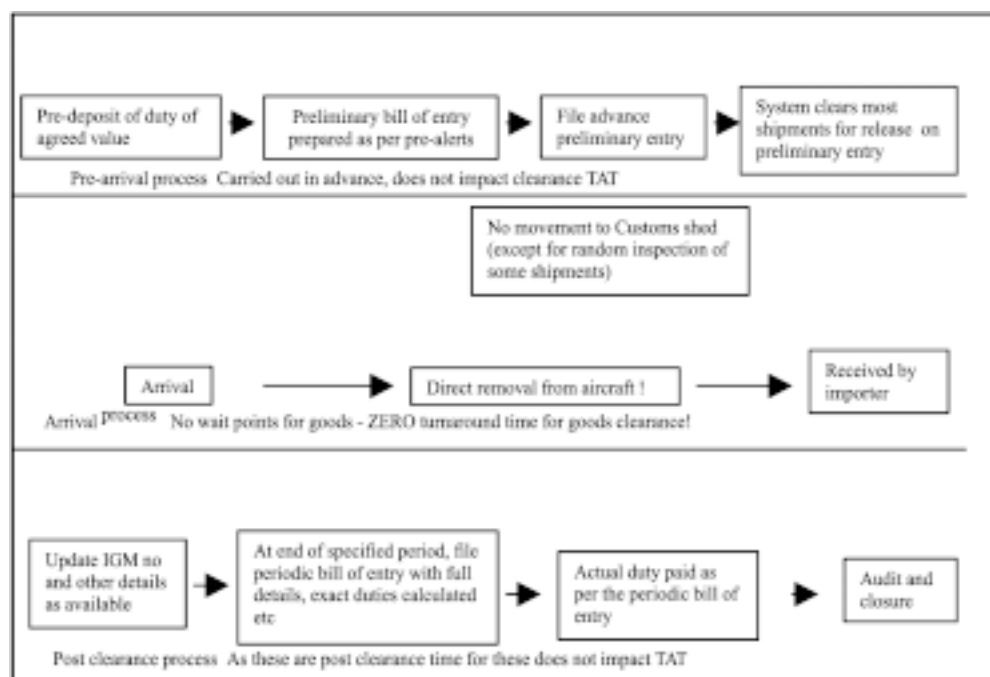
- The Government must create a web-based repository of best practices for content, software and language based applications and this must be available in the public domain (free)
- The State and Central Governments must be mandated to deploy Local Language interfaces on the citizens front/citizen services; and
- The Government needs to play the role of a catalyst and facilitator- it has to handhold and ensure technology transfer to the public and vendors
- The committee feels that industry associations like NASSCOM/MAIT can work on identifying key SME segments and applications to address as a start. For this the government can create a Rs. 100 crore fund to create to develop such applications and software on priority.
- Industry Associations can take up the mandate of evaluating and certifying language software; and
- Industry Associations will need to champion the cause of the industry with different stakeholders. Public conferences, leveraging mass media and establishing thought leadership will be crucial for the sustenance of the Industry
- Vendors need to ensure a wider availability of their products and solutions for their prospective customers. While traditional distribution channels need to be utilised, vendors will also need to ensure that their products are available with DGS&D (Directorate General of Supplies and Disposal) and Apna Bazars (or similar such channels) for easy purchase by Government
- A cohesive integration of the Academia and Research Institutions with the Local Language IT ecosystem is likely to positively impact the efficacy and efficiency of technology and product developments
- The Academia and Research Institutions should form alliances with the Vendors or bid for sponsorships from Vendors for Local Language IT application development;
- Academia and Research should take a lead in publishing local content from epics and other traditional literature.
- Finalization of standards at multiple levels, viz. for font, for script, for indexing and for hardware products should be taken up on an urgent basis.

Periodic Processing



Current Process – Old Manual Process now under EDI

Recommended – Simplified Process



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- Report - 'Road map for Domestic IT in India', March 2005 by Department of IT, Ministry of Communications & IT.

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Exports of Computer Software and Services

1. Executive Summary

1.1 Background

India's success in the export of Information Technology (IT) Software and Related Services over the past decade remains unparalleled. Total export revenues earned by this sector have grown from INR 6,723 crore (US\$ 1.8 billion) in 1997-98 to INR 104,500 crore (US\$ 23.6 billion) in 2005-06 and are forecast to reach INR 139,700 crore (US\$ 30.5 billion) in 2006-07. Today, India is regarded as the premier destination for the global sourcing of IT and IT-Enabled Services (IT-ITES). India now accounts for 65 per cent of the global market in offshore IT and 46 per cent of the ITES market. Of the total 117 companies certified at Level5 of the SEI-CMM, 80 (65 per cent) are Indian. A majority of the Fortune 500 and Global 2000 corporations are sourcing IT-ITES from India.

The growth of the sector has led to tremendous pay-offs in terms of wealth creation and generation of high quality employment. Market capitalization values of leading Indian IT companies now exceed those of global competitors (even though the latter have higher revenues), and the exports segment of the Indian IT-ITES sector directly employed over 920,000 people in 2005-06. In addition to the direct economic impacts, growth of this sector has also indirectly contributed to economic and employment growth in other parts of the economy such

as the increased demand for commercial and residential real estate, catalyzing urban development, and playing a significant role in driving demand for other commercial services such as retail, hospitality and transportation, etc.

With only 10 percent of the US\$ 300 billion market potential addressed so far – there is significant headroom for growth. Further, with the global offshoring market continuing to grow rapidly, as the proven benefits of offshoring (also termed global sourcing or global delivery) induce more and more companies to adopt these practices and providers develop the capabilities to offer more sophisticated products and services – the size of the overall pie is also expanding.

India is fundamentally advantaged and uniquely positioned to sustain its global leadership position, grow its offshore IT-ITES industries at an annual rate of 24-25 percent, sustain nearly 10 million jobs, and generate export revenues of about US\$ 86 billion by 2012.¹ Additionally, this export growth can be further accelerated through deep and enduring innovation by industry participants. Such extensive innovation could generate an additional US\$15-20 billion in export revenue over the next five to ten years.

Key service lines, vertical markets and new emerging areas identified include:

Table 1 : Performance of the Indian IT-ITES (Exports) during the Eleventh Plan (2002-07F)
(US \$ billion)

	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07F	CAGR	Targets	Status
Software and Related	7.7	9.5	12.8	17.7	23.6	30.5	31.7%	50 by 2008-09	On Track
Services Exports								60 by 2009-10	On Track

Source: Tenth Five Year Plan, NASSCOM

¹ In his address at the special session of NASSCOM-2006 India Leadership Forum, the Hon. President of India Dr. A.P.J Abdul Kalam had asked the industry to "aspire to increase our market share to \$200 billion in the IT services, ITES and BPO sector". While the targets presented in this report are relatively modest compared to this aspiration, our analysis indicates that certain concerns and challenges need to be addressed urgently for the industry to even achieve these targets. These issues have been analyzed and required policy actions have been recommended. Further, it is proposed that a committee be reconstituted to conduct a mid term review of the progress on recommended policy action and their impacts and may consider an upwards revision of the industry revenue targets, based on the observed success.

1. Service lines

- a. R&D and engineering services
- b. Consulting services
- c. System integration
- d. Application development and maintenance
- e. Traditional IT outsourcing
- f. Horizontal services (finance accounting and administration, customer interaction services, human resource administration, research, etc.)

2. Verticals

- a. Banking
- b. Insurance
- c. Manufacturing
- d. Pharmaceuticals
- e. Travel and hospitality
- f. Animation, media and entertainment

3. Areas for focussed research

- a. Security
- b. Mobile and communications
- c. Health, biotechnology and life sciences
- d. Energy and Environmental protection
- e. Nanotechnology

This represents a 'make or break' opportunity, capable of catapulting us into a high growth orbit, on the fast track to becoming a developed nation. This opportunity will not last for ever. Given that we are closely chased by countries such as Russia, Ireland, China and few others in East Europe to grab a piece of this pie, we have all of 5-10 years to make the leap.

The benefits of global leadership in these knowledge industries go far beyond the economic dimensions. As major global companies offshore more mission-critical work to India, their dependence on India increases, giving our country significant strategic leverage.

Achieving these ambitious outcomes will require breakthrough collaboration amongst industry players, central and state governments, and NASSCOM & CII to ensure that appropriate actions required to maximize the global sourcing market potential and sustain India's superiority as the preferred sourcing destination are executed in a timely manner.

To that end, this report outlines the policy actions required in five key areas: 1) Improving the supply of suitable talent; 2) Building adequate basic, business and social infrastructure; 3) Ensuring a favourable policy and regulatory environment, with a special focus on encouraging SMEs and new ventures; 4) Global trade development and promoting global free trade in services; and 5) Fostering a sustainable ecosystem for innovation and R&D.

Further, while this report has focussed its analysis to the drivers of and barriers to India's growth in exports, the group would like to highlight that any efforts to this end will remain incomplete without active linkages with development of the domestic ICT market. Key aspects of domestic market development that will indirectly help strengthen India's position in the exports segment include; a) the development of IP led innovation in products suited for low-cost / emerging markets; b) training ground for IT-ITES professionals; c) IT adoption in core sectors such as defence, energy, communications and security – leading to high usage as well as demand for indigenous suppliers.

1.2 Recommendations

Based on a thorough assessment of the key challenges and constraints to the continued growth of the Indian IT-ITES exports, the working group recommends the following policy actions:

1.2.1 Improving the supply of suitable talent

1. To supplement skills in the existing pool of (unemployable) resources, the government should initiate a nationwide 'finishing school' program. The industry should put together the curriculum and faculty for this. However, other costs will have to be covered by student fees and it is recommended that the government provide subsidy/loans for this. It is estimated that piloting this project across 6 cities (estimated 30,000 'students' per year) will cost INR 25-30 crore per annum.
2. To enhance the pool of experienced, mid-level managers, that are willing and suitable to work in the IT-ITES sectors, it is suggested that a 'bridge course' be introduced to equip professionals who may not have read for a course in IT (e.g. civil engineers, people with degrees in mathematics and physics etc.), but after having worked for a few years (in their respective fields) want to branch into the IT-ITES field. The advantage of such bridge courses will be that professionals will have an opportunity to pursue

careers of choice without being constrained by their academic qualifications, the cost of such a program will be lower (as by definition these courses will be meant to bridge the gaps in their academic background and not make them go through a full 4-year degree), experienced professionals will be in a position to afford these courses (as they have been working for a few years), such a program will directly address the need for project management expertise – which these experienced professionals are likely to have acquired in their respective fields, and will now be in a position to apply them to IT.

3. Re-orient the education system to make it demand-based with the focus on ensuring employability of graduates through high-quality, relevant, need-responsive curriculum and teaching. Initiate an intensive program of curriculum updating/development and teacher-training, to address lacunae in relevance, topicality and pedagogic methods. This must be a joint academia-industry effort.
4. Expand capacities at and the number of world-class institutions (e.g., IITs, IIMs, IISc), while ensuring that quality does not suffer. Plans for upgrading the National Institutes of Technology (formerly Regional Engineering Colleges) need to be put on a fast-track. New technologies of pedagogy, such as ICT, broadcasting, etc., must be introduced to provide wider access to high quality education, to overcome the shortage of teachers and to increase capacity. Funds required for upgrading existing NIT's (19) to IIT grade estimated at INR 2,850 crore. It is recommended that an additional 5 per cent (INR 150 crore) be earmarked for promoting distance education from these institutes to other institutes.
5. Decentralize the education sector governance model, increase transparency and ease operational inflexibilities. Also encourage private sector participation in the education sector.
6. Introduce standardized National level tests (similar to SAT, GRE, AGRE, MAT) which may be recognized internationally for benchmarking of students seeking the admissions in Undergraduate and Postgraduate institutes in all colleges in India and abroad. It will help to save resources and ensure the quality of students' entry in bench marked institutes. This will result in the consistency in quality of student passing out from a specific institute.
7. Rating and accreditation by an independent agency must be mandatory for all educational institutions. The present system of accreditation needs to be radically altered to include users and to place

emphasis on quality of output (graduates) rather than on physical infrastructure. Feedback from the key users of the output, i.e., the industry, must be an integral part of the accreditation process.

8. Given the varying standard of different institutes, a common nation-wide benchmark for assessing graduating students is also necessary. The inclusion of industry needs in this assessment will make it useful for recruitment. It will also ensure that colleges or training institutes include these specific elements in their curriculum. A series of such benchmarks need to be created to certify candidates as being suitable for different levels of jobs, beginning with the entry level. The IT-ITES sector has already begun work on the first such certification (for entry level in the BPO industry), this initiative needs to be supported and institutionalised by encouraging universities across the country to participate. Eventually, it should evolve into something along the lines of Chartered Accountants Exam.
9. As an immediate measure to address faculty shortages, increase the retirement age of faculty to 65 years.
10. Provision budgets for a significant increase in the number and value of scholarships offered to encourage a far greater number of graduates to pursue Masters and Doctoral programmes.
11. Remove constraints to make teaching / academics as attractive a career option as working in the industry. Unshackle institutions for higher education from restrictions on fees and faculty remuneration.
12. Formalize international (mutual) recognition of academic degrees and certifications, and encourage internationally renowned academic institutions to establish campuses in the country. This will not only help enhance the international acceptability of the Indian education system but also attract some of those Indian students currently going abroad to pursue higher studies – to remain in India.
13. Encourage students and working professionals to pursue further education for skill enhancement by providing tax incentives.
14. Encourage active involvement of industry in university-level education to make the graduates more employable. To this end, it is recommended that a portion of the education cess be earmarked for the tertiary level and that this fund be administered by a joint government-industry-academic group. The group should decide on programmes and funds disbursement, and be responsible for monitoring and evaluation.

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15. Periodic review and updating of curriculum to make it more industry-oriented will also require faculty to constantly upgrade their skills. This can be best facilitated by greater industry-academic interaction; instituting a process to accredit faculty and mandating that a certain amount of time be devoted to retraining in the industry on a periodic basis.

1.2.2 Building adequate basic, business and social infrastructure

1. Strengthen the intra-city road network and public transport infrastructure to decongest existing hubs.
2. Decentralize the industry beyond existing hubs by developing new townships. Action will need to be taken across various fronts including: master plan development, model financial arrangements, land acquisition and auction, proper re-settlement of displaced persons, aviation and transportation planning, and educational linkages.
3. In Union Budget 2006-07, the Government had announced the development of 1,000 kms of access-controlled Expressways. These will be on new alignment and built on the Design, Build, Finance and Operate (DBFO) model. The sections that have been identified are Vadodara-Mumbai, Delhi-Chandigarh, Delhi-Jaipur, Delhi-Meerut, Delhi-Agra, Bangalore-Chennai and Kolkata-Dhanbad. The concessionaires will be selected through an international competitive bidding process. It is recommended that an electrified double track for high speed trains (Similar to TGV of France and Bullet of Japan) along these access controlled expressways also be planned for faster public transport between these cities.
4. While the quantum of public investment needed to build the required infrastructure has not been estimated, an assessment of the likely demand for capacity in key elements, such as commercial real estate, housing, transportation etc., has been taken into account while formulating the proposed policy alternatives to address the industry's requirements. It is recommended that the Government assess its ability and willingness to fund the required infrastructure demand and focus on creating an enabling policy environment that encourages private sector participation for the balance – ensuring that a lack of funds is not a hindrance to progress.

1.2.3 Ensuring a favourable policy business policy and regulatory environment, with a special focus on encouraging SMEs and new ventures

1. *Continue the Benefits Provided by the STP Scheme*

- a. Establish a level playing field for the STP and SEZ schemes, by exemption from corporate income tax under the relevant provisions of section 10AA of the Income Tax Act, 1961 for all units meeting following criteria:
 - i. Units must be registered under the STP Scheme
 - ii. It must be a unit registered after 31st March 2006
- b. Exemption from corporate income tax for residual years (i.e. corporate tax incentives to continue until the units complete the 10 year tenure) under the relevant provisions of section 10A and 10B of the Income Tax Act, 1961 for all units meeting following criteria:
 - i. Units must be registered under the STP Scheme
 - ii. Benefit under section 10A and 10 B to be available till 31st March 2014
- c. Extension of exemption from corporate income tax under section 10A and 10B for SMEs
 - i. For a maximum of 10 years
 - ii. Till year 2020
 - iii. Not having an equity stake of more than 11% by a company (worth more than INR 100 crore).
- d. Direct exemption from payment of service tax/ Central Sales Tax under section 65 of the Finance Act, 1994 (32 of 1994) be given to the units registered under the STP Scheme

2. *Strengthen the IP Protection, Data Privacy and Information Security Environment in the Country*

- a. Conclude and implement the amendments to the IT Act.
- b. Review the APEC Privacy Principles framework as a model for India.
- c. Mandate computerization of police and criminal records, as well as judicial system across the country
- d. Facilitate a robust mechanism to prevent identity theft; encourage the use of the National Skills Registry / establish a national personal identity system

- e. Establish 5-6 world class centres of cyber crime and dedicated courts for fast track resolution of IP related disputes in the country.
- f. Review national security policies to protect critical infrastructure of national importance from vulnerabilities to technology enhancements (e.g. defence establishments, dams, etc.).

3. Support SME Segment Growth

- a. Ensure that SMEs can continue to leverage the benefits offered under the STP / SEZ scheme without constraints on where they may be located.
- b. Encourage the use of SME / domestically developed IP in e-governance projects.
- c. Explore tax depreciation and investment credits for investment on SME / domestically developed IP by Indian industry.
- d. Large companies (e.g. with a turnover of over INR 100 crore), may be offered tax benefits on costs incurred for goods and services procured from domestic SMEs through a subcontract model. This measure will boost SME growth in the sector.
- e. Government may allow tax deduction of up to 20 per cent of taxable income, to all IT-ITES professionals working with SME companies for a minimum period of two years.
- f. Specific focus on SMEs in trade development initiatives (discussed in the subsequent section on the initiatives for global trade development).
- g. Enable increased creation and mobilization of venture capital funds for technology (discussed in subsequent section).

4. Ensuring adequate access to venture capital

- a. There is an urgent need to stimulate seed and angel-funding for start-ups. In the knowledge sector, much of the new breakthroughs and interesting products come out of such start-up organisations. Encouraging and fostering them must, therefore, be a key element of establishing India as a major player in the innovation/knowledge-creation arena. The angel-funding available to new start-ups in India is yet very limited. Rather than the government directly providing such funding, we suggest that it stimulate the evolution of a professional seed-funding community. To do this, we recommend the creation of a fund that underwrites ("insures") a certain percentage of the seed-funder's investment in a start-up. This will stimulate the appetite for risk, and get more funds into this space.

- b. Government must relax constraints on institutional investment in domestic venture funds, starting with institutions, which were earlier allowed VC investments.
- c. SEBI should register groups of high net worth individuals located in India or overseas, who meet the criteria of being independent investors, as accredited investors and offer them the same rights (including tax pass-through privileges) as registered VC firms.
- d. Government, acting jointly with its counterparts in other countries, should use public resources to facilitate partnerships between Indian and foreign venture funds by underwriting downside risks. The Indian partners for such an exercise should be chosen on the basis of their track record in venture investing, their domain knowledge and their willingness to commit their own resources.
- e. Central Government should establish an Early Stage Venture Fund, under the auspices of the DIT and the major non commercial research organisations of the Government, through a public private partnership would plug this gap. The initial corpus of the fund would come from existing schemes of these departments for promoting entrepreneurship supplemented by additional public and institutional resources. (Such government institutions tend to be research oriented and commercially risk averse. The public private partnership would club this gap.)
- f. Government should enable the creation of limited liability corporations (LLCs) through an amendment on redeem-ability under the Companies' Act. It should also extend the applicability of such LLCs and the proposed limited liability partnership (LLP) structure to venture capital funds. (Worldwide this structure is used as it provides greater flexibility as well as tax transparency).
- g. Fiscal incentive in the form of a set-off against taxable income be provided for individuals who invest in :
 - i. Start-ups emanating from incubation facilities in research institutions, or
 - ii. Domestic venture capital funds under Rs. 250 crore whose charter clearly states that the VCF would be investing primarily in seed stage companies.
- h. Allow venture capital firms the same advantages that are offered to OBU's in SEZ units.

1.2.4 Global trade development and promoting global free trade in services

1. Focus on negotiating bilateral visa agreements for Indian professionals to work in countries such as France, Germany, and Japan, besides further improving the position with regard to the US and UK.
2. Work towards “free trade in services” agreements with US and UK.
3. Department of Commerce may take up the matter in Bilateral Trade Agreements for Software industry with countries such as France, Germany, Japan, US and UK for taking full commitment in Mode 4 (Presence of Natural Persons) for Market Access and National Treatment, Mutual Recognition of degrees and issue of visas.
4. Further strengthen the Incredible India! branding campaign and run it regularly in key international media. Undertake directly, or through trade associations, a campaign to promote open markets and free trade in services in countries of interest.
5. Direct Indian missions to assist all organizations like ESC, NASSCOM, CII and STPI in their trade development programs. Allocate a budget of INR 250 crore over the plan period for central collection and dissemination of market intelligence. This may be facilitated through organizations like ESC, NASSCOM and STPI.
6. Marketing costs for exports in particular in developed countries may be subsidized in respect of the following:
 - a. Cost of advertisement in well known media for innovative products and services, which have already shown adequate market potential.
 - b. All tender costs and cost of follow-up visits as per funding which can be offered through the Market Development Assistance Scheme.
7. Expand the focus of the market access and development initiatives to include all SME units not only for ‘Focussed Areas’ but also for main IT markets such as US, UK, as well as newer markets. Establish incubation centres and shared services facilities (for onsite marketing etc.).
8. Increase industry participation and coverage of the schemes by collaborating with all the key organizations like ESC, NASSCOM, CII and STPI to

increase awareness and include more companies as beneficiaries of these schemes.

1.2.5 Fostering a sustainable ecosystem for innovation and R&D

1. Set-up an Advanced Projects Agency (APA) that drives technology research at central and state government level, facilitated through a public-private-partnership model, on a scale large enough to make an impact.
 - a. This agency would have its own budgetary allocation and fund research at India’s premiere institutions (including private sector companies) on technologies and scientific capabilities that will strengthen the Indian economy and state. It is recommended that the budget allocation for government sponsored technology related R&D spend during the plan period should be at least INR 70,000 crore and should be pegged to the industry revenue targeted in each year.
 - b. The grant allocation process should be open, fair, and transparent to motivate India’s best researchers to submit research proposals. Who will own the IPR is an issue that must be clearly defined at the start to avoid any dispute later. More than one model can be explored from an outright sale of the right to the ‘invention’ or some form of revenue sharing model with a defined time-frame. To facilitate this, it may be advisable to set up the APA as an autonomous corporation or alternatively, a separate entity could be set up wholly owned by it specifically to exploit the commercial potential in any research.
2. Adopt a clustered approach to nurture R&D focussed activities and establish special Research and Education Zones (REdZ) that will house world-class research and academic institutes which can attract top global talent and that will pursue innovative projects. Research within each zone can be designed to focus on complimentary areas fostering the development of an innovation cluster. Ideally, the REdZ should be located in the new townships proposed earlier. Institutions should be given full freedom to operate, with no constraints on organizational structure, faculty compensation, fees or course offerings and content, admission policies or evaluation methodologies within these zones. Market forces will determine their success or failure. The APA and REdZ will be complementary, with the first stimulating the second. Such REdZs may be encouraged to undertake research into organizational development (for IT/BPO organizations) and

technology management, as these will be critical dimensions accompanying increases in scale of operations. Contemporary advances in the field of Information Technology, both hardware and software, clearly demand better and better competencies in managing them.

3. Today, a large number of Indians go to foreign universities (80,000 to the US alone), spending a few billion dollars, because of the inadequate capacity of top-class institutions in India. Instead, India could be attracting thousands of foreign students, and this could become a major economic activity, even as it boosts our image as a knowledge power. The REdZ could facilitate this. The Study team recommends a few such zones, on an experimental basis, with special efforts to attract top Indian and foreign institutions. These should make the best use of technology in general and ICT in particular to ensure the most optimal utilization of land. The success of university cities in the US is ample proof of the feasibility of this concept.
4. Encourage all science departments and technical education and training institutions to include entrepreneurship and new venture management (including global project management) courses in their curriculum. Leverage existing relationships and further expand relationships between Indian and international universities. Encourage exchange programs for students and faculty, working on joint projects and cross-leveraging of curriculum.
5. IP rights awareness should be increased in institutes and industries by providing specialized series of workshops and lectures. Courses could be introduced as a part of academic initiatives and should be actively encouraged by the concerned authorities (the Ministry of Information Technology). Specific focus will be needed to address the lack of well-qualified patent examiners in the country.
6. The government must create a fund to provide grants to SMEs for global patenting and copyrights. This is an expensive process, and many SMEs do not have the funds to file global patents, thus losing their rights on the intellectual property created by them.
7. Encourage and reward Innovation
 - a. Ensure availability of adequate access to funding for technology entrepreneurs, commercialization of innovation (discussed above in 'Ensuring adequate access to venture capital')
 - b. Rewards should be given to innovators for

further motivation. In addition to monetary elements, these rewards must also give due recognition – could be in form of marketing an innovators capability in print media, sponsoring the innovator as a keynote speaker in national and international conferences, nominating the innovator for various national / international awards in the R&D sector, and providing certain policy-making powers.

8. Major centres of technology education and research be encouraged to set up Enterprise Units, organised as independent societies or not-for-profit associations, to (a) provide group consultancy services to industry, (b) undertake contract research for industry (c) partner with private companies for activities like Technology Parks (d) support incubation activities for new ventures within the institution.
9. Leading technology institutions should be encouraged to setup profit-sharing Enterprise Incubation Units, organised as independent societies, able to hold equity and well connected with the local business community. The functions of such an incubation unit would be to (a) provide advisory services and negotiating support to the client entrepreneurs, (b) assist in filing patents and protecting commercially valuable intellectual property, (c) host enterprises at the seed stage with space and other facilities for a short time, (d) forge links with entrepreneurs, alumni and venture funds. Such incubation units should be eligible to receive grants up to 50 per cent of their expenditure from government schemes for entrepreneurship development. Enterprise Incubation Units in research institutions should be exempted from tax as long as they use the returns for further innovations/ entrepreneurship development.

In addition to the outlined recommendations, the committee would like to specially highlight the role of the IT-ITES sectors in creating large-scale employment opportunities for women, especially educated women, and thereby providing a stimulus to female education. With all leading firms offering world class office environments and high standards of employee welfare with special attention to women (such as provision of flexi-work hours, crèches, etc.), this sector is already witnessing an increasing share of women in the workforce. This must be further encouraged and it is recommended that where incentives are provided for employment creation (as is being done by some States), there should be larger incentives for employment of women.

2. Opportunity Assessment

Global spending on IT-ITES in 2005 was estimated at over US\$ 1 trillion.² Of this, the market potential for services that may be sourced globally was estimated at US\$ 300 billion. The total value of IT-ITES sourced from offshore locations in 2005 was estimated at US\$ 30 billion (~10 per cent).

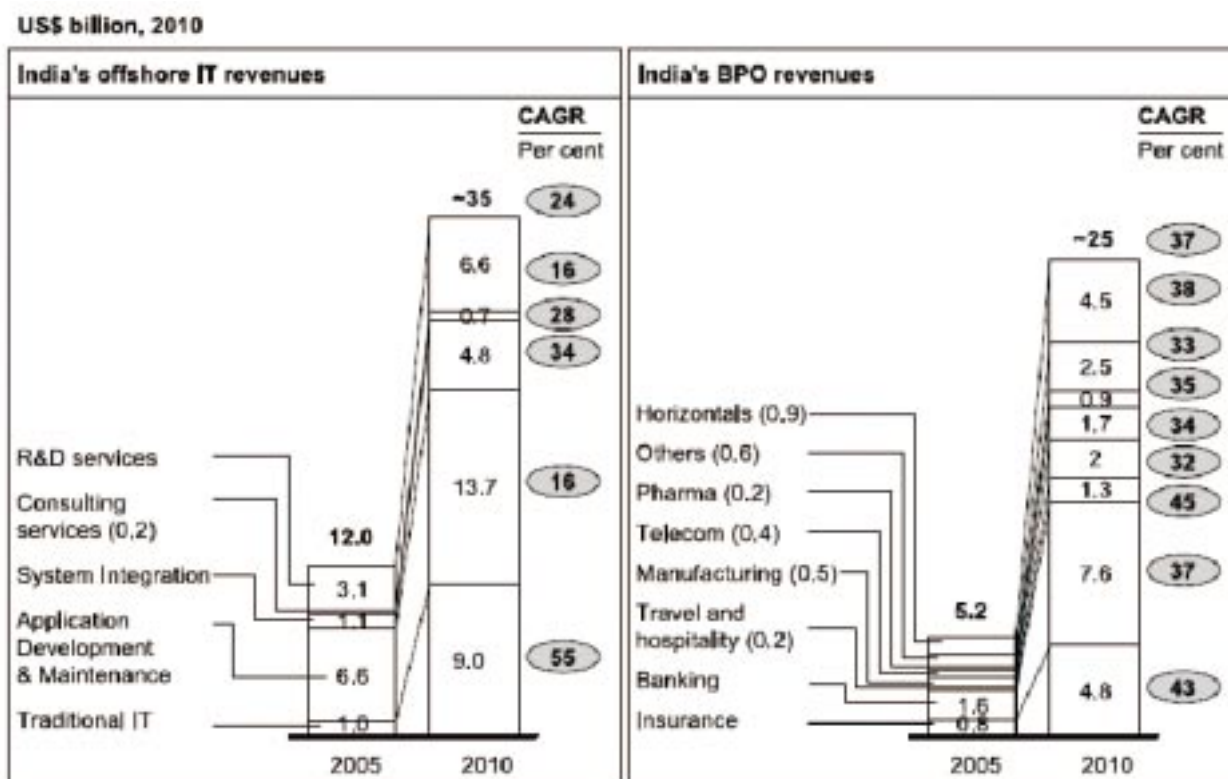
Global Offshore IT-ITES Market Potential

India holds a dominant share of the global offshore IT-ITES sector (65 per cent of the global market in offshore IT and 46 per cent of the ITES market). Yet, at US\$ 23.6 billion in 2005-06, Indian IT-ITES exports accounted for less than 2.5 per cent of the global spend on IT-ITES.

This clearly indicates significant headroom for growth. If India maintains its current shares of the global offshore IT-ITES market, IT-ITES exports from India will exceed US\$ 60 billion by 2010 and US\$ 86 billion by 2012. Further, growing at current trends, Indian IT-ITES exports are projected to reach nearly US\$ 330 billion by 2020 (nearly 14 per cent of the projected worldwide spend).³

As depicted in the preceding charts, forecast growth for the sector is expected to be driven by expansion in existing service lines / verticals as well as opportunities in new areas. Key service lines and vertical markets for the IT-ITES industry are listed below:

1. R&D and engineering services
2. Consulting services
3. System integration
4. Application development and maintenance
5. Traditional IT outsourcing
6. Banking
7. Insurance
8. Manufacturing
9. Pharmaceuticals
10. Travel and hospitality
11. Horizontal services (finance accounting and administration, customer interaction services, human



² Table 4 at the end of this study team report

³ FY2006-2020 IT-ITES Export Forecasts included in Table 2, in the Appendix

Table 2 : Demand for Indian IT-ITES

Description	Measure	Goal Fy12	Current*
Revenue	No. of Indian companies in Top 100 Global IT/BPO companies	15	5
Market share	% share of global ITS/BPO market	6.3%	2.3%
Wealth creation	Market cap of Indian ITS/BPO companies as share of total Indian market cap	20.0%	13.3%
Job creation	No. of professionals employed	3.4m (exports segment)	0.9m (exports segment)
IT consumption	Indian SW+ITS consumption as % of GDP	2.40%	0.70%
ICT Penetration	Global Ranking – WEF	30	57
Innovation	Global Ranking – WEF	20	76

* Latest Available

resource administration, research, etc.)

Infrastructure management services (included in IT outsourcing) and system integration services are forecast to be high growth areas in offshore IT services sourced from India. In case of offshore BPO, relatively lower penetration levels and significant untapped potential is expected to lead significant growth (CAGR 33-45 per cent), across vertical markets, over the next five years.

The US and the UK comprise India's primary markets, accounting for an estimated 80.5 per cent of IT software and related services exports in 2004-05. Japan, Germany, Singapore, the Netherlands and Canada are the next five leading export destinations for Indian IT-ITES. Together, these seven countries are estimated to account for nearly 90 per cent of the total exports in the country. While the US and the UK markets will continue to account for the dominant share of Indian IT-ITES exports over the forecast period, exposure to other markets is expected to increase due to the following factors:

1. Growing adoption levels in newer geographies. There is an increasing interest being shown by newer markets such as Japan, countries in the Nordic region, etc., in leveraging Indian IT-ITES.
2. Global customers of Indian IT-ITES firms driving them to provide some onsite support across all geographies. As Indian firms expand the scope of their services portfolio, they are being required to provide some local support in the global markets

served by their customers. This is helping the Indian firms identify opportunities and test new markets in a low-risk manner.

3. Target for the Eleventh Five Year Plan

Given the backdrop of large untapped demand potential and strong fundamentals, India is uniquely positioned to secure global leadership, grow its IT-ITES exports at an annual rate greater than 24 per cent, and generate export revenues of US\$ 86 billion by 2012.⁴ Additionally, Indian IT-ITES export growth can be further accelerated through deep and enduring innovation by industry participants. Such extensive innovation could generate an additional US\$15-20 billion in export revenue over the next five to ten years.

Further, establishing India's leadership in the global IT-ITES sector will mean more than achieving a targeted growth in exports. Following are a proposed set of indicators that may be used as targets to be achieved during the Eleventh plan. Attaining these ambitious outcomes will require breakthrough collaboration amongst industry players, central and state governments, and NASSCOM – to ensure that appropriate actions required to maximize the global sourcing market potential and sustain India's superiority as the preferred sourcing destination are executed in a timely manner.

Achieving these growth targets will entail a significant demand for incremental human and financial

capital in the country. US\$ 86 billion in IT-ITES exports by 2012 translates to incremental direct employment of about 2.5 million people and capital investment of approximately US\$ 20 billion.⁵ The Table 3 illustrates the input requirements driven by the projected growth of Indian IT-ITES exports during the Eleventh plan period.

Notes:

1. Quantum of public investment required (on education, infrastructure, etc.) has not been estimated. However, an assessment of the likely demand for education capacity, commercial real estate, housing, transportation etc., has been taken into account while formulating the proposed policy alternatives to address the industry's requirements. It is recommended that the Government assess its ability and willingness to fund the required infrastructure demand and focus on creating an enabling policy environment that encourages private sector participation for the balance – ensuring that a lack of funds is not a hindrance to progress.
2. The value of services imports is likely to be minimal due to the high levels of value-added in this business. It is estimated that the total value of software and service imports should not exceed 4-8 per cent of the annual export revenue target of any given year.

4. Key Constraints and Challenges

1. **Shortage in supply of suitable talent:** While India's young demographic profile has the country favourably placed in terms of its quantitative manpower requirements, gaps in suitability and / or access to the entire available pool are beginning to reflect in talent supply shortages – indicated by continued above average wage inflation and high attrition levels in the sector.

To achieve US\$ 86 billion in export revenues and to continue to grow the domestic IT industry, the IT and ITES industries will need to employ nearly 3.5 million professionals. Currently, the industry employs less than 1 million professionals (engaged in delivering exports). Therefore, the higher education system needs to produce enough graduates to provide another 2.5 million willing and suitable professionals over the next five-seven years. Feedback from the industry has indicated gaps in employability in areas such as soft-skills, English language proficiency etc. The NASSCOM-McKinsey Report 2005 projections indicate that if current trends are maintained the higher education system will fall short by about suitable 500,000 professionals by the end of the decade – and in the absence of corrective action, this gap will continue to grow.

Table 3 : Import Requirements for Growth of Indian IT-ITES Exports

Description	Current	Target/ Required In FY2012	Incremental Δ
Export Revenues	US\$ 23.6 billion	US\$ 86 billion	US\$ 62 billion
Direct Employment Generation (exports segment)	920,000	3.4 million	2.5 million
Indirect Employment Generation	2.6 million	9.5 million	7. million
Office Space	100 million sq. ft.	350 million sq. ft.	250 million sq. ft.
Direct Capital Investment*	US\$ 8.5 billion	US\$ 28-30 billion	US\$ 20-22 billion

* Estimated assuming an industry average capital: revenue ratio of 1:5; and a lead of 3 years in the investment cycle

4 While growth forecast projections have been made till 2020 in the previous section, specific targets and analysis has been focused on core terminus, i.e., the period for the XI five year plan (FY2007-12).

5 Assuming an industry average capital: revenue ratio of 1:5; and a lead of 3 years in the investment cycle.

The lacunae in the Indian education system are also contributing to a significant deficit on account of education. The number of Indian students going abroad annually is currently over 100,000 and is projected to cross 200,000 by the end of this decade. In comparison, the number of foreign national students coming to pursue studies in India is estimated at less than 10,000 each year. As a result, the net annual outflow on account of education, currently estimated to be in excess of INR 15,000 crore (US\$ 3.5 billion), is likely to continue to rise rapidly.

2. **Lack of adequate infrastructure:** The derived demand for infrastructure and indirect resources poses a key challenge for policy makers. The incremental infrastructure required to support the projected growth is unlikely to be absorbed into the existing city centres (Tier I / II), which are already witnessing signs of strain. With Tier III / IV cities lacking important elements of business and social infrastructure, decentralized growth of the IT-ITES sector will require a coordinated, large scale (distributed) urban planning exercise.
3. **Sustaining cost competitiveness through an enabling business policy and regulatory environment:** Cost savings remain the primary driver for offshore sourcing of IT-ITES. In addition to the potential loss of absolute cost arbitrage due to wage inflation, firms are becoming increasingly concerned about increasing cost of doing business in India due to infrastructure constraints. For instance, in spite of the progressive reform and declining prices the cost of telecom connectivity, the other key element of the IT-ITES cost structure, is higher in India (when compared to internationally competitive levels).

The business policy environment in a country also plays a critical role in driving cost competitiveness. The STPI scheme, which has played a key role in catalyzing industry growth by providing much needed infrastructure (especially in the early years) and support in the form of financial incentives, is due to expire by March 2009. This, at a time when competing locations are introducing attractive schemes / financial incentives (often modelled on the benefits offered in India) to attract investments in the IT-ITES sectors in their respective countries, is likely to further impact India's competitiveness. The recently introduced SEZ policy is a positive measure, however does not adequately accommodate the

requirements of this sector and is likely to have unfavourable implications for SMEs and smaller cities (not by design). Further, India still ranks poorly on other aspects of 'ease of doing business' when compared to other emerging competitor locations – which also impacts the cost of doing business in India.⁶

4. **Providing adequate support to SMEs / incubation of new ventures:** The positive outlook for the sector coupled with high returns on investments is reflected in strong investor interest (on the stock market as well as in the form of private equity investments); yet raising capital for incubating new ventures and expansion of SMEs is still a challenge. Further, SMEs often face budget constraints while planning their business development and marketing efforts. Government led / sponsored trade development initiatives can help SME companies reach into new markets in an organized and economical manner.
5. **Ensuring adequate access to venture capital, especially at the early stage:** The venture capital environment in India is not very developed. Further, the relative risk averseness brought about by the dot-com bust has made funding, especially for the early stage, scarce.
6. **Global trade development and actively advocating free trade in services:** As an acknowledged leader in the global offshore IT-ITES sector, India is best positioned to expand the market opportunity by leading efforts to consolidate its position in existing geographies (expand client base and / or offshore service portfolio) as well as penetrate newer markets. To this effect, India stands to gain the most from a coordinated global trade development effort. Further, with significant room for policy reform in global services trade (and potential risks of trade barriers constraining sector growth⁷), India's active participation in advocating free trade in services will benefit the country.
7. **Fostering a sustainable ecosystem for innovation and R&D:** In order to structurally strengthen India's proposition and ensure its long term leadership, it is essential to nurture a sustainable ecosystem for innovation and R&D in the country. This will require a multi-faceted approach comprising a) developing core capabilities

6 India currently ranks 116th out of 155 countries www.doingbusiness.org

7 Non-availability of business visa, work permits, residence permits etc. from foreign Missions in India of countries such as USA, EU, Japan etc., on a short notice has been another constant problem being experienced by Indian IT companies for transferring their manpower to their IT software / services assignments and projects overseas. Sometimes, this leads to non-fulfillment of the contractual obligations on the part of the Indian companies concerned.

at the academic level in identified focus areas; b) encouraging industry-academia participation in R&D; and c) facilitating the incubation / commercialization of innovations.

5. Policy Actions Required

The following sections outline the policy actions required to address the concerns and challenges raised in the previous section.

5.1 Improving the Supply of Suitable Talent

This issue of improving the supply of suitable talent needs to be addressed at multiple levels:

1. **Supplementing skills in the existing pool:** Upgrading the skills of people that have already graduated / are about to graduate from the existing education system; and
2. **Structurally strengthening the education system:** To ensure that quality and quantity of future outturn from the education system is enhanced.
3. **Provisioning for universal access to quality education:** Enhancing the quality of school education and ensuring that deserving students are not denied access to quality education due to economic constraints.

5.1.1 Supplement Skills in the Existing Pool

India is demographically advantaged with a very young population (approximately half the population is below the age of 25). Consequently, even at relatively low levels of enrolment, the outturn (number) of graduates from the education system in India is amongst the highest in the world. However, the proportion of graduates found suitable for employment is fairly low (quoted estimates range 10-20 percent). As a result, the effective pool of employable graduates is far lower than the overall pool of people entering the working-age population.

Inadequate English-language proficiency and lack of soft-skills are the key gaps in the current graduate pool, reported by the industry. While these issues are addressable by introducing some changes to the existing education system, the systemic changes are likely to have a lead time to impact and will also exclude the existing pool of recent graduates. As a short term measure, and to also enhance the employability of

existing graduates / graduates that are about to exit the system, a 'bridge course' or finishing school will be of immense value.

The industry should put together the curriculum and faculty for this. However, other costs will have to be covered by student fees and it is recommended that the government provide subsidy/loans for this. It is estimated that piloting this project across 6 cities (estimated 30,000 'students' per year) will cost INR 25-30 crore (US\$ 5-7million).⁸

Policy Action

1. To supplement skills in the existing pool of (unemployable) resources, the government should initiate a nationwide 'finishing school' program. The industry should put together the curriculum and faculty for this. However, other costs will have to be covered by student fees and it is recommended that the government provide subsidy/loans for this. It is estimated that piloting this project across 6 cities (estimated 30,000 'students' per year) will cost INR 25-30 crore per annum.
2. To enhance the pool of experienced, mid-level managers, that are willing and suitable to work in the IT-ITES sectors, it is suggested that a 'bridge course' be introduced to equip professionals who may not have read for a course in IT (e.g. civil engineers, people with degrees in mathematics and physics etc.), but after having worked for a few years (in their respective fields) want to branch into the IT-ITES field. The advantage of such bridge courses will be that professionals will have an opportunity to pursue careers of choice without being constrained by their academic qualifications, the cost of such a program will be lower (as by definition these courses will be meant to bridge the gaps in their academic background and not make them go through a full 4-year degree), experienced professionals will be in a position to afford these courses (as they have been working for a few years), such a program will directly address the need for project management expertise – which these experienced professionals are likely to have acquired in their respective fields, and will now be in a position to apply them to IT.

5.1.2 Structurally Strengthen the Education System

The prevailing system of education in India is constrained by several constraints. These include a lack

8 Estimated for an outturn of 5000 students per city per annum; budgeted costs include operating expenses only and it is assumed that existing infrastructure (e.g. colleges / schools etc.) will be available for use.

of adequate capacities at and number of institutions acknowledged as sources of world-class talent; poor systems of accountability and lack of pressure to perform; operational inflexibilities, bureaucratic controls and complex governance structures shared between the centre and the state; teaching / academics not considered an attractive career option, leading to constraints on faculty resources; key stakeholders (i.e. the education system and the industry) operating in silos, with limited mutual interaction / participation.

As a result of these constraints, today India faces a widening gap between the stock of graduates in the employable pool and the proportion of the pool found suitable for employment (especially in the IT-ITES sector). Addressing this gap will require radical reform of the prevailing policies regulating the education sector in India.

For instance, it is projected that at the annual demand for fresh IT professionals (for the IT Services segment alone) is likely to increase from approximately 150,000 in 2006-07 to over 330,000 by 2011-12. The industry is already witnessing a crunch of suitable, world class quality resources – with the entire annual outturn of the IIT's and the NIT's accounting for approximately 10 per cent of the current annual demand.⁹ Even if one third of the outturn is joining the IT industry, at these levels, the combined capacity at these institutes will need to be more than doubled by 2012, just to maintain status quo. Demand for high-quality graduates is likely to increase further, as the industry moves up the services value-chain.

Given current capacities, meeting this demand will require additional investment to provide the required education infrastructure. It is reported that upgrading an institute from an IT-BHU (example) to an IIT requires an incremental investment of INR 150-200 crore (US\$ 35-45 million) and establishing a Greenfield IIT establishment requires an investment of INR 500-1000 crore (US\$ 110-220 million).

Based on the above, it is estimated that to ensure that the industry will be able to hire 15 per cent of the fresh employee base required in 2011-2012, from world class institutes, the additional education capacity expansion / creation will require an investment to the order of INR 93,000 crore (~US\$ 21 billion) over the next two years.¹⁰

Understandably, expanding capacity in other courses of study is also likely to require comparable levels of investment. Private sector participation will be an effective means of channelling the required investment into the sector. However, current policies (restrictions on student fee / batch sizes / faculty remuneration / curriculum / etc.) act as a disincentive for private sector investment in the sector.

The need for reform in the education sector policies extends beyond the additional investment required for capacity creation. There is a dire need for continuously updating the course content, curriculum and pedagogic methods to make them more relevant to the needs of the industry; institutionalizing a transparent process of assessment and review of the educational institutions as well as certifying the suitability of the output for employment. Expanding capacities in the education system will generate an additional demand for faculty that will require encouraging more people to pursue teaching / academics as a career. Additionally, continuous reviewing and updating of the curriculum / pedagogy is also likely to require existing faculty to re-train / upgrade their skills. The existing system lacks accountability / pressure to perform.

Policy Action

1. Re-orient the education system to make it demand-based with the focus on ensuring employability of graduates through high-quality, relevant, need-responsive curriculum and teaching. Initiate an intensive program of curriculum updating/development and teacher-training, to address lacunae in relevance, topicality and pedagogic methods. This must be a joint academia-industry effort.
2. Expand capacities at and the number of world-class institutions (e.g., IITs, IIMs, IISc), while ensuring that quality does not suffer. Plans for upgrading the National Institutes of Technology (formerly Regional Engineering Colleges) need to be put on a fast-track. New technologies of pedagogy, such as ICT, broadcasting, etc., must be introduced to provide wider access to high quality education, to overcome the shortage of teachers and to increase capacity. Funds required for upgrading existing NIT's (19) to IIT grade estimated at INR 2,850 crore. It is recommended that an additional 5 per cent (INR 150

9 Current outturn at the IITs (combined) is estimated at 4000. Adding the outturn of the 19 NIT's (assuming similar batch sizes) we get ~ 15,000 which is ~10 per cent of the total fresh employee demand estimated for 2006-07.

10 Scenario assumes that all the existing NIT's are converted to IIT's and the capacity in Greenfield projects is split between IIT and NIT grade institutes in the current ratio (4000:11400). Investment will be required to be made over the next two years as the intake for the class graduating in 2012 will begin in 2008.

crore) is earmarked for promoting distance education from these institutes to other institutes.

3. Decentralize the education sector governance model, increase transparency and ease operational inflexibilities. This will also help encourage private sector participation.
4. Rating and accreditation by an independent agency must be mandatory for all educational institutions. The present system of accreditation needs to be radically altered to include users and to place emphasis on quality of output (graduates) rather than on physical infrastructure. Feedback from the key users of the output, i.e. the industry, must be an integral part of the accreditation process.
5. Introduce standardized National level tests (similar to SAT, GRE, AGRE, MAT) which may be recognized internationally for benchmarking of students seeking the admissions in Undergraduate and Postgraduate institutes in all colleges in India and abroad. It will help to save resources and ensure the quality of students' entry in bench marked institutes. This will result in the consistency in quality of student passing out from a specific institute.
6. Given the varying standard of different institutes, a common nation-wide benchmark for assessing students is necessary. The inclusion of industry needs in this assessment will make it useful for recruitment. It will also ensure that colleges or training institutes include these specific elements in their curriculum. A series of such benchmarks need to be created to certify candidates as being suitable for different levels of jobs, beginning with the entry level. The IT-ITES sector has already begun work on the first such certification (for entry level in the BPO industry), this initiative needs to be supported and institutionalised by encouraging universities across the country to participate. Eventually, it should evolve into something along the lines of Chartered Accountants Exam.
7. As an immediate measure to address faculty shortages, increase the retirement age of faculty to 65 years.
8. Provision budgets for a significant increase in the number and value of scholarships offered to encourage a far greater number of graduates to pursue Masters and Doctoral programmes.
9. Remove constraints to make teaching / academics as attractive a career option as working in the industry. Unshackle institutions for higher education from restrictions on fees and faculty remuneration.
10. Formalize international (mutual) recognition of academic degrees and certifications, and encourage internationally renowned academic institutions to establish campuses in the country.¹¹ This will not only help enhance the international acceptability of the Indian education system but also attract some of those Indian students currently going abroad to pursue higher studies – to remain in India.
11. Encourage students and working professionals to pursue further education for skill enhancement by providing tax incentives.
12. Encourage active involvement of industry in university-level education to make the graduates more employable. To this end, it is recommended that a portion of the education cess be earmarked for the tertiary level and that this fund be administered by a joint government-industry-academic group. The group should decide on programmes and funds disbursement, and be responsible for monitoring and evaluation.
13. Periodic review and updating of curriculum to make it more industry-oriented will also require faculty to constantly upgrade their skills. This can be best facilitated by greater industry-academic interaction; instituting a process to accredit faculty and mandating that a certain amount of time be devoted to retraining on a periodic basis.

5.1.3 Provide Universal Access to Quality Education

In addition to improving the system, it is essential that policy reform is directed towards providing universal access to quality education. To this end, the working group recommends the following:

Policy Action

1. To build the educational base, it is essential to accelerate efforts to universalize elementary education and to raise the quality of school education. Special emphasis is needed – possibly through a Centre-sponsored program – on teaching of science, mathematics and English.
2. Ensuring that deserving students are not deprived of access to quality education due to economic disadvantages. This can be done effectively by means of “education coupons” (like food stamps) to meritorious/needy students, which they can utilise in any institution of their choice in which they secure

11 India should become a part of the washiton Accord during its next review and advocate this issue at the GATS.

admission. Combined with this must be a massive programme of students funding (grants and loans). Currently, student loans below INR 500,000 are difficult, and there are none for non-degree, certificate programmes. Government should subsidise these loans (enabling lower interest cost), and catalyse a re-insurance/securitisation institution for student loans. A registration scheme (like the National Skills Register, Permanent Account Number, etc.) can be put in place to minimise default on loans.

5.2 Building Adequate Basic, Business and Social Infrastructure

The IT-ITES sectors will likely employ an additional 2.5 million professionals (export sectors alone) by 2012. In addition to basic utilities and physical infrastructure, growth in the sector will also generate significant demand for world class business and social infrastructure such as Class A office space, conveniently located residential areas, transportation infrastructure that enables an easy commute to their offices, high-quality education facilities for their children, shops, convenient air connectivity, and a wide variety of recreational activities.

Existing Tier I and Tier II cities are already overcrowded, choked, and struggling to provide basic urban services. Upgrading these existing centres is necessary,¹² but can only reduce rather than solve the problem. Further, decentralizing the industry beyond existing hubs is essential to allow wider distribution of the development benefits driven by the growth of the sector. Therefore, this demand will need to be met by developing new townships to house this young and vibrant population.

Taking account of the indirect employment and the dependents of the IT workforce, we will have to create at least 12-15 integrated townships of 2-2.5 million people. Each of these townships will probably employ about 250,000 knowledge workers and require well over 25 million square feet of Class A office space (for IT-BPO alone). There will have to be about 650,000 residential units in these cities and enough transportation capacity to handle at least 800,000 cars.

The new townships present several advantages. Firstly, the young workforce can look forward to live and bring up their family in an attractive, well planned

environment. Secondly, these will serve as model destinations for knowledge work to be offshored to India, and maintain India's competitiveness versus other offshore locations in China, Malaysia, Singapore, and elsewhere. Thirdly, they will take pressure off existing cities that are already bursting at their seams. Finally, they will serve as regional growth magnets and provide employment to adjacent areas.

New developments like Gurgaon, Salt Lake City, Malad, Powai, Whitefield, Tidel Park, have been far from ideal, but provide lessons on what we need to do. The new townships must be located near (30-60 kms) a major city, and also be connected through world-class highways and an efficient mass transportation system. Local transportation within the township too needs attention. Apart from office-space, the township must have housing, shopping, entertainment, recreation, medical and education facilities of high quality. As knowledge hubs, these townships should foster a vibrant academic atmosphere, with a close relationship between working professionals and the student community. Innovative ideas will find their way as business solutions in such an environment. The Central government should carefully plan out how various premier institutions (such as the IITs and IIMs) should be distributed across these integrated townships.

Building such integrated townships will call for urgent action by both central and state governments. Action will need to be taken across various fronts including: master plan development, model financial arrangements, land acquisition and auction, proper re-settlement of displaced persons, aviation and transportation planning, and educational linkages.

Work must begin on 12-15 townships in parallel. This will create competition among the townships to attract tenants and raise everyone's standards. Given the definite and growing demand, many developers and investors have evinced keen interest in investing in such townships. A positive policy framework and quick approvals through a single authority will, however, be necessary. A revenue share model, in addition to a one-time payment for land, may be the best approach. An ambitious program of this kind is not only essential for the IT industry, but could serve as a magnet for other growth. It will also generate huge employment in the construction and allied sectors, while giving a boost to industries like cement and steel.

12 The recently announced initiatives in airport infrastructure modernization highway development and mass rapid- transportation-systems in Delhi, Mumbai and Bangalore are significant steps to this end.

5.3 Ensuring a Favourable Business Policy and Regulatory Environment

A favourable business policy and a regulatory environment are critical for the success of any sector. The example set by the STPI scheme stands testament to this fact – and its phasing out only to be replaced by a sub-optimal alternative (in the context of this sector) in the form of the SEZ Act 2005 is a key concern. Additionally, to strengthen India's proposition for sustained leadership in the IT-ITES space, it is essential to actively support the SME sector. Lastly, the issue of intellectual property protection, data and information security is a key risk to the sector (in the form of a potential non-tariff barrier to international IT-ITES trade). Hence, it is essential for India to proactively formulate a robust policy framework to address this challenge. The following sections discuss these aspects in further detail and propose policy action alternatives to address each issue.

5.3.1 Continue the Benefits Provided by the STP Scheme

The Government of India has taken several initiatives towards creating an internationally competitive and hassle free environment for IT-ITES sector. The Government policies and initiatives have acted as a catalyst for the growth of IT-ITES industry and facilitated it to attain global recognition. One major initiative by the Government has been the establishment of Software Technology Parks in India (STPI) in 1991 and the evolution of STP Scheme.

STPI is an autonomous non-profit society set up by Ministry of Communication and Information Technology, Government of India, in 1991 with the objective to promote and facilitate Software and Related Services exports from India. Over the last few decades, IT has played a seminal role in placing India on the Global map as an IT superpower. Today, all across the country, STPI centres are synonymous with excellent infrastructure facilities and statutory support aimed at furthering growth of IT-ITES in the country. In fact significant credit for the record growth in exports, foreign exchange earnings, employment generation and the development of the Indian IT-ITES sector is attributed to this scheme.

Further, the STPI scheme has also contributed immensely to other major thrust areas such as growth of Small and Medium Enterprises (SMEs). STPI has also facilitated regional development by uniform dispersal of STP units across secondary cities and thereby increasing employment opportunities in these areas.

The industry has expressed two sets of concerns regarding the phasing out of the STPI scheme:

1. Phasing out of the tax benefits: Under the STP scheme units, engaged in the export of IT-ITES, are eligible for a number of direct and indirect tax incentives. However, the said benefits under the scheme are scheduled to lapse post assessment year 2009-10. Considering that the industry is already witnessing stiff competition from companies from other emerging low-cost destinations, the added tax liability will negatively impact the economics of sourcing from India.
2. The SEZ scheme is a major initiative to promote exports and to create world-class facilities in defined areas. It is expected to be a positive stimulus for the manufacturing industry and likely to be useful for big IT Software companies seeking to set-up large campuses of their own. Notwithstanding these potential benefits, there would be disadvantages for the SMEs and start-up companies. Following is a brief assessment of the impact of the phasing out of the STPI scheme:
 - a. SMEs will have to face forced locational inflexibilities as well as higher operating costs: Under the STP scheme companies were free to locate their operations at any place and avail of all the financial and procedural benefits offered. This was especially beneficial for start-ups and SMEs that often started out of the homes of the entrepreneurs / promoters. Further, many SMEs choose to locate their operations away from the offices of the large IT companies in order to control their employee attrition rates.

Under the new Act, IT-ITES SEZs are likely to introduce entry barriers in terms of location as well as minimum scale of operations. IT-ITES SEZs require that a unit must possess a minimum land area of 25 acres. The need to identify contiguous land is likely to result in IT-ITES SEZs being located in the outskirts of the city. As a result, firms will have to incur higher operating costs in terms of transportation and logistics. Further, SMEs and start-ups are likely to face higher rental charges since their facilities are unlikely to satisfy the minimum requirements of an independent SEZ and the SEZ developers will take advantage of the situation to drive up the rates offered to SMEs.
 - b. Investments on existing IT parks as well as investments made by large IT companies in

building their own campuses will face a risk of wastage: Over the last decade, the initiatives taken by various State Governments have resulted in creation of several state-of-the-art IT parks across the Country. However as per the SEZ Act 2005 the existing IT parks may not be converted into an SEZ as only the new investments brought into the industry can apply for an SEZ status. Significant investments have been made over the last few years to develop these software parks.

Once an IT-ITES SEZ is developed in / near a city, many of the tenants of the existing parks are likely to shift to the IT-ITES SEZ in order to enjoy the fiscal benefits over a longer period. Many IT parks came into existence before the specifications under the SEZ Act 2005 were laid and hence some of them do not meet the minimum area criteria (land and built-up area). Hence, even if they apply for IT-ITES SEZ status in order to provide fiscal benefits to their tenant; they may not qualify for the same (For Instance: Tidel Park in Chennai with a total investment of ~INR 220 crore, is spread across a land area of 7.5 Acres). Thus the existing IT Parks may lose their tenants over a period of time, resulting in under utilization of existing infrastructure/ resources.

Further, factors such as availability of land at desired location, lack of demand for optimum space etc., is expected to hinder creation of IT-ITES SEZs. The existing infrastructure is capable of meeting the requirements of industry. However, many enterprises may be compelled to move to an SEZ in search of fiscal benefits. This may not only create an artificial demand for an IT-ITES SEZs, which could lead to an increase in their rentals, but is also expected to lead to under-utilisation of state-of-the art infrastructure created in India which has served as a backbone for Indian IT-ITES industry for several years.

Several Indian IT Companies have made substantial capital investments for setting up their own state-of-the-art campuses. Companies like Infosys, Wipro, Satyam, TCS etc have constructed dedicated centres across several locations in the country. Most of these centres are registered under the STP scheme.

The SEZ Act 2005, in its present format, would not allow these existing state-of-the-art infrastructures to be notified as IT-ITES SEZs; as migration of existing units into SEZs is not allowed as the new SEZ Scheme aims to promote fresh

investments. However, most of these companies are likely to gradually move their set-ups to SEZ in order to leverage the fiscal benefits

In order to maintain the level of competitiveness, most of the IT companies may switch their existing operations to the new IT-ITES SEZs to continue receiving benefits accruing due to preferential policies. This would result in huge re-location costs for these companies and also wastage of the existing state-of-the-art infrastructure. This loss would be higher for large companies which own large campuses.

- c. Development bias towards existing hubs: The lower manpower and real estate costs has engendered new locations as viable alternatives to the existing IT clusters such as Bangalore, Mumbai, Delhi, Pune etc. As a result, the smaller cities (the Tier III and IV cities like Vizag, Mysore, Mangalore, Nagpur, Indore, Bhubneshwar etc.) are witnessing emergence of several IT companies.

These cities currently provide definite cost advantages of 15-30 per cent over Tier I and Tier II cities and have attracted a host of IT-ITES ventures that are spin-offs from the institutes and universities or are new entrepreneurial ventures. Under the existing 'universal location' model, a unit can avail of the fiscal / procedural benefits (under the STP scheme) without having to locate in a designated area.

In the near future, IT-ITES SEZs, with their minimum area requirements, are not likely to be located in Tier III and Tier IV cities; as these cities would not be able to generate sufficient demand. Thus, the IT-ITES companies in Tier III and Tier IV cities would have the option either to move to an IT-ITES SEZ in Tier I and Tier II cities in order to avail the direct tax incentives; or leverage cost benefits offered by smaller cities – without access to the benefits designed for promoting the industry. Hence, IT-ITES SEZs may skew the growth of IT-ITES industry in favour of the large cities.

IT-ITES SEZs have common minimum built-up area criteria for all cities. While it may be easy to fulfil this criteria in large cities; it may be difficult to generate demand in smaller towns in short span of three years (based on estimates the target number of employees per IT-ITES SEZ to fulfil minimum criteria would form 1.3 per cent, 0.7 per cent and 0.5 per cent of the total population of Chandigarh, Indore and Nagpur respectively). The existence of only few IT-ITES SEZs in smaller towns would increase the

suppliers bargaining power, which would enable them to pass the burden of surplus space created, to the tenants.

The Tier III & IV cities would need to become far more competitive to retain the jobs and SMEs that form their economic base. Thus, in its current form, the Act is likely to encourage a specific pattern of investment flow which could exacerbate existing imbalances.

In order to overcome the negative impact of SEZ Act and phasing out of the STP scheme the following remedial action alternatives are recommended:

Policy Action

1. Establish a level playing field between the SEZ and STP scheme, by providing an exemption from corporate income tax (under the relevant provisions of section 10AA of the Income Tax Act, 1961) for all units meeting following criteria:
 - a. Units must be registered under the STP Scheme
 - b. It must be a unit registered after 31st March 2006
2. Exemption from corporate income tax for residual years (i.e., corporate tax incentives to continue until the units complete the 10 year tenure) under the relevant provisions of section 10A and 10B of the Income Tax Act, 1961 for all units meeting following criteria:
 - a. Units must be registered under the STP Scheme
 - b. Benefit under section 10A and 10 B to be available till 31st March 2014
3. Extension of exemption from corporate income tax under section 10A and 10B for SMEs*
 - a. For a maximum of 10 years
 - b. Till year 2020
 - c. *Not having an equity stake of more than 11% by a company (worth more than INR 100 crore).
4. Direct exemption from payment of service tax/ Central Sales Tax under section 65 of the Finance Act, 1994 (32 of 1994) be given to the units registered under the STP Scheme.

5.3.2 Strengthen the IP Protection, Data Privacy and Information Security Environment in the Country

Strengthening the IP protection, data privacy and information security policy framework is another key aspect of policy reform required to strengthen India's IT-BPO sector. This is essential not only for strengthening India's value proposition as a secure destination prepared

to manage confidential information, but also to encourage the growth of IP oriented technology creation in the country. Specific policy action recommended:

Policy Action

1. Conclude and implement the amendments to the IT Act.
2. Review the APEC Privacy Principles framework as a model for India.
3. Mandate computerization of police and criminal records, as well as judicial system across the country.
4. Facilitate a robust mechanism to prevent identity theft; encourage the use of the National Skills Registry / establish a national personal identity system.
5. Establish 5-6 world class centres of cyber crime and dedicated courts for fast track resolution of IP related disputes in the country.
6. Review national security policies to protect critical infrastructure of national importance from vulnerabilities to technology enhancements (e.g. defence establishments, dams, etc.).

5.3.3 Support SME Segment Growth, and Ensuring Adequate Access to Venture Capital

Encouraging the growth of the SME segment of the industry is critical for India's sustained leadership in this space. Unlike the early days of the industry, today there are a few examples of Indian companies that have assumed the stature of multinational IT-ITES companies. Yet there are several hundred other small and medium enterprises that need to be nurtured into larger corporations – and will need focused attention (in addition to the financial and procedural incentives mentioned above). It is essential that any policy reform likely to influence Indian IT-ITES accounts for this diversity in the vendor landscape and is not detrimental to the interests of the SME.

Policy Action

1. Extend the STP scheme / universalize the SEZ model to ensure that SMEs can continue to leverage the benefits offered under the STP / SEZ scheme without constraints on where they may be located.
2. Encourage the use of SME / domestically developed IP in e-governance projects.
3. Explore tax depreciation and investment credits for investment on SME / domestically developed IP by Indian industry.

4. Specific focus in trade development initiatives (discussed in the subsequent section on the initiatives for global trade development).
5. Large companies (e.g. with a turnover of over INR 100 crore), may be offered tax benefits on costs incurred for goods and services procured from domestic SMEs through a subcontract model. This measure will boost SME growth in the sector.
6. Government may allow tax deduction of up to 20 per cent of taxable income, to all IT-ITES professionals working with SME companies for a minimum period of two years.
7. There is need to stimulate seed and angel-funding for start-ups. In the knowledge sector, much of the new breakthroughs and interesting products come out of such start-up organisations. Encouraging and fostering them must, therefore, be a key element of establishing India as a major player in the innovation/knowledge-creation arena. The angel-funding available to new start-ups in India is yet very limited. Rather than the Government directly providing such funding, the Study Team suggests that it stimulate the evolution of a professional seed-funding community. To do this, the Study Team recommends the creation of a fund that underwrites ('insures') a certain percentage of the seed-funder's investment in a start-up. This will stimulate the appetite for risk, and get more funds into this space.
8. Government must relax constraints on institutional investment in domestic venture funds, starting with institutions, which were earlier allowed VC investments.
9. SEBI should register groups of high net worth individuals located in India or overseas, who meet the criteria of being independent investors, as accredited investors and offer them the same rights (including tax pass-through privileges) as registered VC firms.
10. Government, acting jointly with its counterparts in other countries, should use public resources to facilitate partnerships between Indian and foreign venture funds by underwriting downside risks. The Indian partners for such an exercise should be chosen on the basis of their track record in venture investing, their domain knowledge and their willingness to commit their own resources.
11. Central Government should establish an Early Stage Venture Fund, under the auspices of the DSIR and the major non commercial research organisations of the Government, through a public private partnership would plug this gap. The initial corpus of the fund would come from existing schemes of these departments for

promoting entrepreneurship supplemented by additional public and institutional resources.

(Such government institutions tend to be research oriented and commercially risk averse. The public private partnership would club this gap.)

12. Government should enable the creation of limited liability corporations (LLCs) through an amendment on redeem-ability under the Companies' Act. It should also extend the applicability of such LLCs and the proposed limited liability partnership (LLP) structure to venture capital funds.

(Worldwide this structure is used as it provides greater flexibility as well as tax transparency).

13. Fiscal incentive in the form of a set-off against taxable income be provided for individuals who invest in :
 - a. Start-ups emanating from incubation facilities in research institutions, or
 - b. Domestic venture capital funds under INR 250 crore whose charter clearly states that the VCF would be investing primarily in seed stage companies.
14. Allow venture capital firms the same advantages that are offered to OBU's in SEZ units.

5.4 Global Trade Development and Actively Advocating Free Trade in Services

Expansion of the global IT-BPO market opportunity is directly influenced by the policy and regulatory frameworks governing cross-border trade in services. Growth of cross-border trade in services is constrained not only by tariff barriers – but more so by non-tariff barriers (e.g. national treatment in cross-border supply and movement of people). India must continue to work proactively with its trading partners (through the WTO and other trade promotion agencies) to streamline trade in professional services. This will require further efforts focused on the Mode 4 negotiations currently underway.

India must push for the free movement of professionals engaged in delivering services on the basis of formal contracts, through a global GATS or professional services visa. At the same time, it must engage in bilateral or plurilateral negotiations on this with countries of specific interest to us. Negotiations are also needed to conclude agreements relating to exemption or refund of social security taxes paid by Indian professionals working abroad. In return, India needs to further open up several service industries such as financial services, accounting, legal services, retail, and education; improve the enforcement of IP and patent violations; and ensure responsible visa usage.

Increased government support in trade development programs for this sector can play an important role in expanding the market for India. Today many companies, especially SMEs are constrained in their marketing efforts to lack of funds and the size / base to drive their messages in new markets and geographies. The government already has underway several schemes and promotions (such as the Market Access Initiatives, setting up of export facilitation and business support centres in the US, Market Development Assistance (MDA) schemes.

Policy Action

1. Focus on negotiating bilateral visa agreements for Indian professionals to work in countries such as France, Germany, and Japan, besides further improving the position with regard to the US and UK.
2. Work towards “free trade in services” agreements with US and UK.
3. Department of Commerce may take up the matter in Bilateral Trade Agreements for Software industry with countries such as France, Germany, Japan, US and UK for taking full commitment in Mode 4 (Presence of Natural Persons) for Market Access and National Treatment, Mutual Recognition of degrees and issue of visas.
4. Further strengthen the Incredible India! branding campaign and run it regularly in key international media. Undertake directly, or through trade associations, a campaign to promote open markets and free trade in services in countries of interest. Provision a budget allocation of INR 100 crore.
5. Direct Indian missions to assist organizations like ESC, NASSCOM and STPI in their trade development programs. Allocate a budget of INR 250 crore over the plan period for central collection and dissemination of market intelligence. This may be facilitated through organizations like ESC, NASSCOM and STPI.
6. Marketing costs for exports in particular in developed countries may be subsidized in respect of the following:
 - a. Cost of advertisement in well known media for innovative products and services, which have already shown adequate market potential.
 - b. All tender costs and cost of follow-up visits as per funding which can be offered through the Market Development Assistance Scheme.

7. Expand the focus of the market access and development initiatives to include all SME units not only for ‘Focussed Areas’ but also for main IT markets such as US, UK, as well as newer markets. Establish incubation centres and shared services facilities (for onsite marketing etc.).
8. Increase industry participation and coverage of the schemes by collaborating with all the key industry organizations like ESC, NASSCOM and STPI to increase awareness and include more companies as beneficiaries of these schemes.

5.5 Fostering a Sustainable Ecosystem for Innovation and R&D

Supplementing the initiatives to sustain India’s value proposition by fostering a sustainable innovation and R&D ecosystem will be instrumental in consolidating India’s lead and moving it towards its next phase of growth. Indian IT-ITES export revenues can be further accelerated through deep and enduring innovation. Such extensive innovation could generate an additional US\$15-20 billion in export revenue over the next five to ten years. Innovation is required across three dimensions: (a) business model innovation (e.g., focusing on new service lines like infrastructure offshoring) by companies; (b) knowledge innovation (e.g., developing deep IP-based solutions) by companies and research institutes; and (c) improvements to the innovation ecosystem (e.g., systematic talent enhancement, better technology research, more seed-stage capital).

The Central government can improve the innovation ecosystem by focusing on the following actions:

Policy Action

1. Set-up an Advanced Projects Agency (APA) that drives technology research at central and state government level, facilitated through a public-private-partnership model, on a scale large enough to make an impact.
 - a. This agency would have its own budgetary allocation and fund research at India’s premiere institutions (including private sector companies)

13 As per the NASSCOM McKinsey Report 2005, the IT-ITES Exports for the Eleventh Plan period are estimated to be US \$ 304 billion (Rs.14,00,000 crore). Based on the above, and assuming an R&D spend of at least 5% of total revenues, the total R&D spend by the Government and Industry would work out to Rs. 70,000 crore. Major portion of the R&D spend would come from the private sector. Significant portion would also come as a component of various technical programs/projects of the Government. Additionally, Government need to sponsor programs focusing on fundamental research.

- on technologies and scientific capabilities that will strengthen the Indian economy and state. It is recommended that the budget allocation for government sponsored technology related R&D spend during the plan period¹³ should be at least INR 70,000 crore and should be pegged to the industry revenue targeted in each year.
- b. The grant allocation process should be open, fair, and transparent to motivate India's best researchers to submit research proposals. Who will own the IPR is an issue that must be clearly defined at the start to avoid any dispute later. More than one model can be explored from an outright sale of the right to the 'invention' or some form of revenue sharing model with a defined time-frame. To facilitate this, it may be advisable to set up the APA as an autonomous corporation or alternatively, a separate entity could be set up wholly owned by it specifically to exploit the commercial potential in any research.
2. Adopt a clustered approach to nurture R&D focussed activities and establish special Research and Education Zones (REdZ) that will house world-class research and academic institutes which can attract top global talent and that will pursue innovative projects. Research within each zone can be designed to focus on complimentary areas fostering the development of an innovation cluster. Ideally, the REdZ should be located in the new townships proposed earlier. Institutions should be given full freedom to operate, with no constraints on organizational structure, faculty compensation, fees or course offerings and content, admission policies or evaluation methodologies within these zones. Market forces will determine their success or failure. The APA and REdZ will be complementary, with the first stimulating the second. Such REdZs may be encouraged to undertake research into organizational development (for IT/BPO organizations) and technology management, as these will be critical dimensions accompanying increases in scale of operations. Contemporary advances in the field of Information Technology, both hardware and software, clearly demand better and better competencies in managing them.
 3. Today, a large number of Indians go to foreign universities (80,000 to the US alone), spending a few billion dollars, because of the inadequate capacity of top-class institutions in India. Instead, India could be attracting thousands of foreign students, and this could become a major economic activity, even as it boosts our image as a knowledge power. The REdZ could facilitate this. We recommend a few such zones, on an experimental basis, with special efforts to attract top Indian and foreign institutions. These should make the best use of technology in general and ICT in particular to ensure the most optimal utilization of land. The success of university cities in the US is ample proof of the feasibility of this concept.
 4. Encourage all science departments and technical education and training institutions to include entrepreneurship and new venture management (including global project management) courses in their curriculum. Leverage existing relationships and further expand relationships between Indian and international universities. Encourage exchange programs for students and faculty, working on joint projects and cross-leveraging of curriculum.
 5. IP rights awareness should be increased in institutes and industries by providing specialized series of workshops and lectures. Courses could be introduced as a part of academic initiatives and should be actively encouraged by the concerned authorities (Ministry of Information Technology). Specific focus will be needed to address the lack of well-qualified patent examiners in the country.
 6. The government must create a fund to provide grants to SMEs for global patenting and copyrights. This is an expensive process, and many SMEs do not have the funds to file global patents, thus losing their rights on the intellectual property created by them.
 7. Encourage and reward Innovation
 - a. There is need to stimulate seed and angel-funding for start-ups. In the knowledge sector, much of the new breakthroughs and interesting products come out of such start-up organisations. Encouraging and fostering them must, therefore, be a key element of establishing India as a major player in the innovation/knowledge-creation arena. The angel-funding available to new start-ups in India is yet very limited. Rather than the government directly providing such funding, we suggest that it stimulate the evolution of a professional seed-funding community. To do this, we recommend the creation of a fund that underwrites ("insures") a certain percentage of the seed-funder's investment in a start-up. This will stimulate the appetite for risk, and get more funds into this space.
 - b. Rewards should be given to innovators for further motivation. In addition to monetary elements, these rewards must also give due recognition – could be in form of marketing an innovators capability in print media, sponsoring the innovator as a keynote speaker in national and international conferences, nominating the innovator for various national / international awards in the R&D sector, and providing

certain policy-making powers.

8. Major centres of technology education and research be encouraged to set up Enterprise Units, organised as independent societies or not-for-profit associations, to (a) provide group consultancy services to industry, (b) undertake contract research for industry (c) partner with private companies for activities like Technology Parks (d) support incubation activities for new ventures within the institution.
9. Leading technology institutions should be encouraged to setup profit-sharing Enterprise Incubation Units, organised as independent societies, able to hold equity and well connected with the local business community. The functions of such an incubation unit would be to (a) provide advisory services and negotiating support to the client entrepreneurs, (b) assist in filing patents and protecting commercially valuable intellectual property, (c) host enterprises at the seed stage with space and other facilities for a short time, (d) forge links with entrepreneurs, alumni and venture funds. Such incubation units should be eligible to receive grants up to 50 per cent of their expenditure from government schemes for entrepreneurship development. Enterprise Incubation Units in research institutions should be exempted from tax as long as they use the returns for further innovations/ entrepreneurship development.

The focus on developing an ecosystem of R&D and innovation will supplement the industry's efforts to move up the value chain in terms of business model evolution and services provided. Further, the government should also encourage technology led R&D in related areas such as embedded systems and hardware development.

In addition to developmental research, it is also necessary to build capabilities in new / emerging areas that are likely to grow in importance over the next few decades. Five areas identified for core research focused investment (potential critical areas in the future):

- a. Security
- b. Mobile and communications
- c. Health, biotechnology and life sciences
- d. Energy and environmental protection
- e. Nanotechnology

Efforts aimed at fostering a sustainable innovation ecosystem in the country will remain incomplete without active linkages with development of the domestic ICT market. While the domestic market is being analyzed in detail by a separate study group, the following initiatives can help enhance Indian IT-BPO export growth indirectly, through the development of the domestic market.

1. Increase government led IT usage; become a model for successful usage of technology for governance in developing countries.
2. Encourage public usage of IT in the country through 3-4 key e-governance initiatives that facilitate citizen welfare; provide access (service and infrastructure) free / at significantly subsidized rates to drive adoption; increase IT literacy.
3. Drive IT adoption in the domestic commercial sector, especially in significantly under-penetrated sectors such as retail, hospitality, etc.; development of applications better suited for nascent, bottom-of-the-pyramid segments.

Table 4 : Worldwide Spending on Software and Related Services

USD million	2004	2005	2006	2007	2008	2009	CAGR FY04-09
Worldwide Services Total	800,601	863,187	935,649	1,013,144	1,099,516	1,197,874	8.4%
Worldwide Software Total	193,176	205,704	219,758	234,847	250,209	266,031	6.6%
Total	993,777	1,068,891	1,155,407	1,247,991	1,349,725	1,463,905	8.1%

Source: IDC, NASSCOM

Table 5 : Indian IT-ITES Exports Forecast 2006-2020

US\$ billion	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
IT-ITES Exports	23.6	29.8	37.6	47.5	60.0	72.1	86.6	104.0

US\$ billion	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	CAGR FY2006-20
IT-ITES Exports	124.9	150.0	175.5	205.3	240.2	281.1	328.9	20.7%

Source: NASSCOM McKinsey Report 2005; Consensus Estimates

Table 6 : Estimated Financial Outlay for Specific Recommendations (over the XI Five-year Plan Period)

INITIATIVE	AMOUNT (INR Crore)
Finishing School (Pilot scale estimate)	150
'Incredible India' Branding	100
Market Intelligence Service	250
Upgrading existing NIT's to IIT grade institutes (estimated for 19 units)*	3000
Recommended Technology Research and Development Fund Budget (4-5% of annual export revenue target over the 5 years)	70,000 [†]
Total	73,500

* Cost of Greenfield units required (estimated at INR 90,000 crore) not included in this outlay.

† The total R&D spend by the Government and Industry would work out to Rs. 70,000 crore. Major portion of the R&D spend would come from the private sector. Significant portion would also come as a component of various technical programs/projects of the Government. Additionally, Government need to sponsor programs focusing on fundamental research.

Domestic Computer Software and Services

Introduction

Over the past few years several initiatives have helped to demonstrate the potential to use ICT in working towards developmental goals such as poverty alleviation, increased access to education and health services, and reduce gender inequalities.

Poverty alleviation programs have leveraged ICT to increase opportunities for wage employment and micro-entrepreneurship. Use of technology has also helped raise the magnitude and reduce the vulnerability of returns earned by small producers from their economic activities by providing timely access to relevant information (e.g. details about the best prevailing prices for farmers, location of fish shoals for fishermen, weather reports, etc.). Further, direct effects of ICT on poverty reduction may also be achieved through a reorganization of economic activity that allows producers increase their returns.

Besides the direct contribution that ICT can make towards alleviating poverty, it can also contribute indirectly by facilitating and reducing the costs of delivery of services that either promote wage and self employment or help overcome structural constraints to poverty alleviation, and by improving the quality of delivery of employment generating and poverty alleviating projects being implemented by the government.

ICT can play a role in bridging gender disparities by directly benefiting the women who use technology as well as by improving the delivery of services to women. This is also reflected in the relatively higher proportion of women employees in the Indian IT-ITES sector – as compared to other sectors of the economy. The influence on gender equality is not restricted to the urban cities alone. There are also examples where ICT is being used to strengthen earning opportunities for women and to build productive skills among disadvantaged women as well as offer knowledge-based services that help improve the productivity of women's enterprises in smaller towns and cities.

Technology may also being applied towards building an equitable knowledge based society by facilitating better access to education people in remote locations or from underprivileged sections of the society in an economical manner. Potential gains from ICT in health have been

highlighted through some grass-roots usage experiments in which ICT has been applied to increase the efficacy of social service delivery.

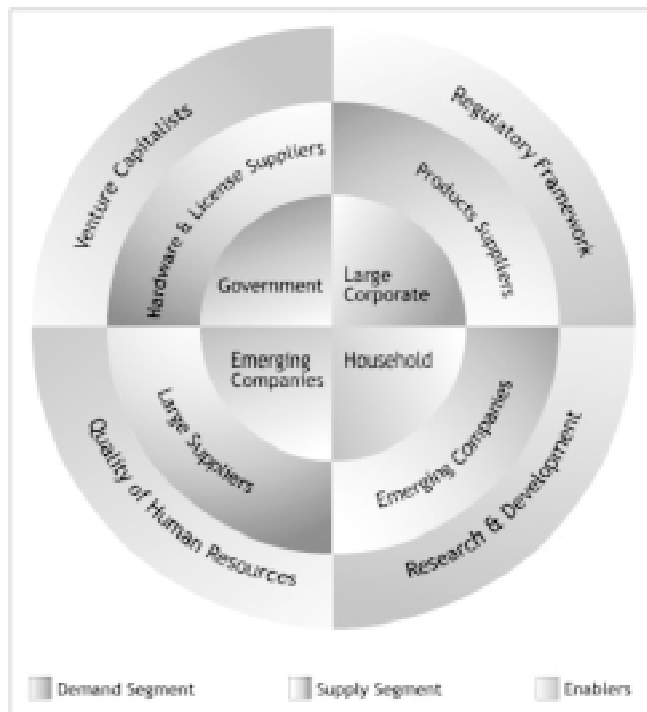
However, widespread diffusion usage of ICT is imperative for these gains to be realized on a large scale. Though still lagging behind global benchmarks, India has made steady progress on this front in recent years. For instance, the average teledensity across OECD countries is over 60 per cent. In comparison, teledensity in India reached double digits for the first time in 2005 and stood at 11 per cent at the end of November – growing by nearly 30 per cent over the previous year. The mobile segment is witnessing explosive growth with nearly 27 per cent of 71.5 million subscribers being added in the first 8 months of 2005. Access to telephones in Indian villages has improved significantly in the last five to six years through the introduction of the Public Call Office (PCO) run by local shopkeepers. As of September 2005, there were over 3.6 million PCOs across the country – a growth of 60 per cent over the previous year. Nearly 86 per cent of the villages in the country now have at least one phone including over 535,000 Village Public Telephones (VPTs). The total internet subscriber base in the country crossed 6.1 million during the quarter ending September 2005. While India does have a relatively higher penetration levels for alternate mediums such as terrestrial TV, cable and radio, they are still inadequate to realize the full potential of large scale projects designed to use ICT for human development.

Strong demand over the past few years has placed India amongst the fastest-growing IT markets in the Asia-Pacific region. The Indian software and ITES industry has grown at a CAGR of 28 per cent during the last 5 years and the industry's contribution to the national GDP has risen from 1.2 per cent during the year 1999-2000 to a projected 4.8 per cent during 2005-06.

Today, a majority of the companies in India have already aligned their internal processes and practices to international standards such as ISO, CMM, Six Sigma, etc., which has helped establish India as a credible sourcing destination. As of December 2005, over 400 Indian companies had acquired quality certifications with 82 companies certified at SEI CMM Level 5 – higher than any other country in the world. The total number of IT and ITES-BPO professionals employed in India is

estimated to have grown from 284,000 in 1999-2000 to 1,287,000 in 2005-06, growing by over 230,000 in the last year alone.

However while the export component of the IT industry has grown aggressively, the domestic IT market has not grown proportionately. In 2005, the domestic IT market accounts for one third (approx USD 12 billion) of the total IT industry size (US 36 billion). With an average growth rate of 25 %, the domestic IT market has progressed but still there are huge opportunities waiting to be tapped. A schematic representation of the domestic IT market is as follows:



As evident from the above schematic, the domestic IT market is not homogenous but an aggregation of heterogeneous segments. It is important to understand the needs of each segment before formulating action plans.

Some of the key highlights of the current situation in the demand and supply segment are as follows:

Demand Segment

- E-government initiatives are mostly decentralized leading to effort and investment duplication
- Pace of IT investment in Government departments is slow and there is no time-bound plans especially at the individual state and ministry level

- IT spending among Indian businesses continues to trail US / UK benchmarks – 1.5 % of annual revenue v/s 5.5 % of annual revenue
- Indian businesses maintain internal IT departments leading to transactional relationships with vendors. This often leads to a higher threshold of technology upgradation
- IT usage pattern is focused on automating processes instead of enabling business transformation
- Household usage of IT is low due to very few B2C applications
- IT penetration in emerging companies is low with only 17 % of SME' computerized
- Lack of products / solutions / services for emerging companies segment leads to a poor IT adoption in critical business processes
- Poor infrastructure (connectivity, power, support and service etc) in tier 2 and tier 3 towns
- Regulatory environment needs to incentivise IT consumption not merely deployment
- IT penetration in many verticals significantly lags behind international benchmarks (insurance, education, healthcare, travel).

Supply Segment

- ROI from domestic market business is not comparable to export business
- Price sensitivity of Indian consumer requires creating India specific products which requires investments which many SMB suppliers can ill afford
- Lack of access to funds, business skills and market knowledge inhibits entrepreneurs
- Non-uniform tax environment for domestic and export sales
- Imports Tariffs are high as compared to international benchmarks
- Complex Government procurement procedures increase cost of sales and discourage emerging IT companies
- Lack of compliance with copyright, patent laws and unsatisfactory enforcement inhibits IP / product creation
- Common infrastructure often cannot be used for domestic and export work thus increasing fixed costs
- Inadequate effort to access to Government / academia IP assets for commercial work leads to high cost of innovation

The following sections will discuss the above challenges in more detail.

The Study Team on Domestic Computer Software and Services discussed strategies for India to become world leader in terms of Domestic Computer Software and Services, assessed the impact of IT on various sectors of economy and suggested measures to improve adoption of IT for increasing productivity. The team also discussed how to accelerate the National e-Governance Plan and align it favorably with domestic software & services market. The issue of filling the digital divide and that of developing content in local languages was also given due consideration by the Study Team. Cyber security and R&D issues were also discussed during the meeting.

2. Current state of the Domestic IT and ITES Market

The domestic IT market in India was valued at approximately INR 54,000 crores in 2006. Although this segment is estimated to have grown at a CAGR of 19.7 per cent over the past six years, it has fallen short of the projected 22.1 per cent (CAGR over 2000-2010). This contrasts negatively with the higher than projected growth in the exports segment over the same period.

The implications of the slow growth are further accentuated when we compare the levels of ICT penetration in India with other developed as well as developing economies – highlighting significant untapped potential. Market trends over the past 2-3 years have indicated that increasing levels of competition and

exposure to global practices are having a positive impact on the growth of IT adoption in select segments of the market. This may be extended to catalyze growth in other segments through appropriate policy action.

2.1 Key market components

Hardware accounts for a majority share of the domestic IT market in India. Though spending on services and the outsourced model has gained some traction over the past 18-24 months, it has not yet achieved the service oriented nature observed in more mature markets.

2.1.1 Hardware

Hardware systems account for more than half of the domestic spending on IT hardware – with MNC players accounting for a significant share of the market. This segment of the market is estimated to have grown at approximately 19 per cent last year and is currently valued at approximately INR 28,000 crores (FY 2005-06).

2.1.2 IT Services

Domestic demand for IT in India is witnessing a gradual transformation from being predominantly hardware driven towards a solutions oriented approach – resulting in a growing emphasis on services. In fact, revenue growth in the services segment alone has reported faster growth than that for the overall domestic IT market (including hardware, software and services) over the past few years. As depicted in Figure 2, this trend is expected to continue over the forecast period.

Figure : 1 Domestic market coming into its own, to grow by nearly 22% in FY 2006

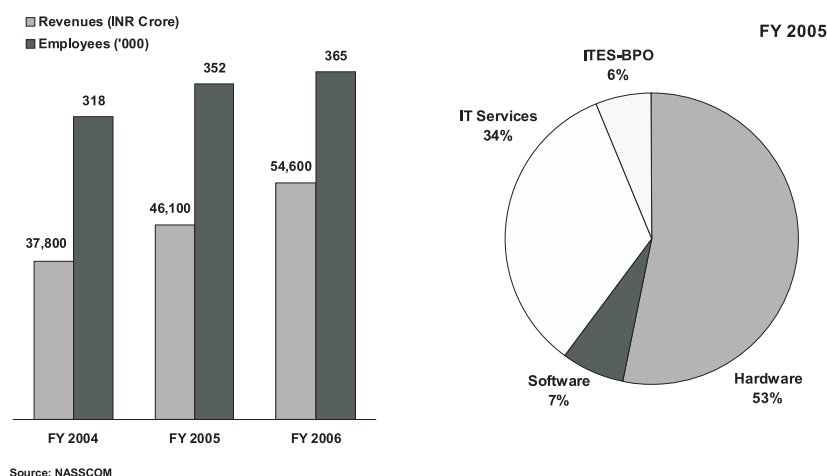
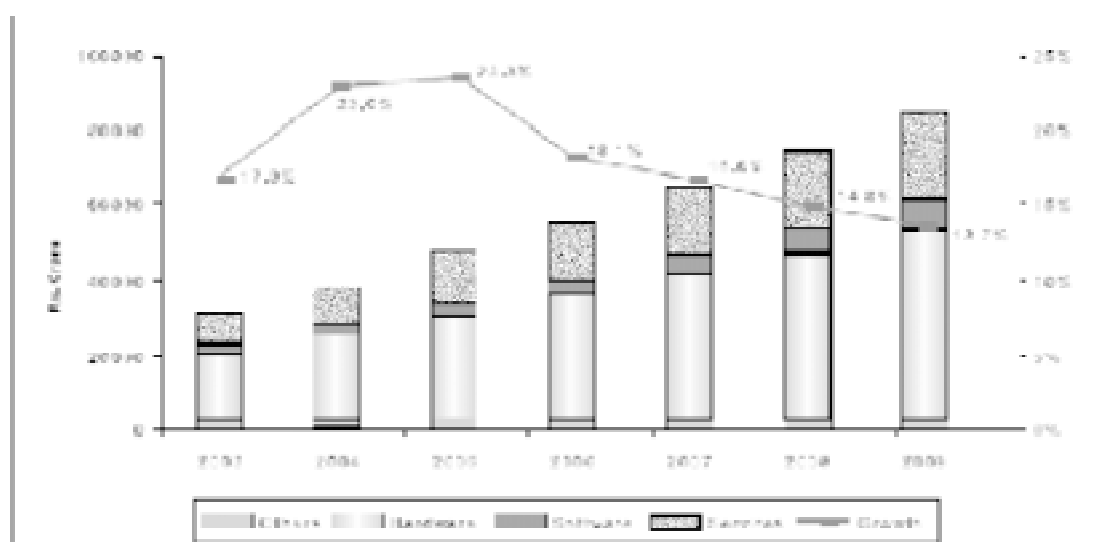


Figure 2 : Growth of IT Spending in India



The liberalization of Indian economic policy, deregulation of key sectors and progressive moves towards further integrating India with the global economy has been a key driver of increased IT adoption in the country. This is best reflected in the fact that most indigenous players in telecom and banking, two key sectors with significant multinational corporation (MNC) participation, have significantly upgraded their levels of IT adoption to offer best-in-class services comparable to those offered by the global competition and these two sectors together account for approximately 35-40 per cent of the domestic spend on IT services.

Similar competitive pressures in other more recently deregulated service sectors such as airlines and insurance, and the uptake in the manufacturing and

industrial sectors; and the several large e-governance initiatives launched by the government under the National E-Governance Plan (NEGP) are expected to provide sustained growth in domestic demand for IT services over the next few years. Over the next five years, domestic spending on outsourced IT services is projected to more than double, from INR 103 billion in 2004 to over INR 238 billion in 2009.

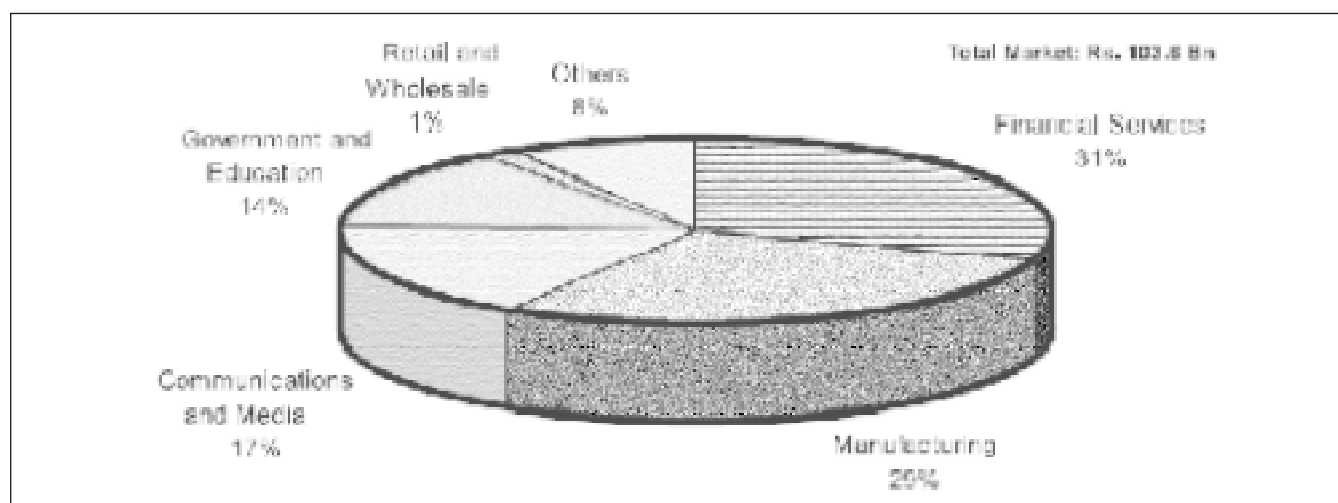
Systems integration and network integration make up a high growth-large size category within the IT services engagements. These services will continue to be prime drivers of the domestic IT services market in the enterprise segment due to the increasing growth in the enterprise application implementation and increased demand for network integration from telecom & banking verticals.

Table 1 : Five Year Revenue Forecasts for Key Service Lines in the Domestic Market (INR Million)

Breakups	2004	2005	2006	2007	2008	2009	CAGR
IT Consulting	4,784	5,669	6,775	7,774	9,109	10,674	17.4%
System Integration	34,011	42,979	51,900	62,065	72,960	85,399	20.2%
Application Development	13,997	17,115	19,852	22,586	25,113	27,924	14.8%
End-to-end Outsourcing	6,328	8,221	10,247	12,343	14,344	16,850	21.6%
Discrete Outsourcing	16,731	21,055	25,819	31,401	36,262	41,509	19.9%
Deploy and Support	23,631	28,321	32,907	37,651	42,510	48,186	15.3%
IT Education and Training	4,126	4,879	5,609	6,534	7,260	8,067	14.3%
Grand Total	103,606	128,239	153,109	180,354	207,559	238,607	18.2%

Source: IDC, 2005

Figure 3 : Key Vertical Markets and Domestic Software



Source : IDC, 2006

Domestic IT Services Revenues by Key Vertical Markets (2004)

The financial services, communications and media, and manufacturing verticals accounted for over 3/4th of the revenues earned by service providers in the domestic IT services market in 2004.

2.1.3 IT Software products

Application software accounted for approximately 43 per cent of domestic spends on software in 2004. Total revenues in this segment were estimated at INR 13950 million in FY 2004-05 and projected to reach INR 16650 million in the current fiscal.

Demand for business intelligence products is projected to grow by 25 per cent in the current year, to cross USD 10-11 million in FY 2005-06. Other categories of the application software market, such as collaborative software, content applications and industry-specific applications continue to witness modest growth. The market for collaborative software applications is valued at approximately USD 10-12 million (2005, FY 2005-06).

Table 2 : Domestic ITES-BPO Revenues

	2004	2005	2006
HR	2428.9	4412.5	8019.5
F&A	2563.9	2975.4	3454.1
Customer Care	7696.1	16161.8	33939.7
Sales & marketing	8465.2	12019.6	17756.4
Other	2059.2	2449.4	2914.6
Total	23213.3	38018.6	66084.4

Source: IDC, 2005

2.1.4 ITES-BPO

ITES-BPO is a very nascent segment of the domestic market, driven by voice based services with customer care and sales and marketing activity accounting for approximately 70 per cent of the total.

Domestic ITES-BPO Revenues (INR Million)

Currently, the BFSI and Telecom verticals account for over 70 per cent of the demand for ITES-BPO services in the domestic market.

Table 3 : ITES-BPO Revenues Vertical Market

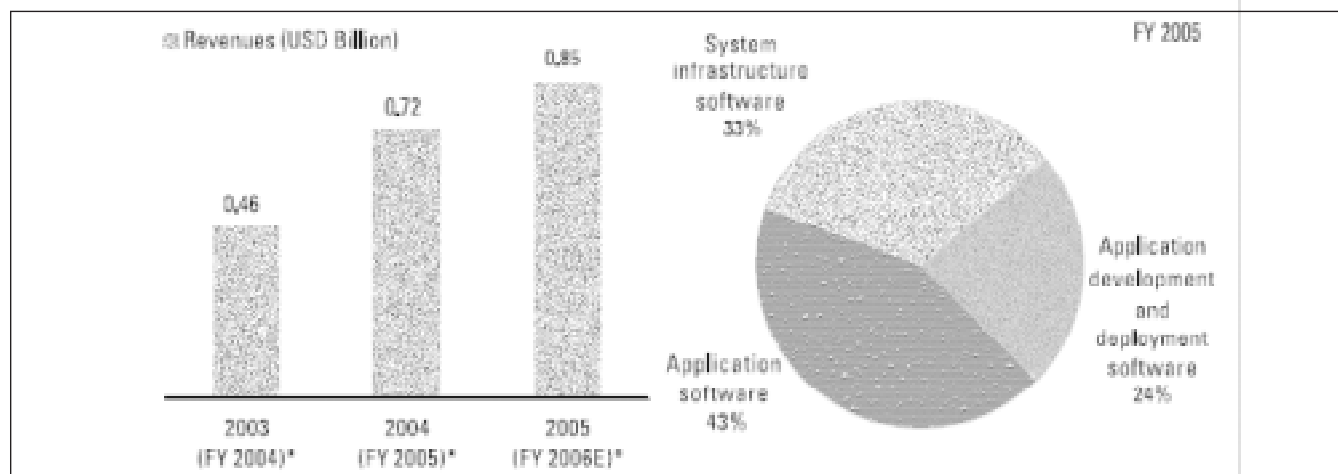
Verticals	% Share (2004)	Typical Process Outsourced
Banking and Financial Services	47.1	Customer support, marketing and sales, collections, billing, transaction processing, market analytics, HR
Telecom	24.1	Customer support, cross-selling, loan processing, claim processing, market analytics, data validation, HR
Manufacturing (Consumer Durables/Automobile)	12.2	Customer support, sales and marketing, transportation, supply chain management, accounts payable/receivable
Others (IT-ITES, Aviation, Hospitality, Retail)	16.4	HR, Customer support, marketing and sales, billing, transaction processing, analytics, etc.

Source: IDC, 2005

Domestic ITES-BPO Revenues by Vertical Market (2004)

While cost savings have been the primary driver of offshore outsourcing, vendors do not have comparable differences in labour costs to leverage while serving the domestic market. As a result, the primary motivation for the domestic market, in its early years of evolution are

Figure 4 % Domestic Software Products (including packaged software) Market : Growth Trends and Share of Key Segments



* Calendar year figures are comparable to the closest fiscal year, eg. CY 2003 is comparable to FY 2004

Source : NASSCOM, IDC

not cost savings but access to specialist skills and freeing client resources to focus on the core business. Scalability and process efficiency is expected to return some degree of cost savings in the domestic market as well. However this may not compare with the levels achieved by overseas (e.g. US/UK) clients.

Notwithstanding its relatively smaller contribution to the industry revenues, this segment has over the past twelve-eighteen months witnessed a noticeable increase in interest and activity on the part of customer organizations as well as service providers.

2.2 Challenges for increasing IT adoption

Low ICT penetration and usage compared to global benchmark levels is the primary factor constraining domestic IT market growth in India. Key challenges that need to be addressed in order to increase ICT penetration and usage across user segments, and drive growth in the domestic market include:

1. Demonstrating the business benefits of IT and reducing cost of adoption
2. Increasing levels of IT literacy
3. Integrating IT usage into everyday life.

2.2.1 Demonstrating the business benefits of IT and reducing cost of adoption

Although awareness about the operational efficiencies achievable by leveraging IT has been growing steadily,

the cost of switching to IT-based systems is still a key factor constraining its business adoption – especially for the SMB segment. Over the past few years, increasing global competition and rising customer expectations have driven businesses in a few sectors such as Banking and Telecom to increase their IT investments – with positive results. However, widespread adoption of IT in the domestic corporate sector is still low – as competition in many segments is still not so compelling – and the additional investment is not considered a business imperative. Hence, there is a strong need to incentivise business IT spending to spur adoption.

2.2.2 Increasing levels of IT literacy

Retraining of existing employees to use new IT systems is a significant cost for businesses beginning to adopt IT – that may be reduced considerably if the existing staff is already IT literate. Further, knowledge of IT applications is often a precursor to their innovative use in solving business problems. Lastly, increasing widespread IT literacy is integral to addressing issues of the digital divide.

2.2.3 Integrating IT usage into everyday life

At about nine computers per 1,000 people compared to a global average of 27 computers per 1,000 people, and over 500 in the United States, notebook and PC penetration levels in India are still very low. While hardware prices have been declining steadily over the past few years, and have had a noticeable impact on volume growth, PC penetration has not grown as rapidly as desired. In contrast, mobile

telephony (introduced in India much later than the PC) penetration has grown very rapidly. The key factor explaining this difference is the higher degree of 'usability' of the mobile phone – for the average Indian user. As a result, while the mobile phone ranks amongst the first few durable goods that a household purchases, the PC is often missing from that list. Not only does this result in lower IT usage – but is also forms a systemic barrier to increasing IT literacy.

3. Status and Review of Tenth Five Year Plan

3.1 Infrastructure

State Wide Area Networks (SWANs)	Under National eGovernance Plan, many states have already setup their State Wide Area Networks. The Cabinet Committee on Economic Affairs (CCEA) has approved the scheme for establishing State Wide Area Networks across the country in 29 States/ 6 UTs at a total outlay of Rs.3, 334 crore. SWANs will be established from State Headquarters upto the Block level with a minimum bandwidth capacity of 2 Mbps.
State Data Centres	State Data centre has been identified as one of the important element of the core infrastructure for supporting e-Governance initiatives under NEGP.
	Integrated Service Delivery Centres – CSCs - A draft Framework for establishment of 100,000 CSCs across the country has been finalized and published by the Department of Information Technology (DIT) website
PC penetration	The Department of IT has conducted a study on 'Improving PC penetration in the country'. The report envisages a seven-fold growth in the domestic IT market by 2008 with annual PC sales at 28 million

3.2 Research & Development

- Horizontal transfer of successful e-Gov Applications.
- Pilot replications of successful e-Governance projects

(Land Records, Property Registration and Transport).

- **India Portal** – launched successfully. India Portal is envisaged to be a unified portal for accessing information in the Government Sector.
- **Service Delivery Gateway** - This Gateway would enable standards based communication linkages between the back end applications in the departments with the Service Access providers and will facilitate joined up services.
- **Indian Language Data Centre and TDIL Portal** was initiated -To disseminate Indian language technology products and provide support to users (www.ildc.gov.in).

3.3 Skill Development

- **Capacity Building** -The Department of IT has issued Capacity Building Guidelines to all the States and Union Territories (UTs) for providing technical support to respective State government policy makers. The State Governments have already submitted the proposal for Capacity Building implementation.

DIT has taken initiatives with all the State governments and UTs for capacity building to bring more capacity in the government to implement and execute various e-governance plans and projects within a definite time frame and properly formulate the projects and provide services to the citizens. This is not only in terms of technological ability but also in terms of how to conceptualize and manage and execute various programs and projects, such as chain management, product engineering etc, which are not easily available.

- **Human Resource Development in Language Technology** - A project for introducing 'Master' level and 'Post Graduate Diploma' level courses in the domains of Knowledge Engineering, Computational Linguistics and Software Localization has been initiated at eight institutions in India.

4. Eleventh Five Year Plan Recommendations to increase Domestic IT market

As part of the IT Vision for India, some of the key national IT targets are as follows:

1. Increase the PC penetration to 65 per 1,000 from the 11 per 1,000 PCs in 2004
2. Increase the Internet penetration (subscribers) to 40 per 1,000 by 2008 from the current
3. All villages to be made online for agricultural services, health care services and education

4. Total yearly PC market at 28 million from the current 4 million
 5. Domestic software market to grow 7 times from the current
 6. 1.8% of the GDP growth from contribution of the Domestic IT implementation
 7. Out of the proposed 6% of GDP spending on education in the NCMP, 1% should be set aside for IT-support to education through PTICs, HSPTICs, local language content creation, installation of PCs in each of the government primary and secondary schools.
 8. Out of the proposed 2-3% of GDP allocation for public spending for health over the next 5 years, with focus on primary health care, 0.5% should be set aside for telemedicine support to deliver medical services to rural and remote parts of the country.
3. Create new business models suited to the needs of the SMB clusters. The complexity and cost of IT is a strong deterrent for SMB firms to adopt IT in a meaningful way. New business models e.g. utility computing, software as a service, etc., will need to be promoted to reduce the cost of IT adoption

To aid this to happen, the Government can play a very pro-active role as it played in the 1950's and 60's when a very coordinated strategy was adopted by the Government at both Central and State level to promote automation in the industrial clusters. Setting up of shared facilities including tool rooms, education and training programs, funding assistance were integral part of these initiatives and it resulted in a significant uptake of automation in the industrial clusters.

As the scheme in Section 1 indicates, the domestic IT market is a not homogenous but an aggregation of heterogeneous segment, each of which will require specific action plans to address their needs. Some of the levers to accelerate the growth of the domestic IT market are discussed below.

4.1 Increase IT adoption in the SMB segment

A key segment in India which has severely lagged behind in IT adoption has been the SMB segment across sectors. While the larger firms (>1000 crores annual revenues) have largely adopted IT as a critical element of competitiveness, the SMB sector has lagged behind. The SMB sector therefore represents a huge lever to increase IT adoption and accelerate the domestic IT market. However doing this will not be easy as what has worked with the larger firms will not work with the SMB segment both in terms of products and business models.

To increase the IT adoption in the SMB sector, a cluster oriented approach is required. There are nearly 450 industrial clusters in India as per a UNDO report. A cluster development strategy will need to address the following issues:

1. Increase awareness of positive role IT can play in business growth. This is very important as IT is often looked at only a tool for creating task efficiency and not as an enabler for business growth
2. Understand the business needs of each cluster. Every industrial cluster will have certain critical business processes where deployment of IT is needed more as compared to deployment in routine processes as accounting, HR etc.

4.2 Increase efficiency of E-governance investments

Adoption of IT in governance has several potential benefits. These include direct benefits such as increased operational efficiencies, greater transparency and accountability. Additionally, e-governance solutions can be an effective means of driving IT access and adoption to the masses; and become a key source of employment generation (as a part of the various e-governance projects, delivering public services through the use of IT).

Recognizing the importance of the role that ICT can play in the country's development, the Indian government has initiated the National E-Governance Plan for implementation during the years 2003-07, which lays out the blueprint for a more e-enabled India. Building on the objectives of this vision are several mission mode projects that are already underway and a few of which are beginning to see early signs of success. However, it is also observed that some regions have been more successful in implementing these projects. It is recommended that greater emphasis be laid on the adaptation of successful model in other regions in a time-bound manner to promote balanced e-readiness in the country.

The vision of the National e-Governance plan is to:

“Make all Government services accessible to the common man in his locality, through common service delivery outlets and ensure efficiency, transparency and reliability of such services at affordable costs to realize the basic needs of the common man.” The NeGP emphasizes on:

- Public service delivery
- Measurable outcomes
- Clearly defined Citizen Centric Services and Service Levels (SLAs)
- Transparency and accountability
- Development of sustainable revenue models for implementing eGovernance projects
- Participation of private sector in infrastructure development and service delivery

The plan has identified 25 Mission Mode Projects — of which 10 are in the State sector, 8 in the Central sector and seven are integrated projects. A total investment of INR 26,000 crores has been earmarked.

However it is important that the efficiency of the investments in e-Gov initiatives have to improve significantly if the NeGP has to meet its objectives of better governance and social improvements. To monitor progress, the focus has to shift from outlays to outcomes.

Some specific recommendation for improving the efficiency of e-Governance initiatives are as follows:

- Encourage the use of IP / products developed by Indian companies in e-governance projects.
- Encourage the Central and State governments to procure e-governance services rather than procuring hardware, software, services, and networks separately. This will bring about a more outcome based procurement model as compared to the current outlay oriented model.
- Encourage reusability in e-governance projects at both the infrastructure and application level.
- Encourage the banks and financial institutions to fund e-governance projects above a certain size as a priority sector funding.
- Fast replication of already successful e-governance programs.
- Define interoperability standards / criteria and ensure that e-governance applications adopt these standards irrespective of the vendor supplying the technology.

- Incentivise citizens for using online services.
- Prepare a detailed e-governance plan for each central ministry and state which details a time-bound schedule for implementing e-governance. The budgetary support from the central government for the e-governance initiatives can be linked to achievement of specific milestones.
- Ensure that e-Governance applications are IPv6 ready.
- National programme on replication of already successful e-governance projects having potential to enhance citizen services.
- Bring private sector investments and expertise into the e-governance domain by evolving sustainable PPP models.
- Maximize Government transactions online through development of content in local languages.
- Sensitizing citizens for using online services
- National Citizen Database with the National ID card will prove to be the corner stone for the e-governance drive in India.
- Delivering e-services to the villages by using, existing infrastructure, to the extent possible, such as:
 - Post offices
 - Village STD booths
 - Village telephone exchanges etc.

4.3 Increase Digital Signature / Security issues awareness and acceptance

After many years of indifferent performance, e-commerce is beginning to rapidly grow in India at both B2B and B2C levels. Adding to the increase in e-transactions will be the G2C interactions. However the cornerstone of a successful e-commerce environment is data security. Unfortunately this area has been relatively neglected in the recent years. Some specific recommendations to create an increased awareness of digital security and ensure adoption are as follows:

- Make digital signatures mandatory for e-commerce initiatives
- Fund/sponsor “Know Digital Signatures” campaigns
- Apply accredited digital signature to e-Government initiatives
- Banks to employ digital signatures in electronic banking
- Identify and Develop “Killer Applications” – Online auctions, e-Voting, Home Banking etc

- Electronic Fund transfers-Implementation of legislation to recognize electronic fund transfers to provide an impetus to E-Business transactions in India. Providing a common platform for banking transactions and promoting use of Internet banking by SME's
- Security is a major concern for users on a public medium like the Internet. Hence, the prevailing restriction on using encryption higher than 40 bits should be removed and the new limit (at least 512 bits, if at all to be fixed) must be reviewed annually.
- Security audit of all services being provided through CSCs must be done by reputed organizations to ensure authenticity of transactions and data.

4.4 Education and Skill Development

- To supplement skills in the existing pool of (unemployable) resources, a nationwide 'finishing school' program needs to be initiated. The industry should put together the curriculum and faculty for this. However, other costs will have to be covered by student fees and it is recommended that the government provide subsidy/loans for this.
- Re-orient the education system to make it demand-based with the focus on ensuring employability of graduates through high-quality, relevant, need-responsive curriculum and teaching. Initiate an intensive program of curriculum updating/development and teacher-training, to address lacunae in relevance, topicality and pedagogic methods. This must be a joint academia-industry effort.
- Expand capacities at and the number of world-class institutions (e.g., IITs, IIMs, IISc), while ensuring that quality does not suffer. Funds required for upgrading existing NIT's (19) to IIT grade estimated at INR 2,850 crore. It is recommended that an additional 5 per cent (INR 150 crore) be earmarked for promoting distance education from these institutes to other institutes.
- Decentralize the education sector governance model, increase transparency and ease operational inflexibilities. Also encourage private sector participation in the education sector.
- Rating and accreditation by an independent agency must be mandatory for all educational institutions.
- A common nation-wide benchmark for assessing students is necessary. The IT-ITES sector has already begun work on the first such certification (for entry level in the BPO industry), this initiative needs to be supported and institutionalized by encouraging universities across the country to participate.

Eventually, it should evolve into something along the lines of Chartered Accountants Exam.

- Provision budgets for a significant increase in the number and value of scholarships offered to encourage a far greater number of graduates to pursue Masters and Doctoral programmes.
- Remove constraints to make teaching / academics as attractive a career option as working in the industry. Unshackle institutions for higher education from restrictions on fees and faculty remuneration.
- Formalize international (mutual) recognition of academic degrees and certifications, and encourage internationally renowned academic institutions to establish campuses in the country. This will not only help enhance the international acceptability of the Indian education system but also attract some of those Indian students currently going abroad to pursue higher studies – to remain in India.
- Encourage students and working professionals to pursue further education for skill enhancement by providing tax incentives.
- Encourage active involvement of industry in university-level education to make the graduates more employable. To this end, it is recommended that a portion of the education cess be earmarked for the tertiary level and that this fund be administered by a joint government-industry-academic group.
- Periodic review and updating of curriculum to make it more industry-oriented will also require faculty to constantly upgrade their skills. This can be best facilitated by greater industry-academic interaction.
- Upgrade the ITI infrastructure by introducing ICT vocational education. This education should include courses for PC and peripheral maintenance, broadband installation, desktop publishing, office productivity software usage etc.

4.5 Infrastructure

4.5.1 Telecommunication Infrastructure

- To spur competition in the domestic leased line market, PPC (Private Partial Circuit) should be mandated whereby the local loop has to be provided by an access provider to every other long distance carrier for the purpose of leased line.
- As a part of e governance delivery the connectivity of SWAN to village can be achieved in addition to leased lines and dial ups, through

- Broadband wireless
- Satellite based delivery

- **Support from USO found for Rural Broadband**

Support from the USO Found must be provided of all new rollouts if the service offering inherently and necessarily includes broadband in the rural areas; limiting the same to voice telephony alone would mean higher dependence on subsidies and lesser local support from the community. This would significantly reduce the load on subsidies.

- **Rural Internet Telephony**

Internet Telephony in rural/remote areas can easily be bundled with Broadband connection. One PC with broadband connection with Internet Telephony at least to a post Office, Panchayat and/or District Head Quarter. The bundle of services instead of plain Telephone can benefit rural mass immensely.

- **ISPs role in remote/rural Broadband Penetration**

A local ISPs can help peoples in remote/rural areas by providing them training, guidance and maintain their computers/systems. It can help in creating new employment opportunities for the rural people by encouraging them to start their own business (cyber dhaba).

Since local/small ISPs are closer to the user and in a position to know their social and financial conditions better than multiple service providers can provide the best possible route to entrepreneurship to rural mass with a sense of fulfillment of a larger social goal

Infrastructure Sharing

Effective use of National Internet Exchange of India (NIXI)

There is a need for setting up more NIXI nodes in different part of the country. At least we should target to cover every State Capital by 2010. For effective utilization of NIXI, it should be interconnected so even smaller ISPs can be connected to NIXI and will be able to save International Bandwidth and get better QoS for their users. NIXI should facilitate Indian users to connect to content hosted in India through domestic route.

Content Providers and Data Centres should be mandated to connect to the NIXI through ISPs so that domestic traffic remains within the country.

This would enable faster access, cheaper service and growth in usage of information. This would also give

a tremendous boost to content hosting in India. It is specially relevant to the content specific to India, like culture, rural folklore, Indian wisdom, tourism, mythology, local government information, market information, land records etc. NIXI would be enabler for such content, largely hosted abroad, to migrate to India. This would also help in better management of information security. As the content gets hosted in the country, scope for disruption in information flow would reduce due to any hostile situation and sanctions etc.

SAARC Internet Exchanges

India should also take a lead in connecting with various SAARC Internet Exchanges in to different NIXI Nodes. It will help all the SAARC countries to save expensive International Bandwidth as there is substantial traffic exchange amongst these countries.

4.5.2 Promotion of xDSL Technology

- India had 1.5 million broadband subscribers as on 31 May 2006 which is still far away from the policy targets. xDSL technology is one of the ways to accelerate broadband growth. However, the local loop must be unbundled in line with TRAI's recommendations to use it more effectively.
- Low-cost solutions should be explored to extend broadband into millions of homes that have cable connection but no fixed telephone.

4.5.3 Wireless in the Last Mile

- xDSL and cable extend broadband to only limited subscribers and beyond a certain level, we have to use wireless – even in urban areas and as viable media in much of the rural areas.
- Broadband Wireless Access (BWA) like Wimax is one of the most promising technologies in this context and spectrum in the 3.5 GHz and 2.5 GHz should be made available besides de-licensing in the 5.15-5.35 GHz and 5.725-5.825 GHz bands.
- Technologies like BVL (Broadband on Voltage lines) should be explored to address the last mile connectivity gap.

4.5.4 Effective Spectrum Management

- Frequency spectrum, being a national and natural resource, the National Radio Spectrum Management

System (NRSMS) must be updated with the relevant database of frequency licenses, actual usage and overlaid with the geo-spatial topography to determine availability of spectrum in different areas and assign the same expeditiously.

- Uniform spectrum pricing (applicable for all except for cellular mobile telephony) across the country must be reviewed and TRAI's specific recommendation on this issue be adopted and implemented.
- Global harmonization should be looked at, so that we derive benefit from low cost as a result from scale of economy. Part of the spectrum fees must be kept aside in a permanent non-lapsable 'Spectrum Relocation Fund'.

4.6 PC and Internet Penetration

- Education – All Government schools should have basic minimum IT infrastructure and connectivity.
- Expand the Village Knowledge Centre (VKC) concept across the country to deliver citizen services. However these need to move away from grant / subsidy model towards a model of micro-entrepreneurship.
- Fast track implementation of National Telemedicine Grid connecting primary health care network across the nation.
- Enable IT deployment in SMEs Easy Finance; 100% Depreciation for IT products.
- Encourage IT adoption in homes by enabling loans for PC purchases.
- Easy Finance/loans, Offer Loans to all Government Employees (currently available only beyond a certain scale).
- Media Campaign for Awareness: Industry-Government partnership
- Focus on development of applications and content in local language
- Incentivise production of multi lingual software.

4.7 Increase development and deployment of multi-lingual products

India has 22 official languages and this advocates the requirement of content in local language for different regions. Enabling all Government transactions online, necessitating development of content in local languages. Software applications for domestic use should be useable by more than 50% of the population rather than by restricting them to a mere 5% of the English speaking

population. In the medium and long-term, multiple (Indian) language software and content is essential, so that penetration extends beyond the limited English-knowing population. In the short term too, content in various Indian languages is essential, but software could be in English since the extent of English-language knowledge required for this purpose does exist. As noted, further (long-term) growth will require multi-lingual software.

Some specific recommendations to achieve this are:

- A web-based repository of best practices should be created for content, software and language based applications and this must be available in the public domain (free).
- The State and Central Governments must be mandated to deploy Local Language interfaces on the citizens front/citizen services.
- Industry associations should take up the mandate of evaluating and certifying local language software.
- Vendors need to ensure a wider availability of their products and solutions for their prospective customers. While traditional distribution channels need to be utilized, vendors will also need to ensure that their products are available with DGS&D (Directorate General of Supplies and Disposal) and Apna Bazars (or similar such channels) for easy purchase by Government.
- The Academia and Research Institutions should form alliances with the Vendors or bid for sponsorships from Vendors for Local Language IT application development.
- Finalization of standards at multiple levels, viz., for font, for script, for indexing and for hardware products should be taken up on an urgent basis.
- Generating support for encouraging the use of Indian languages through multilingual user interface, which includes, multilingual desktops, operating systems and keyboards, etc.
- Promoting adoption of Internationalization (i18n) Development Framework for e-Governance Application Software.
- Product documentation for CSCs should be in at least one of the 22 official languages.

4.8 Increase commercialization of domestic R&D

- Encourage creation of consortiums between vertical industry and research institutes for focusing on

specific technology initiatives. To incentivise the industry to participate in such consortia, the industry' investments in these projects should be treated as R&D expenses.

- Identify specific technology areas / sectors where India can leapfrog available technologies. Selection of these sectors can be based on the following criteria:
 1. Where India has a potential to assume global leadership e.g. pharmaceuticals and bio informatics
 2. Where a large domestic demand and global opportunity necessitates developing domestic technology e.g. automotive infotonics
 3. Where technology can play a transformational role in national development e.g. Wireless (Wi-fi, broadband etc).

For the above sectors, it is important to create consortiums between Government institutions and user industry and IT industry on a PPP model. Given the large scale of investments required, the Government should consider creating a specific corpus on the lines of the infrastructure fund to fund these consortiums programs.

- Industries utilizing domestically created technologies e.g. the output of above consortium projects, should be allowed tax holidays on revenue accrued through deploying domestic technologies.
- Allow industry funding university research as direct R&D expenses.
- Incentivise vertical industry to establish R&D centers within or in collaboration with academic/research institutes. While some enterprises have established.
- Allow academics / Government scientists to take sabbatical leave for fixed duration and work in the industry.
- Enact enabling legislations to define clear policies for transferring Government owned/funded IP to the public domain on a commercial basis. The US Bayh-Dole Act is a good model to study in this regard.
- Mandate that a certain proportion of a research institutes expenses should be funded through funds generated through IP asset sales.
- Create mechanisms for Government research institutes to showcase their IP assets to VC/ entrepreneurs.
- Allow Government scientists to incubate start-ups based on IP generated by them. The parent institutes can own the majority equity but the scientist

responsible for incubating must be allowed to hold some proportion of equity in the start-up.

- Promoting multilingual software applications and infrastructure supporting Indian languages.

4.9 Enhancing usage Free/Open Source Software (FOSS)

Indian domestic market is extremely cost-sensitive as well as language sensitive. As the market expands and volume increases the cost of computer hardware would be coming down steadily. Consequently, the software price would become an appreciable per centage of the total price. It is not expected that the proprietary software owners would reduce the price to increase the volume of the sale. The experience of last few years further strengthens this apprehension.

If computer adoption has to reach from current 1% of population to say 5% in next five years, we have to seriously pursue some other route, viz., that of Free/Open Source Software (FOSS). Today, all basic system software including Operating Systems, DBMSs, Networking and Web Services, various Application Software, etc., are available as FOSS. They are not only free, but in some cases far more efficient, superior, and robust to corresponding proprietary software. What limits the widespread usage of FOSS is the absence of market-driven mechanism of making the end-user aware what is available, where is available, how to use it, and hand holding support for its usage for considerable period. In brief, Indian domestic software users need, in addition to the availability of FOSS, is the continued service support of FOSS at lower cost.

Further, developing Indian Language software on proprietary platforms is not very commercially attractive proposition in cost-sensitive market of India. The absence of widespread usage of FOSS has, consequently, restricted the growth of software in Indic language, and this in turn, has starved the spread of computer to larger Indian commercial and home segments. This gridlock can be broken only when Government of India takes qualitative steps to make:

- Easy availability of FOSS for few identified application segments (e.g., e-governance),
- Making available all basic software as FOSS with Indic interfaces and make appropriate fund available for the same,
- Service support of FOSS at lower cost to all taluka towns, through Call Centers in all regional languages,

- Encouragement of development of Indic Software (may be proprietary) on FOSS platform through well thought incentive programs, (e.g., no sales tax or service tax).

4.10 Encouragement of E-Commerce & Connectivity

4.10.1 Encouragement of E-Commerce and Connectivity would help in the following ways

- Empowerment: In a large and diversified country like ours, connectivity is the only way to empower people so that they can have a say in issues that affect their lives. Empowerment is the first and the critical step towards inclusiveness.
- Equity: All pervasive connectivity and access is the easiest way to an equitable participation, equitable transaction and equitable say in governance, business and social issues.
- e-Infrastructure: India is an infrastructure poor country and it is unlikely that the development of infrastructure here will be able to keep pace with the ambitions and aspirations and needs of the people. One of the best infrastructures for the last 10 years has been the telecom and IT infrastructure and we need to leverage that much more and in novel ways to enable our people.
- e-Business: It is an accepted notion that business drives development to a large extent. E-business is nothing but doing the same businesses in a different way. In a way that is more efficient, has greater outreach and hence more inclusive, and more cost effective. In a country with poor infrastructure and high input costs, e-business is the best way to take business to the people.
- Entrepreneurship: Indians are known for their entrepreneurial skills but much of this is wasted due to obvious roadblocks. By promoting e-business, connectivity allows the flowering of entrepreneurship in the country. Any one with a small idea can capitalize on it as the cost of doing online business is much lower.
- Employment: government, commercial and social activities riding on all pervasive connectivity is likely to give an unprecedented boost to employment in

the country. This employment would not be based on narrow skills such as engineering, but would offer a scope to people with different levels and types of skills to be employed profitably.

- Efficiency: With better and pervasive connectivity, large part of our governance, commercial activities and social activities being conducted online, India and Indians will become more efficient as a nation.

4.10.2 In order to achieve the above we suggest two ways to create demand

First, Create Demand through Content.

The National E-Governance Programme is going drive a part of this demand. But we need to promote commercial and socially oriented content in a much larger way in the country.

Towards this, private sector and the non-government sectors should be encouraged to create more and more transaction based content which would give the citizens a reason to access PCs and devices as well as get connected.

We suggest two ways to achieve this:

- a) Instead of micro management, subsidies, opening VC funds other such measure which would directly involve the government in managing such schemes, we should work towards a national policy for 5 years which would be akin to the Internet Tax Freedom of Act (1998) of the US.
 - i. All legal commercial transaction carried out primarily through the internet should be free of service tax and CST for a period of 5 years.
 - ii. This is suggested because typically the online business activities are either free information or very low margin business and this business will not grow if at the outset an entrepreneur has to make a provision of over 15-20 per cent in additional taxation (this would leave no margin)
- b) Synchronous connectivity: This is very critical and is connected with the point above. Currently, the online business is supply side drive. People access what they are offered! In such a situation the vast majority of citizens in the rural and also urban areas become passive participants in the process and decide to keep away from the process. Synchronous connectivity would mean that rural and urban groups would also be able to offer to others their products and services.

This will make connectivity a two way traffic.

- c) Local language: More and more content should be generated in local language which will encourage citizens to connect. Currently it is a chicken and egg situation: no users hence no local content. Let us break this situation by mandating that all Indian websites need to carry information in at least two local languages. To encourage this local language based businesses can be given some exemptions. But what is more important is to adopt a universal standard (Unicode) for the whole country.

Second, Create Demand through Connectivity

- a) National E-governance programme may consider capturing rural supply side as in addition to the demand side so that rural India can offer its products and services to a larger internal and international market.
- b) Work with private companies to make three major cities (Mumbai, Delhi and Bangalore) wi fi enabled. No cost for access by consumers but charged for usage.
- c) Lowest telephony cost, high connectivity cost, surplus bandwidth lying in India. This is an anomalous situation. Bandwidth costs are proportionately high government should work closely with the industry to bring it down for the end consumers.
- d) When we are talking about connectivity let us only talk about high speed connectivity as per the government's definition of broadband and set them as standard across board.

4.11 National Digital Library

A National Digital Library (NDL) should be set up to increase access to content in electronic format and preserve rare content. Eventually linking it with better and bigger digital libraries worldwide. Such a National Digital library will.

- Foster and Strengthen learning skills – moving from collection centric approach to learner centric approach
- Strengthen country's identity by digitally preserving the national cultural heritage and intellectual output
- Utilize country's resources

Department of Information Technology has already set up a National Digital Library (NDL) Cell.. The aim of

setting up of National Digital Library Cell is to convert department's own achieves and library-resources available in printed format or non-printed document such as museum artifact resources (murals, paintings, sculptures etc.), into digital format using digital technology. This will provide universal access with links to other digital libraries.

The main issues to be taken up during the Eleventh Plan are:

- (a) digitizing, preserving and archiving the content
- Digitization, Preserving and Archiving new content
 - Distributing Achieving
 - Providing Links though NDL Portal
- (b) Policy Issues
- Type of content to be digitized
 - Regularly access New Potential subject
 - Addressing Gaps in Copyright Act
- (c) Research and Development Issues
- Metadata Standards
 - Resource indexing and discovery in Digital Library
 - Development of Software tools-preferable open source to empower users
 - Development of new interfaces \especially for physically challenged
 - Addressing issues concerned with interoperability of Digital Library Systems

4.12 Government Policy as an enabler

4.12.1 Excise Relief

- Remove the excise on software announced in the current budget
- Create and mandate B2B data transaction standards especially for the manufacturing industry. This is critical for the growth of B2B e-commerce which will reduce the cost of transactions especially between the suppliers and the large OEMs.
- Encourage the adoption of e-procurement model in all government procurement.
- Tax Exemptions to B2C E-Commerce:
 - All B2B and B2C taxes to be determined by the central government
 - 5 year tax holiday in specific taxes such as Service Tax and CST on B2C e-commerce to encourage

entrepreneurship as well as adoption. These currently act as entry barriers to smaller entrepreneurs.

- Suitable encouragement to brick companies to move to e-commerce and online transactions.
- Tax Holiday on E-Commerce - Grant of a five year tax holiday or reduced taxes on e-transactions for B2B transactions to encourage E-Commerce transactions, which may be reviewed at regular intervals on parameters such as:
 - Computer density
 - Total number of internet users
 - Quantum of E-Commerce transactions

4.12.2 Funding

- To encourage State government to initiate major citizen centric mission projects under NeGP financial support upto 75% by the Center may be considered. Also States should be encouraged to come up with models that generate revenues without them having to share their revenues with the Centre. The State would be allowed to retain their share over and above 25% generated by them, to be utilized for other e-governance projects within the State.
- Domestic industry should be encouraged to contribute to Venture Capitalist (VC) funds aimed at seed funding. A possible incentive to make this happen is to treat such VC investments as R&D investments (subject to cap) / zero tax on capital gains based on VC investments etc.
- Government agencies responsible for seed funding (TDB, SIDBI Ventures etc) should re-orient themselves. Instead of directly investing in start-ups through loans/grants, these agencies should act as 'fund of funds' and invest in VC sponsored funds. A possible model could be that for every X of GOI funds, the VC has to provide for 3X. The reason for this is that most of the agencies do not possess sufficient

amounts of the skills required for VC investments and secondly the high risk nature of VC investments is antithesis to behavior patterns of Government institutions. The Yozma program in Israel and SBIC program in USA are good models to study.

- Create a dedicated fund to promote IT adoption in the SMB segment.
- Banks should be mandated to treat loans for IT procurement similar to loans for infrastructure funding.
- High Net-worth NRI should be encouraged to invest in domestic VC funds or directly as angels by providing attractive treatment for capital gains and removing the current complex procedures for individual NRI investments in VC funds/start-ups.
- Recently the RBI has removed lending to VC funds from the priority sector lending list of PSU banks. As a result, domestic VC funds are finding it difficult to access capital. Foreign VC funds do not have this problem but they generally do not provide seed funding. The RBI should allow the PSU banks to lend funds to VC as part of their priority sector lending. Misuse of this facility can be checked by:
 - Specifying size of funds which can be created.
 - Specifying size of investment per company.
 - Specifying nature of investee company.

4.12.3 Legal frameworks

- There needs to be a distinct law on the legality of electronic payments.
- There needs to be a distinct law governing e-commerce and internet based businesses.
- Amendment of Indian Laws in alignment with global jurisdictions which recognize technology neutral rather than technology specific guidelines especially with respect to digital signatures.

Report of the Study Team on Human Resource Development

1. Introduction

1.1 Growing Manpower Requirements

India has been developing as a major hub in knowledge creation in IT & Electronics in the Global arena. The contribution from the IT/ITES Industry to the national GDP has risen from 1.2% in the year 1999-2000 to about 4.8% in the year 2005-06. IT/ITES exports from the country has grown from US\$ 13.3 billion in the year 2003-04 to about US\$ 23.9 billion during the year 2005-06. The growth of this sector primarily depends upon the availability of knowledge centric professionals. The number of professionals employed in this sector has grown to 1.28 million by 2005-06. The indirect employment generated by the sector, is approximately three (3) times the direct employment. To retain our position as a major player in the IT arena over a period of time, there is a need to address the human resource requirement of the industry on a continuous basis.

The fast growing IT Sector has created a huge career opportunity in its wake. The profiles of the career opportunities keep dynamically changing as newer and newer technologies emerge and the global market requirements change.

In the initial stages of the growth of IT industry the formal sector was predominantly meeting the manpower requirement of this sector. The formal sector education system focuses on the fundamentals, concepts in different subjects and bring-out engineers with excellent basics and strong foundation over which the super structure could be built. However, the need and demand placed by the fast technological changes and the emerging global market trends that are marking the growth of Indian IT industry brings out the demand for complementing and supplementing the formal sector through the non-formal sector of education and training. The need is in the form of continuing education for training the existing professionals and the teaching faculty to keep pace with the demands of the industry as well as technological changes. The burgeoning demand for the IT professionals has marked the growth of non-formal education sector.

1.2 Current National Scenario

Realizing the various opportunities that are arising out of the Global IT industry expansion and the demographic imbalances that are likely to arise, India has taken steps in the area of HR pertaining to Information Technology.

Following intensive cross-country discussion, the National Council for Educational Research and Training (NCERT) released the National Curriculum Framework for School Education in India in November 2000, providing guiding principles for reshaping the curriculum for schools.

While recognising that the process of education can no longer ignore the social and psychological impacts of ICTs, the framework also acknowledges the potential that global information sharing enables, identifying the need to provide access to global information sources as a priority goal.

Designing a course of study to integrate information technology into schooling is by no mean easy, as technology changes faster than ideas can be implemented. Still, there remain certain basic principles that define the prospect of this emerging area in school education, implications of which have been elaborated in the Curriculum Framework.

Identified goals include the formulation of plans for the integration of computers into the curriculum, the creation of a framework for enhancing learning opportunities using ICTs across the curriculum, designing a flexible curricular model which would embrace interdisciplinary and cross-disciplinary thinking and the development of attitudes that are value driven, rather than technology-driven.

Furthermore, it is deemed vital to the success of the implementation of ICTs to provide professional development opportunities for teachers, enabling them to act as facilitators of learning, helping the students to become their own teachers and to think for themselves.

The Government of India, State Governments, Industry, etc., have taken steps from time to time to address the HR needs arising out of the growth of IT Sector of industry as a whole and the IT Sector in particular.

1.3 Global Demographics Scenario

According to the study entitled 'India's New Opportunities 2020' undertaken by the High Level Strategic Group (HLSG) of the All India Management Association, India and South Asia has an advantage in the international arena over the rest of the nations as India will be having a large pool of human resource in the productive age of 16-60 years while the rest of the nations will be facing demographic imbalances. The report identifies that 'The contribution of remote service alone, which is the focus of this report, will be \$ 133-315 billion of additional revenues flowing into the country, and an addition of 10-24 million jobs every year (direct and indirect) by 2020 (the large variation is due to uncertainty in critical variables that could affect the size of this opportunity and the actions India Inc. will take to increase its share). Additionally, importing customers into India (medical tourism, educational services, leisure) may add \$ 6-50 billion and create 10-48 million jobs by 2020. India is in a strong position to capitalize on these opportunities; however, India Inc. will need to enhance capabilities in several areas. HLSG estimates that through remote services and import of customers, India could enhance year on year GDP growth by up to 1.5% over current growth rates, most (~80-85%) of which would be through remote services'.

2. Tenth Plan Period

2.1 Tenth Plan Working Group - Human Resource Development

The 10th Plan Study Team had estimated that the total size of the IT Industry will be over US\$ 87 billion (Rs. 3,91,500 crore) by 2008 and had indicated that a substantial part of it will be from IT services. The report had also indicated that the IT Industry, would require 22 lakh IT professionals by 2008 – 11 Lakh in the IT sector and another 11 lakh for IT enabled services as per NASSCOM.

Further, the report has also indicated a figure of 23.67 lakh professionals in 3 categories - 2 lakh IT professionals in category 'A' for software products, 5.77 lakh of IT professionals of category 'B' for IT services and e-Business and 15.9 lakh of IT professionals of category 'C' for IT enabled services and e-business. This translates to 7.77 lakh professionals in the IT sector, if category 'A' & 'B' are considered.

Although the demand for IT manpower requirement will be met by the supply from various educational

institutions in the country, there are serious concerns about the quality of IT manpower. A fraction of the graduating students are employable by the industry.

The two important issues that India needs to tackle to maintain and enhance its competitive advantage of abundant, high quality and cost effective human resource are (i) develop high quality knowledge workers of over 2.2 million by 2008 and (ii) ensure that its workforce has a right mix of technical, business and functional skills to meet the needs of individual business segments and customer markets.

To meet these twin challenges, the report further suggests:

- To expand the base of people with basic skills in IT
- To ensure continuous and rapid up-gradation of skills
- To launch a concerted efforts to improve India's value proposition as a workplace of choice so that the people who are trained do not migrate.

Further, the report indicates that it is not easy to undertake a long-term prediction of skills needed and tune the syllabus accordingly. This needs to be done at frequent intervals. Industry has to spend a lot of money and time to impart computer skills to other disciplines of engineering in conformity with their line of business projects. If institutes could incorporate computer skills in their syllabus for non-computer science disciplines, it will help both industry and students. Industry also needs contemporary skills for computer science students for their line of technology projects that are not usually taught in most of the engineering colleges due to lack of expert faculty. Therefore, the Study Team recommended that the technical skills, functional skills and life skills to be analyzed, which are needed by the Industry.

Quality IT professional team needs to comprise domain experts, software engineers and experts with functional and life skills. Software Engineers need to have a thorough knowledge of Software requirements, design, construction, testing, quality, etc. In addition, IT professionals particularly engaged in software exports need to have life skills such as communications skill, time management, team working, technical writing, ethics, value and attitude. It may not be possible for an academic institute to impart all the skills that are essential for a quality IT professional. This can be done through the bridge courses in the identified thrust areas as well as high-end applications and product development activities. Bridge programmes can increase the IT workforce by

training graduates, non-computer science engineers as well as Computer Science Engineers. The need for domain and functional experts can be met by training industry professional with a basic understanding of IT.

The recommendations of the Study Team covered the aspects such as faculty development, enhancing the quality and content of courses, fiscal/government issues, accreditation, students welfare, industry/academia interactions, online learning besides basic and fundamental research and VLSI Design.

2.2 Task Force on HRD in IT

The Government of India had set up a Task Force on 'Human Resource Development in Information Technology' with the main objective to prepare a long-term strategy for significantly increasing the number of well trained IT professionals in line with economic projections. The Task Force recommendations had come in the form of the reports entitled (i) 'Strengthening the human resource foundation of the Indian IT enabled services/IT industry' and (ii) 'Task force on meeting the Human Resources Challenge for IT and IT enabled Services' (Report and Recommendations) during December, 2003.

The Task Force has indicated that the global IT/ITES market is expected to grow to US \$ 2497 billion by 2008-09 and US \$ 3391 billion by 2012, registering a CAGR of 11 % between 2003 & 2012. India is expected to achieve revenue of US \$ 62 billion by 2008-09 & US \$ 148 billion by 2012 in IT & ITES at a CAGR of 35% over 2003-2012. This translates into a direct employed manpower requirement of around 0.97 million for IT export services and 2.72 million for ITES by 2012 (Table 1 and Table 2). Compared to the employed manpower of 0.21 million for IT and 0.16 million for ITES in 2003, manpower requirement for domestic and captive IT services would amount to an additional 0.5 million in 2008-09 and 1.0 million in 2012. The report further indicated that there is a possibility of a shortage in terms of availability of skilled personnel for IT/ITeS even in the medium term i.e., by 2009. The gap could be to the tune of 2,35,000 for IT and 2,62,000 for ITES and could increase in 2012 in the absence of any special efforts to meet the manpower requirements. Addressing this gap is critical for India to achieve its target market share in the IT/ITES market.

While formulating the strategy for meeting the Human Resource requirements, the Task Force noted that the issue of manpower gap is not as much about the institutional seat availability as about the nature of skills and training provided

in these institutions. The overall strategy to meet the Human Resources requirement thus rests on the ability to inculcate the skill sets, establishing a standard to certify the quality of skills provided and attracting people to get them certified and deployed in IT/ITES.

2.3 DIT Initiatives during Tenth Plan Period

The IT Task Force recommendations include the aspects of educating/developing the requisite skills, certifying skill level of resources etc. A set of planning/implementation initiatives with reference to some of the important recommendations have taken place.

As a result of discussions in various fora and with the Industry, the verticals viz. finance - banking and insurance, travel and hospitality, pharmaceuticals and retail marketing were identified as the promising areas which require immediate attention to be taken up for designing of course structure, curriculum, certification scheme, etc. Actions have been initiated to design ITES-BPO courses for banking and finance verticals as a first step.

The number of IT-ITeS Professionals employed in India has grown from 8,30,000 in the financial year 2003-04 to one million during financial year 2004-05. The industry employment is estimated to be 12,87,000 by end of 2005-06. Table 3 indicates the knowledge professionals employed by the IT sector from 1999-00 to 2005-06.

Various initiatives have been taken for Human Resource Development during the Tenth Plan Period by MHRD, AICTE, UGC, DGE&T, DIT etc. These initiatives are in various domains like Information Security, VLSI design, Bio-informatics, IT Enabled distance education, etc., both in formal as well as in the non-formal sector.

3. Eleventh Plan Imperatives and Strategies

3.1 IT Manpower Projections and Structure of IT industry

As elaborated in section 2.2, India is expected to achieve revenue of US \$ 62 billion by 2008-09 and US \$ 148 billion by 2012 in IT & ITES at a CAGR of 35% over 2003-2012. This is equivalent to an increase in overall share of global ITES/IT market from 0.8-0.9% in 2002 to 2.5% by 2008-09 and 4.4% by 2012 (Table 1).

This translates into a direct employed manpower requirement of around 0.97 million for IT export services

Table 1 : Global ITES/IT market (USD billion)

	2002	2003	2006	2009	2012
IT*	392	441	625	864	1,193
ITeS#	792	1,838	1,213	1,633	2,198
Total	1,184	1,322	1,838	2,497	3,391

Source: IDC, NASSCOM, KPMG 2003

* IT Services include Systems Integration and Information Systems Consulting, application development and support as well as IT training services.

IT-enabled services include support for human resources, payment processing, finance, customer care, administration and content development (including high-end design and development work).

and 2.72 million for ITES by 2012. Compared to the employed manpower of 0.21 million for IT & 0.16 million for ITES in 2003, manpower requirement for domestic and captive IT services would amount to an additional 0.5 million in 2008-09 and 1.0 million in 2012 (Table 2).

The observation of the Task Force that the manpower gap is not as much about the institutional seat availabilities as about the nature of skills and training provided and the certification issues, continues to be operational during the 11th plan period also, since the structure of the IT-ITeS industry, educational institutions etc., have not yet metamorphasised/ evolved to meet the rapidly changing needs.

The rapid growth in industry employment has been facilitated by the combination of two fundamental factors – a favourable demographic profile and a large, expansive and established network of academic infrastructure.

The underlying factor highlighting Indian's long-term attractiveness is its highly favourable demographic profile. With nearly 60% of its population between the age of 15-59, and more than half below the age of 25, India will continue to have a significantly higher number of people in the productive (working) age group than in the dependent age group for at least the next few decades. In contrast, countries including the US, Europe, Japan and China have a more aged population with dependency ratios likely to increase over the same period.

The succeeding sections, discuss the factors that highlight the changing industries profile, global demographic profile, technological and pedagogical issues.

3.2 The Transformation of the Industry from BPO to KPO and related HR Issues

The society is shifting from an era of industrial society into the “knowledge society”. Knowledge creation and its applications are primary features of this change in today's networked society.

In any industrial society, the growth rate in the service sector is higher than that of the manufacturing sector. Services themselves are also becoming an increasingly integral part of all production businesses and there are relatively more people working in this sector now. This trend is ultimately leading to an increased emphasis on intangible products, which is also called service concepts.

Providing services is a much more challenging task than just delivering goods, and therefore, there will be an increasing focus on making optimal use of resources for maximizing their competitiveness.

One of the main challenges that the IT/ITeS-BPO sector faces is to continuously identify the emerging verticals, which have the potential to grow and generate revenues keeping the dynamic nature of this sector in view.

Generating the right kind of manpower with skill-sets requirement for each of the potential vertical is so diverse that it becomes a challenge for the HR function of a company to continuously evolve vertical specific training methodologies and design suitable training modules. Further, the HR companies will have to continuously scan the horizon for the emergence of newer technologies and knowledge areas. The situation will become more complex as the transition from BPO to KPO (Knowledge Process Outsourcing) takes place. Intuitively, one can say that the transition is likely to be very crucial for sustenance of the industry's growth and subsequent establishment in the market place.

It will be essential for each company to build internal capabilities to manage knowledge effectively and also the collective competence building for the Information Technology sector. Managing knowledge is a process, which involves multi-period decision framework, starting from investment in research and development to diffusion of knowledge to creation of innovation and ultimately realizing the value through commercialization of innovation and inventions.

Table 2 : Manpower Requirements for ITES / IT in India (millions)

	2002	2003	2006	2009	2012
IT export services					
Consulting, Integration, Installation	0.01	0.02	0.03	0.09	0.27
IT Development	0.07	0.08	0.08	0.08	0.11
Outsourced IT Support	0.09	0.11	0.17	0.28	0.53
Training and education	0.00	0.00	0.00	0.02	0.06
Total	0.17	0.21	0.29	0.48	0.97
IT-enabled services					
Customer Care	0.03	0.05	0.15	0.42	1.03
Finance	0.02	0.03	0.05	0.09	0.21
Human Resource	0.00	0.00	0.02	0.15	0.69
Payment Services	0.00	0.1	0.05	0.14	0.45
Administration	0.2	0.3	0.5	0.15	0.15
Content Development	0.03	0.04	0.07	0.09	0.20
Total	0.11	0.16	0.38	1.0	2.72

Source: ITD. NASSCOM-MckInsey. Manpower Profile of India. KPMG. 2003

The Study Team on Software Export has, however, indicated a direct employment generation of 3.4 million nos. for export of IT & ITES for the year 2012 and indirect employment of 9.5 million (Table 3 of Software Export Study Team Report- page 78)

In order to harness the maximum potential of the IT sector in the long run, both manufacturing sector in terms of hardware development and knowledge based embedded system and VLSI Design area have to be nurtured. Further, with the policy initiatives of the Government to encourage manufacturing, a large pool of qualified manpower would be required. Succeeding

paragraphs discuss the characteristics and the manpower requirement for the Hardware Sector, VLSI Design and Embedded Systems.

3.2.1 HR Needs for Hardware Sector

During the year 2005-06 the production of electronics hardware industry is estimated to be Rs.56,000 crore (12.7 billion US\$ <1% of global production).

The Hardware Market and Production projections for the Eleventh Plan period may be seen at Table 31 (page 60) of the Hardware Manufacturing Report.)

The direct employment in hardware sector during the year 2005-06 is estimated to be 0.42 million which is expected to be 1.6 million during 2008 as per the tenth Plan Estimates. It is projected that for every direct employment, two indirect employments gets created in hardware manufacturing sector.

The projected growth rate for the hardware industry leveraging India's demographic is expected to generate 7 million direct employment and 14 million indirect employment for 2011-12.

The manpower requirement is expected to dynamically change depending upon the investments made in various areas in the sector and there is a need to have a mechanism to continuously assess the need and recommend suitable structural mechanisms for generation of area specific manpower.

3.2.2 HR Needs for Embedded System & VLSI Design

India has a growing domestic market for the consumption of semiconductor based electronic equipment. The ISA-Frost & Sullivan reports have predicted that the electronics equipment market will grow to \$363 billion by 2015 which will be 11% of global market for electronics equipment as compared to 1.2% today.

It has also been projected that in India, semiconductor driven industries will create over 3.5 million jobs by 2015. The Department of Information Technology is in the process of ascertaining the requirement of trained manpower in the area of VLSI design, fabrication, testing, etc., especially in light of the new initiatives being taken up by government for attracting major investment in the area of microelectronics and semiconductors.

Revenues and Talent Pool

The Indian semiconductor and embedded design industry has revenues to the tune of USD 3.2 billion (2005) and employs nearly 75000 people. This is expected to increase to US\$ 43 billion in 2015 with employment projections of 7,80,000 plus in 2015. The semiconductor sector encompasses VLSI design, hardware/board design and embedded software development, offered by both captive and third party companies across India (Table 4).

Curriculum update

Industry support in updating of classroom curriculum and introduction of relevant curriculum at the appropriate time to students could help build knowledge for entry into the industry and to make the semiconductor industry a viable option.

Table 3 : Growth of IT-ITES Professionals in India

Indian IT Sector: Knowledge Professionals Employed*							
(Nos.)	1999-00	2000-01	2001-02	2002-03	2003-04E	2004-05E	2005-06E
IT, Engineering and R&D, Software Products Exports	110,000	162,000	170,000	205,000	296,000	390,000	513,000
IT-enabled Services Exports	42,000	70,000	106,000	180,000	216,000	316,000	409,000
Domestic Sector	132,000	198,114	246,250	285,000	318,000	352,000	365,000
Total	284,000	430,114	522,250	670,000	830,000	1,058,000	1,287,000

* Does not include employee numbers related to the hardware sector

Source: NASSCOM

Centers of excellence and joint ventures

Joint initiatives between industry and universities to establish centers of excellence and competency for R&D in VLSI engineering, design automation and embedded system engineering, that is expected to lead to creation of IP and raising familiarity amongst academia.

Future ahead for Engineering Workforce in India

There are many options available to professionals in this industry:

- **Academia**
Since there is an acute shortage of trained talent in the education sector, this is an area that is completely open to semiconductor professionals.
- **Research**
Increasingly companies both Indian (mainly military/space organizations) and MNCs are setting up R&D centres in India that are focused on semiconductor processes. This is a nascent area and one that is offering good potential for Engineers with a Semiconductor Physics lineage.

3.3 Opportunities arising out of Global Demographic Imbalances

The report 'India's New Opportunities 2020' (reference section 1.3), while discussing the opportunities

arising out of demographics imbalances has indicated that the developed nations will be facing shortage of trained manpower in selected professions like IT, medical services, etc., thus opening up significant opportunities for developing countries like India, Malaysia etc, to provide remote services as they are expected to have surplus manpower and the developments in communication technology will enable offshore delivery. Opportunities are also expected to open up in the areas of health care, education, tourism, etc.

The report identifies the following two opportunities:

- **Remote Services:** India is expected to have the largest pool of manpower in 2020 and is also recognized for value delivered at attractive price points.
- **Import of Customers:** Medical tourism, Education services, Leisure/Adventure tourism: the cost of medical treatment and educational services in India is a fraction of the cost in developed countries and despite increasing presence and influence in world affairs, India's share in the global tourism industry is insignificant.

This is expected to generate an average increase of approx 0.6~1.5% in year on year GDP growth rate over the current growth rates till 2020. The estimated revenue ranges between \$135bn~\$365bn in 2020 under various scenarios (\$133~\$315bn from remote services and \$6~\$50bn from import of customers). Another, 20mn~72mn jobs are expected to be created by 2020 (50~67% jobs from tourism and balance from remote services). An equal number of

Table 4 : Revenues and Talent Pool (2005-2015)

Total design market	Share of overall revenues 2005 (%)	Share of engineering work force 2005 (%)	Share of overall revenues 2015 (%)	Share of engineering work force 2015 (%)
VLSI	US\$ 0.6 billion (18)	0.011 million (15)	US\$ 5.1 billion (12)	0.078 million (10)
Hardware / Board Design	US\$ 0.1 billion (4)	0.003 million (4)	US\$ 1.6 billion (4)	0.031 million (4)
Embedded Software	US\$ 2.5 billion (78)	0.06 million (81)	US\$ 36.6 billion (84)	0.67 million (86)
Total	US\$ 3.2 billion (100)	0.074 million (100)	US\$ 43 billion (100)	0.78 million (100)

Source: ISA-Frost & Sullivan, 2006

direct and indirect employment creation is also expected.

As a part of the agenda for action in the area of education and training for the private sector the group had identified the following: Create a cell within the 'interest group' with a mandate to push reforms in education and training and to create a comprehensive agenda for education by merging all existing reports. Additionally, the cell should ensure alignment between various ministries on policy issues, implementation plan and propose creative solutions to resolve differences when they arise. The industry should help the government to identify upcoming vocational areas where educational facilities are required and also contribute to education via funding and expertise.

As a part of the agenda for action in the area of education and training by Central and State Governments as an enabling role, the group had identified the following: Form a committee of secretaries to ensure alignment among concerned ministries on policy issues and implementation plan; upgrade curriculum in existing courses and start new courses in relevant fields such as IT, Bio-Technology, Nanotechnology etc.; make education more broad based and available to more people across the country; explore options to privatize higher education.

3.4 Strategy for providing highly skilled manpower

To keep the edge there is a need to be attentive and work towards generating quality manpower continuously. There is a need to arrive at specific strategies. Some strategies are listed below:

Teacher Training

- To train the ICT Faculty of formal and non-formal sector of education
- To make the teaching profession very attractive to attract and retain best talents as faculty

Centres of Excellence

- To develop centres of excellence for different segments of ICT which in-turn would spearhead national level programs in these areas (Embedded Systems, VLSI design, Grid Computing, Web servers, System Software, GIS, ERP, Mainframes etc.)
- Improving the Curriculum of ICT courses in engineering

colleges to be at par with the needs of industry

- To develop a national programme to promote finishing/bridging schools concept to meet the need of industry requirements.
- A suitable structure/mechanism to be put in place, which will continuously monitor the horizon for emerging technologies like nanotechnology, quantum computing, soft computing, evolutionary information systems, etc.
- There is a need to evolve innovative instructional system with the objective to familiarize professionals with the latest tools and techniques to improve productivity through continuing education programmes.
- Restructuring the technical curriculum by retrofitting it with a practical centric approach.
- By providing regular training on latest technologies in order to upgrade the skill set.

ICT and Learning Technology enhanced learning

- To promote e-Learning and Internet based education for reaching everyone with quality education
- Promoting partnership and cooperation with the Universities/Institutes (national and international)

3.5 Strategic Analysis of HR Needs

The succeeding paragraphs discuss the HR issues that require strategies/ planning to ensure that the HR needs are addressed to not only meet the IT industry's growth but also address its impact on the other sectors, as well as the society. Some of the issues, which will require attention in the long-term are also brought out.

3.5.1 Shortage in supply of suitable talent

While India's young demographic profile has the country favourably placed in terms of its quantitative manpower requirements, gaps in suitability and / or access to the entire available pool are beginning to reflect in talent supply shortages – indicated by continued above average wage inflation and high attrition levels in the sector.

To achieve US\$ 86 billion in export revenues and to continue to grow, the domestic IT industry, the IT and ITES industries will need to employ nearly 3.5 million professionals. Currently, the industry employs about 1.28 million professionals. Therefore, the higher education system needs to produce enough graduates to provide another 2.5 million willing and suitable professionals over

the next five-seven years. Feedback from the industry has indicated gaps in employability in areas such as soft-skills, English language proficiency, etc.

This issue of improving the supply of suitable talent needs to be addressed at multiple levels covering continuing education, providing access to high quality education through centres for excellence, structurally strengthening the existing educational system, evolving new continuum of formals and non-formal education.

3.5.2 Supplement Skills in the Existing Pool

As per the industry feedback, inadequate English-language proficiency and lack of soft-skills are the key gaps in the current graduate pool, reported by the industry. While these issues are addressable by introducing some changes to the existing education system, the systemic changes are likely to have a lead-time to impact and will also exclude the existing pool of recent graduates. As a short-term measure, and to also enhance the employability of existing graduates, graduates that are about to exit the system, a 'bridge course' or finishing school will be of immense value. Industry should put together the curriculum and faculty for this.

In addition to the above, there is a need to provide a mechanism to regularly upgrade the skills of the existing professionals for evolving a continuing education mechanism using the potentials of ICT.

To cope with the challenges placed by the rapid growth of IT/ITES industry and the resultant manpower need, there is a need to evolve new educational and institutional systems with freedom to evolve courses, providing operational flexibilities, simplified governance structure, attractive career option for teaching professionals, etc. There is also a need to bring up private partnership for supporting this structure.

New structure needs to be designed to provide for continuously updating the course content, curriculum and pedagogic methods to make them more relevant to the needs of the industry; institutionalising a transparent process of assessment and review of the educational institutions as well as certifying the suitability of the output for employment. Expanding capacities in the education system will generate an additional demand for faculty that will require encouraging more people to pursue teaching / academics as a career. Additionally, continuous reviewing and updating of the curriculum / pedagogy is also likely to require existing faculty to re-train / upgrade

their skills. The existing system lacks accountability / pressure to perform.

3.6 Long-term Impact of IT/ITES on Economic/ Social/ Cultural aspects - HR Issues

The IT and ITES has been the one of the largest industry segments responsible for contributing to the growth of the Indian economy in the past few years. A gradual shift has been seen, in terms of the choice of one's profession, with an increasing number of people from diverse backgrounds opting for a career in IT and ITES.

In the past few years, a large number of graduates, from a diverse range of backgrounds, have been leaving their chosen disciplines and joining the IT sector. The number of students taking up disciplines other than computers has also decreased. Shortage of graduates in basic science and engineering streams may result in the near future. This is likely to have an impact on research and innovation and also on other primary and secondary sector of economy. Further, as the ITES-BPO industry shifts to Tier II cities, there will be an increase in the infrastructure requirements in those semi-urban areas also. In addition to this, there are challenges arising out of social and cultural changes that are being brought out by the IT/ ITES Industry growth, since the professionals are employed in the virtual environment of the target industry. There is a need to continuously study the changes that are taking place in economic as well as cultural domain of various sectors also as a result of IT/ITES growth.

3.7 Innovative Instructional System

Technological changes force the pace of development and the educational institutions have to respond to these changes with relevant educational programmes, both in content and in delivery. This marks the need to have a system, which is capable of having a dynamic instruction system for responding to the following needs:

- Increasing the reach of educational systems in a cost effective manner
- Providing continuing education for fast changing technologies – anywhere, anytime learning with synchronous and asynchronous learning.
- Providing education facilities for the non-formal, continuing education groups (covers school dropouts and the industrial workers) needs on-demand education characterised by 'learning anywhere-anytime-any aspect'.
- The convergence of formal education programmes, continuing education programmes for the

professionals from the industry and the distance education programmes for the dropouts, personnel from the industry, and others put considerable financial demands on the conventional education system.

- Shrinking educational budgets and the increasing number of students requires cost effective and innovative instructional systems to be devised.

The e-Learning methodology and an innovative approach of evolving a continuum of non-formal and formal education, lend themselves to an innovative approach to the instructional system, which is evolutionary in nature.

3.7.1 New Technology Trends for HRD - e-Learning potentials and issues

The tools of the information age – PC and the Internet – store, process and manage information needs to align with the needs and the objectives of our educational institutions. Countries world over are effectively leveraging technological resources to enhance teaching and learning at all levels. Information technology, no doubt, will empower teachers and students, within and outside the classroom, to learn more purposefully and enjoyably hereafter. Today, everybody, particularly students must acquire knowledge at a rapid rate. This demands the need for new means and mechanisms for learning. Equipping schools with these tools is an expensive proposition even for schools in advanced countries. Introducing new instructional engineering methodologies is a viable proposition and it would improve education significantly. It is the best investment we can make for the transformation of society since downstream benefits flow to every part of our society.

e-Learning is a combination of learning service and technology to provide high value integrated learning. Cost savings and higher productivity are the reasons most frequently cited for selecting e-learning solutions. There are other very good reasons as well like, manageability, flexibility, speed and learning effectiveness. e-learning can be delivered anywhere, any time, and can provide flexible models, such as just-in-time learning. e-learning systems that deliver course content can monitor student progress, generate reports, and automate the administration of course catalogs and enrolments. Breakthroughs in collaborative learning and learning models are producing effective learning directly linked to business performance and bottom-line results.

There is also a possibility to export the educational instructional materials to other countries. Some of the research issues regarding introduction of e-Learning on a large scale would involve the following:

- a) The efficacy of Online Learning is yet to be understood in all its dimensions. World over experiments with this methodology has given mixed results.
- b) It's potential for scalability, the characteristics of which have not been fully explored.
- c) A hybrid model of brick and mortar classroom and web-enabled education is considered a better approach.
- d) Applicability, adaptability and efficacy of the Online Learning methodology for undergraduate programme is still not clearly understood. It is at the undergraduate level at which abstract concepts are introduced and a strong foundation is aimed to be built.
- e) The potential and introducability of online learning methodology at primary, middle and secondary level school education and for rural education needs to be explored, as at this level the basics are aimed to be introduced.

Courseware development is a very complex domain, which involves content creation, instructional designs, pedagogical models, granularity of content based on the learning models etc. All these aspects need to be kept in mind while designing a suitable system

3.7.2 Seamless continuum of Formal and Non-Formal Education

The IT Industry in India is rapidly growing to carve out the export and the domestic business opportunities that are created by the changing economic and social needs globally as well as in India. The problem is further highlighted by the changing global demographic profile and its projected structural imbalances in 2020. This would mean that the work would have to be done cross-border in India and South Asia for almost every known developed economy. This would depend heavily on the deployment of IT in various sectors. This in fact would mean providing IT skills and capabilities to work force from other domains like nursing, medical, travel and hospitality, entertainment, garment design, etc.

The above indicates that there will be a surge in the requirement of human resource who are trained in IT skills

in various other domains as well as in the IT / ITES sector. While the conventional formal system of education has evolved industry-academic interaction, applied R&D, Industries input for designing courses and syllabus etc., it still becomes difficult to address the fast changing needs of the industry and the society in terms of the number of students trained as well as the variety of areas of specialization.

The non-formal sector had emerged to address the fast changing HR requirement in terms of numbers and the skill sets. By staying close to the industry and the market needs, over years, the non-formal sector had played an important role in bringing in private institutions with their strength in the knowledge of market demand and close contact with prospective employers. At the same time, major drawbacks of the non-formal sector include, lack of standardization, less/unqualified and untrained staff (from conventional sense), less emphasis on conceptual aspects, inability to provide in-depth courses. The private institutions in the non-formal sector have the strength in networking with other institutions, infrastructure and the capability to implement technology based education.

Further, as the industry grows, it is expected that the BPO / KPO industry will be spreading outward from major cities to semi-urban areas to remain competitive. It is observed that the quality of manpower drops as we move out of major cities to semi-urban areas and further on to rural areas. There is a need to spread quality IT education to semi-urban areas and to the disadvantaged section of the population. This would require deployment of e-Learning methodologies as well as integrating non-formal and formal system education to tap the potential manpower available in these areas. The issues would be more of improving the employability of the qualified manpower in this area as well as delivering quality education/training to the people.

While both the formal and non-formal sector have their own role to play in the past years in their respective domains, now the time has come for integrating these two sectors in a seamless fashion to address the emerging human resource requirements that are arising out of:

- a) Technological changes and the resultant market opportunity,
- b) Global demographic imbalances,
- c) The need for sourcing manpower from semi-urban and rural areas etc.

This lays emphasis on integrating the formal and non-formal sector of education using technologies like e-Learning and networking technologies to deliver quality education in a synchronous mode for achieving anywhere any time learning. This would require bringing in changes in course/ education administration, teaching methodologies, pedagogical models, courseware delivery etc. Such a system would have to adopt innovative methodologies to:

- a) generate quality manpower
- b) provide flexible mechanism for continuously updating their skills and
- c) provide flexibility for cross migration of people from other areas of specialization into IT etc.

This system should also provide for multiple points of exit and multiple points of entry, cross recognition of courses and the credits earned in one system by the other.

3.8 Recommendations

- i. To spread the concept of Finishing Schools/Bridge Courses in various educational institutions across the country, a programme for capacity building has to be initiated. This may include identification and supporting of Mentor Organizations for conducting teachers training programmes, identification of gap areas, development of course curricula, course material, etc; and training teachers from various educational institutions, who would subsequently go to their respective institutions and conduct Finishing Schools/Bridge courses.
- ii. Evolving technologies for new paradigm in pedagogy, utilizing the potentials of ICT, broadcasting, Digital Library, etc., need to be introduced to provide wider access to high quality education, to overcome the shortage of teachers and to increase capacity. In this regard e-Learning programs for higher skill generation; and setting up of a national body of e-Learning practitioners to arrive at e-Learning solutions, standards, and interoperability, R&D, Digital Library, etc., need to be taken up on mission mode projects. In this manner quality education could be made accessible to students in Tier-II and III cities (i.e. other than metros). There is a need for providing broadband connectivity at concessional rate for educational purposes.
- iii. To set up Centres of Excellence for different domains of ICT viz. Embedded Systems and VLSI design, Grid

Computing, Web Servers, System Software, GIS, ERP, Mainframes, Nanoscale Design and Fabrication, etc., and in other identified areas on a continuous basis. In this regard, the efforts initiated to study the evolving knowledge economy and the emergence of new knowledge streams to be identified for undertaking HR development efforts, R&D efforts, etc., to be continued during the Eleventh Plan period. Other initiatives taken during the Tenth Plan period in the area of Information Security, VLSI Design etc., should also be continued during the Eleventh Plan period and efforts to be made to consolidate the results and scale up these efforts.

- iv. Provide adequate budgetary support for significant increase in the number and value of scholarships offered to encourage a far greater number of graduates to pursue Masters and Doctoral programmes.
- v. In order to remain competitive in the ICT area, as globally other countries are also taking appropriate steps to grab higher share of International Market, there is a need to provide Universal Access to Quality Education. There is a need to ensure that deserving candidates are not deprived of access to quality education due to economic disadvantages. This should be done by evolving a suitable "*Assistance-ship Programme*" for the needy and deserving students. This could be in the form of access to institutional education loan with interest being offset by the Government assistance-ship. Selection of the students could be done by appropriately designing an assessment mechanism similar to 'MEANS TEST'.
- vi. There is a need to introduce vocational courses on modular structures in ITIs including Women Polytechnics to impart skills which are directly relevant to the industry.
- vii. There is a need to integrate formal and non-formal system of education by introducing the concept of virtual university. This could be done by developing and introducing credit system and cross recognition of the credits awarded to the students who are pursuing courses in the formal and non-formal education system. The credits earned in the non-formal system to be recognized for award of certificates in formal system.
- viii. In order to spread IT education as well as to be concurrent with changing needs of the industry, there is a need to promote education as a whole to be one of the activities under SEZ. IT is to be given special preference and IT education should be permitted in the SEZs as one of the activities.

ix. Institutionalisation of Industry-Academia interaction:

- Industry experts to be made a part of curriculum development, courseware development and conducting of courses;
- designing a system with features for students to spend the last one/two semesters with Industry for projects;
- creating suitable chair for faculty to come from industry;
- introduction of high-end technologies for learning at lower-end institutions to improve the quality of education with the support of industry; and
- university system to create a suitable space for involving industry in the policy making process.

As a part of Industry academia interaction, there is a need to institutionalize 'Public Private Partnership' for Human Resource Development as a nation-wide effort. At present there are individual efforts made by the IT companies to create chairs at academic institutions, institute scholarships, organize joint courses, etc. Under the proposed 'Public Private Partnership' mechanism, Industry through its Associations or by forming consortia of companies could jointly work with educational institutions or organize joint programme and course, R&D activities, etc. in existing institutions, in collaboration with academia and with the support of the Government. There is also a need to explore the possibility of setting up joint educational institutions, training schools like finishing schools, etc. specially dedicated to IT domain under this 'public private partnership' in SEZs, STPIs, etc.

- x. A common bench marking system to be evolved and institutionalised which takes into account the quality of output from the institution, industry feedback, etc.
- xi. Constraints to be removed make teaching / academics as attractive a career option as working in the industry. Institutions for higher education to be unshackled from restrictions on fees and faculty remuneration.
- xii. Formalize international (mutual) recognition of academic degrees and certifications, and encourage internationally renowned academic institutions to establish campuses in the country.
- xiii. Expenditure incurred by the students/professionals towards skill enhancement/ continuing education is to be made 100% deductible from the income for income tax purposes. In the case of students who have taken educational loan for regular programmes in IT education, similar tax benefits to be given to

their parents/guardians.

xiv. It is recommended that a portion of the education cess be earmarked for higher education.

3.9 Funding Requirement during the Eleventh Plan Period

The recommendations are expected to result into action points like spreading the concept of finishing schools – capacity building, promotion of e-learning, broadband connectivity at concessional rates to students, setting up of Centres of Excellence, etc. The broad action points and the funds requirements are given below:

- (i) Capacity building for spreading the concept of Finishing Schools : Rs.150 crore
- (ii) Promotion of e-Learning – as an alternate mechanism, evolving technologies for new paradigm utilizing the potentials of ICT, broadcasting, Digital Library, etc. : Rs.150 crore
- (iii) Provision of broadband connectivity at concessional rates to the students for enhancing their learning. : Rs.500 crore
- (iv) Setting up of Centres of Excellence in emerging areas, Consolidation of manpower development projects in VLSI Design & Embedded System and Information Security, Study of evolving knowledge economy to identify emerging areas for setting up centres, R&D activities, etc. : Rs.1250 crore
- (v) Provision of scholarship for students pursuing doctoral programmes : Rs. 150 crore
- (vi) Provision for support to needy students in the form of assistance-ship to offset the interest component of education loan : Rs. 500 crore

- (vii) Introduction of new courses in ITI and support to women polytechnics etc. : Rs. 200 crore
- (viii) Rating and accreditation by an independent agency for all educational institutions – Setting up of an implementation structure. : Rs. 50 crore
- (ix) Integration of Formal and Non-Formal education system - evolving methodology & implementation at various locations : Rs. 50 crore

TOTAL :Rs. 3,000 crore

It is estimated that all these activities would require Rs. 3000 crore during the Eleventh Five Year Plan period as investment from the Government. In addition, it is anticipated that the industry/private educational institutions would be spending an equal amount during the Eleventh Five Year Plan period.

Schemes like Finishing School, Broadband Connection, Scholarship for doctoral programme, setting up of Centre of Excellence, loan schemes, etc. may not solely be covered under DIT schemes and may be taken care of by MHRD, Ministry of Labour-DGENT, Ministry of Finance, etc.

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Report of the Study Team on Research & Development for the Eleventh Plan

Executive Summary

India's expenditure on R&D at 0.8% of GDP is well below that of many nations and needs to be stepped up progressively. While India's success in software is a matter of pride, the trade deficit in Electronics hardware for a demand of \$22 billion has grown to reach \$ 10.4 billion and is projected to grow to alarming levels. Within DIT, Electronics has taken a backseat and there is a need for encouraging design led manufacturing which will also be an employment generator. Furthermore, within DIT, the thrust to R&D activity has decreased in comparison to applications and infrastructure. To address the above issues and to bring R&D to centre stage, it is suggested that an IT&E Commission (IT and Electronics) be created and the department be renamed as Department of IT & Electronics.

The report also focuses on processes for commercialization of technology by strengthening and fostering innovations of the "Lab to market" processes. A looming shortage of talent is visible and steps for attraction and retention of talent will need to be taken.

For attraction of additional funds for R&D in IT&E, it is suggested that an R&D Corporation of India (RDCI) be created which should be empowered to float tradeable bonds of Rs.1000 crores for the IT&E sector alone.

RDCI Corporation and other measures detailed in the report will also enhance the contribution of Private Sector towards R&D.

For prioritization of R&D funding the report indicates guidelines by classifying all budgets into areas of National Security, Social sector, Strategic and Cutting edge technologies. However, it is important to have a grand vision whereby India chooses a few areas for global leadership and R&D is executed through a coordinated, cluster of labs to achieve the goal.

Conext, Background and Current Situation Analysis

1. R&D as percentage of GDP

In today's knowledge economy, new products and services developed through R&D are going to be amongst

the most significant contributors to future GDP growth. R&D, therefore, acquires prime importance for the economy. Furthermore, R&D research in ICT is of critical importance for the nation's security and fulfilling various societal objectives. Unfortunately, India's investment in this crucial area at 0.8% of GDP is very low compared to most other countries as can be seen from Table 1.

Table 1 : Investments in R & D

Country	R&D % to GDP
USA	2.5
Europe	1.9
Japan	3.15
China	1.31
Sweden	3.74
Denmark	2.63
Finland	3.51
Israel	4.80
Brazil	1.05
India	0.8

Note: There are two implications here. National investments in R&D should grow with GDP or alternatively size of the output of the sectors concerned, in this case IT and Electronics or ICT and Electronics. Secondly, the base of 0.8% itself must progressively increase to say 1.6% by the end of the XI Plan period i.e. 2012 and 2.4% by the end of the XII Plan period i.e. 2017 in line with India's aspirations to emerge as a Knowledge Economy and strengthen national competitiveness.

2. IT and Electronics Hardware Industries

The nation and DIT justifiably take pride in the development of a \$ 36 billion globally competitive export oriented IT industry and a Telecom industry which is amongst the fastest growing in the world.

Unfortunately, what is not adequately recognized is that the Electronics Hardware Industry has become very import dependent. Against \$ 11.2 billion of Electronics production in 2004, the trade deficit was \$ 10.4 billion.

The total demand is expected to grow from \$ 22 billion in 2004 to \$ 160 billion in 2015. Since the demand is growing faster than local manufacture, the Electronics hardware trade deficit is set to accelerate to alarming numbers. The solution to this is to have design led manufacturing growth in the country which will also lead to employment generation. It would appear that, while Department of Electronics morphed into DIT, the focus on Electronics design has got deprioritized.

Within the Electronics hardware industry, special attention is needed on Semiconductor industry which is the base for success for so many other industries be it Consumer Electronics, Industrial Electronics etc.

Even where national initiatives were taken at the right time, (as in parallel computing/supercomputing, computer networking) there has been lack of consistent priority over the years on new levels of work in consonance with developments in the world. These are to be contrasted with other national initiatives like Space.

3. Category of R&D sources of funding and institutions of delivery

The sources for R&D funding and delivery in the ICT sector in India are:

- R&D undertaken by Academia and R&D Labs through extra-mural funding and funding by DIT, DST, MHRD and from funding by industry.
- First party Labs which undertake R&D largely for their own missions or to fulfill in-house needs as in the case of Space, Atomic Energy, DRDO and user agencies/Sectors.
- R&D undertaken by third party R&D labs, as in the case of C-DAC, SAMEER, C-DOT, CSIR Labs, etc. who get funding from respective ministries and various sources.
- R&D work undertaken by Indian Public sector as in the case of BEL, ECIL and ITI.
- R&D undertaken by large Private Sector and SME sector (for domestic markets and exports) including export of R&D services.
- R&D undertaken by global MNCs and other foreign companies.

Over 100 Fortune companies, including all the leading Semiconductor companies, are making India an increasingly important base for their global R&D needs. In most cases, the India labs have become their largest labs globally or outside of their home country.

Private sector R&D effort has primarily accelerated due to the R&D outsourcing market. Companies such as HCL, MindTree, Sasken, TCS, Wipro, and others have established themselves as global players. However, in the case of the outsourcing industry, the IPR invariably belongs to the customer and so there is no multiplier benefit. The R&D outsourcing market for India has become a \$ 4.00 billion market, growing at 30% / annum. Many countries like China, Korea, Russia, East European countries etc are trying to capture a bigger share of this market and our leadership could be threatened.

The above mentioned firms also generate their own licensable IP. In addition, there are a host of relatively young and new companies also developing their own IP/Products. These include Ittiam, iFlex, Midas, Tejas and others.

4. Plan Expenditure and Revenue Generation

Leaving aside the outsourced R&D, the largest source for ICT R&D in the country is the DIT. The R&D budget was enhanced for the tenth plan in contrast to ninth plan R&D budget as follows:

Ninth Plan :	Rs.320.0 crores
Tenth Plan :	Rs.824.0 crores

Year-wise distribution of R&D funds and data related to revenue generated in DIT is given below. Revenue generation is mostly through societies of DIT, by providing

Table 2 : Eleventh Plan R&D Expenditure
(Rs. Crores)

Year	R&D Expenditure	Outlay
2002-03	113.3	188.8
2003-04	110.06	167.6
2004-05	189.5	263.5
2005-06	192.5	308.6
2006-07	218.5	344.3

Table 3 : Revenue Generated

(Rs. Crore)

Year	LR	EBR	Total
2002-03	29.40	24.99	54.43
2003-04	21.71	34.79	56.50
2004-05	26.06	82.99	109.05
2005-06	NA	NA	157.00
2006-07			188.00 (Anticipated)

Note : IR - Internal Revenue

EBR - Budgetary Support from other sources

consultancy, sponsorships by industry, technology transfer, charges for the utilization of test facilities, providing training etc.

Direct positive correlation between grant funds and IR/ EBR generated is observed.

It is also evident that all Projects are not getting commercialized. In the medium to long term (say 5-10 years), it should be the goal to make the budgets self-sufficient except for investments in areas of national security and societal benefits such a ICT for differently abled persons.

2. Achievements of R&D Activities in DIT upto and including the Tenth Plan

There is no question that over the years DIT funding has generated several projects of national, strategic and social importance – including development of supercomputer by C-DAC, RF and microwave work at Sameer, Indian language technologies – just to mention a few. A complete list of these is enclosed in Annexure 1. As on March 2005, through projects funded by DIT and its societies, 347 technologies were ready for commercialization.

While acknowledging the above success, it would be equally fair to say that, by the very nature of high rate of obsolescence, pervasive nature impacting on all sections of Society and dynamic nature of industry, the thrust and quantum of resources injected into the IT and Electronics sector for R&D has been grossly inadequate. This can be seen in relationship to DOS or DAE or DRDO for instance. While private sector efforts are beginning in this area through R&D services and the setting up of Research Centres by multinational companies, unless these are complemented by Government's investment,

the process of reinforcement of the two will not take place as is true even in most advanced countries.

DIT programs have made significant contributions to the IT and Electronics sector. The effectiveness and visibility of these programs can be further enhanced by developing an integrated vision. Some of the suggestions include:

- The R&D should be brought on the main agenda of DIT. Research and Development should be included in the Allocation of Business of DIT and the organization of DIT should be changed to include technical persons up to the highest level to handle this aspect.
- The R&D support should be provided on a bigger scale, and at least a few flag-ship programs covering both long-term and short-term technologies should be started. The Government must also fund deployment of selected R&D outputs in order to derive full advantage (outcomes)
- The Government must review and revise its R&D policies to encourage higher levels of investments in R&D, which can lead to design led manufacturing and employment led growth
- The processes for transfer of technology (ToT), including ToT on exclusive basis, should be clearly defined to facilitate quick decision making.
- The R&D projects must encourage collaboration and outsourcing to leverage on external expertise. The Public Private Partnership (PPP) for development and commercialization of technology should be enhanced.

The challenges for R&D development are poised to get exponentially higher because of a talent crunch, whereby even the Private sector is unable to get sufficient experienced resources. This will make it increasingly difficult for the Public sector labs to attract quality talent.

With the above review of the past and current situation, we can articulate the proposed objectives and recommendations for R&D in the XI Plan in Electronics and ICT.

Recommendations for the Eleventh Plan

With a view to make India a Global R&D hub and keeping in mind the Terms of Reference for the Study team, recommendations are made as follows:

1. Structure and organization – Creation of an IT & Electronics Commission

2. Technology Commercialization – Lab to market
3. Talent Availability and Attrition
4. Private Sector R&D
5. Intellectual Property
6. Attraction of funds for R&D, including the Private Sector
7. Thrust Areas for Technology Development
8. Funding of the R&D for Eleventh Plan

1. Structure and organization – Creation of an IT&Electronics Commission

The thrust given to R&D activity in DIT has, over the years decreased in comparison to applications, replication, and infrastructure in the priority of things. There is an absence of a focused attention at the apex level to take R&D to higher and higher levels – in breadth and depth, in terms of impact and institutions thereof.

This is in contrast with, say, the DSIR labs where R&D is the centre piece and reason for their existence and commercialization of the R&D effort of a much higher level.

To significantly energize and strengthen the R&D effort and also restore Electronics to its appropriate place, it is suggested that an IT&E Commission (IT and Electronics) Commission be created with administrative and financial powers in line with Space and Atomic Energy Commissions. The Chairman of the IT&E Commission who should be a technocrat would report directly to the Minister and also be the ex-officio Secretary to the Government of India in the department which could also be renamed as Department of IT and Electronics to accurately reflect the range of activities carried out.

The Government can take a look at the model of Taiwan where their Institute for Information Industry (III) has been the heart of its ICT revolution. The III Chairman is the Science and Technology advisor to the Prime Minister. The range of III functions is impressive. For industry promotion, it functions as a think tank, proposing government policies and providing market analysis. In research and development, it works on software and hardware technology and incubates startups, develops concepts such as the integrated service model and the digital home, and generates consumer, communications, and computer technologies, including over 100 patent applications annually. In education, it has provided professional IT training to over 350,000 people in both the public and private sectors. The models of several

other countries such as US, Japan and France are also enclosed in Annexure 3 for study and adoption.

Another model is our own DSIR labs which have structured programs/cells for Technology Promotion and Utilization, Technology Development and Innovation, Technology Scanning, Technology management and Technology Transfer, etc.

Technology delivery and development should be through Labs which are identified to be Global Centres of Excellence striving for international leadership. Accordingly, even when DIT funds projects in Universities etc. it should do so on the basis that the Lab is identified as building leadership in the area.

2. Technology Commercialization – Labs to Market

The Government has been supporting research at a large number of academic and research organizations. A lot of good work has been done through these efforts. There is a need to strengthen the mechanism to take these technologies from lab to market for commercial exploitation. The following is proposed in this regard:

- 2.1 **Technology Showcasing:** DIT has been successfully holding Electronics & IT Exposition (ELITEX) for the last few years to showcase the technologies developed through the support of DIT. Many technologies have been transferred to the industry during this exposition. This mechanism should be strengthened by an effective outreach programme to showcase the technologies developed by the Government, and to hold such events at different cities.
- 2.2 **IPR Policy and TOT:** The IP rights for all Government funded research should be given to the participating institutions, who should be encouraged to protect and commercialize the IPR and also evolve a frame work for revenue sharing between the project investigators, inventors and others. A mechanism to take on the spot decisions on Transfer of Technology and the terms of TOT should also be put in place.
- 2.3 **IPR Policy:** Government should have a clear policy defining the IPR and the royalty sharing mechanisms between developing institutions, inventors, and the industry. This will reduce the delays in taking decision on TOT and also motivate the research to take up industry oriented R&D.

For Public-Private projects, India requires suitably adapted policy/framework on the lines of the Bayh-Dole Act that will clearly stipulate the revenue/royalty sharing arrangements between the participants.

2.4 Take all projects to the field: All development oriented projects must include making prototype units for field deployment, and upgradation based on the feed back of field testing. Funding should be provided for this.

2.5 Technology Incubation: The Department has supported technology incubation program at several premier academic institutions in the country. As a result, several technology start ups have been set up at these institutions. The success of these companies can trigger higher levels of technology incubation at these and other academic institutes. Government should share the success stories of these companies among budding entrepreneurs at other institutions, provide higher support to the better performing centers and extend the technology incubation program at Tier-II institutions (RECs : IITs). DIT should work out a detailed scheme for young entrepreneurs for supporting innovation/ incubation. The support should include infrastructure, legal, marketing and mentoring support, grant in aid for projects, fiscal incentives and tax rebates.

2.6 Technology Innovation Promotion Scheme: It is also seen that new wave of innovation in IT in Silicon Valley is happening (IEEE Spectrum Aug. 2006) and its ripple factor in India is slowly-taking shape (Businessworld Oct 2, 2006). VCs/angel investors and technical entrepreneurship in ICTE innovation to develop India's own IP are on the rise. The emerging trend of IP Development is building on the ongoing trend in R&D outsourcing to India from major ICT companies abroad. To facilitate and accelerate the ongoing trends, DIT may take an integrated view through a Technology Innovation Promotion Scheme (TIPS). DIT may work-out details of the scheme in consultation with the stakeholders such as venture capitalists, techno-entrepreneurs, industry and academic & research community after reviewing the existing national innovation system and successful models adopted in some leading countries to draw parallel.

2.7 ICTE Clusters: Several countries including Japan, France and others have set up enabling environments to bring synergies in research and development amongst local industry, academics, and research. DIT may initiate a detailed study to examine different models for adoption in India. (Annexure 2).

2.8 Design led Manufacturing: Higher proportion of total value add for the country as well as higher employment will occur when there is design led manufacturing within the country. A suitable tax credit scheme to be evolved based on R&D investment. A

well designed scheme can be done without new budgetary support as the value addition based tax credit can be defined as a rebate on indirect taxes collected on product shipment.

2.9 Sustainable Models of Deployment: Government should develop replicable and sustainable models of deployment of technologies and products by taking up field deployment beyond threshold levels

2.10 Outsourcing Development: With the convergence of technologies, and high rate of obsolescence, it is beyond the capacity and capability of any one organization to become a global leader with internal expertise in all the areas of ICT. The R&D organizations must concentrate on the areas of their core competence, and out-source the other jobs. The R&D policy of the Government should facilitate such outsourcing.

2.11 Media Lab Asia, because of its structure, can facilitate in the process to take technologies from Lab to Land.

3. Talent Availability and Attrition

The talent crunch for DIT Labs and Universities is truly looming as a major impeding factor since the talent is being drawn into the R&D outsourcing industry and MNC labs.

To create more manpower for research and to offset attrition the following to be introduced:

3.1 The pay scales for technical manpower in Academics, Government, and R&D laboratories should be enhanced to enable attracting / retention of qualified manpower.

3.2 Prestigious Research Fellowships: As a result of setting up of large R&D Centres by MNCs in India, the requirement for high end manpower (Ph.Ds), as also their remuneration, has increased. This is likely to result in more acute faculty shortage for academic institutions, and result in slower growth of R&D centers. With a view to attract more students to go for Ph.D, DIT should create a prestigious research fellowship, at enhanced rates, with a provision for participation of the scholar in national and international conferences for presentation of his paper.

3.3 Extend Research Outreach: A Large proportion of the present R&D funding of the Government is being given to the bigger academic and research institutions. It is recommended that DIT should also involve the faculty of tier II institutions in research

by supporting a large number of small projects based on the strengths and interests of the concerned faculty. It should advertise the scheme and evolve a mechanism to quickly evaluate and support the proposals received. It should aim to support about 100 small projects per year at tier II Institutes by the end of Eleventh Plan. In addition, DIT should also set up Centres for Excellence at premier academic institutes involving multiple faculty members with different specialties. It should aim to set up at least 10 such Centres, with a funding of Rs.10 crores each, during the next plan.

- 3.4 In respect of autonomous R&D Labs like C-DAC, SAMEER and company like Media Lab Asia, part of the solution could be in the earlier C-DOT / C-DAC model of contract manpower in which contract manpower along with a higher level of compensation packages and incentivization – as opposed to performance independent, guaranteed, incentive-less life-long employment. The other alternative is to follow IIT kind of system where one kind of a people are provided tenure position, yet with number of incentives like consulting, sabbatical etc., supported by contract / project manpower of the type mentioned above. Besides, the package could vary from area to area and institution to institution to best fit the needs as opposed to stereo-typing the package for all institutions.

4. Private Sector R&D

The contribution of Private sector to ICT R&D (other than R&D outsourcing) has been a small proportion of the country's R&D expenditure. In about 5 years there should be a goal of bringing it up to a level of 50%. Even Taiwan went through such a cycle where Government contribution to R&D progressively came down from 80% to a minority share.

In India too, while private sector contribution to R&D has progressively increased to a higher amount, thus increasing its contribution to the overall percentage of National R&D spending. However, Government R&D spending itself needs to be significantly increased, so that the target of 50% represents that of a much larger pie.¹

The means for achieving this will include:

- 4.1 Creation of 50 additional Incubators in the country and equipping them with enabling Infrastructure like EDA Tools and hardware platforms.
- 4.2 Tax credit scheme defined above.
- 4.3 Extending the fiscal benefits of tax rebates available to Government Labs and Universities also to Private Sector Labs.
- 4.4 Where Private Sector does R&D through a

Government lab or university, DIT to provide a matching grant.

5. Intellectual Property

Many recommendations have been made on Intellectual Property in the section on Commercialization of R&D.

In addition, the following should also be considered for further creation of Intellectual property:

- 5.1 Direct rewards to the researcher and innovator who generates the Patentable IP.
- 5.2 Creation of a centre for global trading in IP.

6. Attraction of funds for R&D, including the Private Sector

The situation in recent years has improved considerably with the availability of venture funding, creation of some Incubators etc. However, the above are yielding only incremental gains. To make an order of magnitude gain, the following suggestion for creating an R&D Corporation of India (RDCI) is commended to the Government for the IT&E sector.

- 6.1 Government should sponsor R&D Corporation of India (RDCI) with an initial corpus of Rs.100 crores. This Corporation will help in creating, enabling environment and ecosystem. It will operate on "profit" motive. It should be managed by a Board which has representation from Government, Banks/Finance organizations, R&D organizations including Industry.
- 6.2 RDCI should be empowered to float long term high risk/ high return tradable bonds for an initial amount of Rs 1000 crore in partnership with recognized R&D enterprises for recognized R&D products and projects. These bonds can be subscribed by any individual and/ or by any profit making enterprise upto a specified limit. The investment in these bonds should be tax deductible. The principle amount of these bonds must be guaranteed but the return on these bonds will be based on 5 year return generated by the corporation. Return and capital gain on these bonds is suggested to be tax-exempt. (The bonds can be enhanced to Rs.5000 crores if Government extends this scheme to other sectors).
- 6.3 These R&D bonds will provide resources for all R&D activities in the country to all recognized R&D entrepreneurs. Royalty and revenue flow from financed/RDCI supported projects will generate the required return.
- 6.4 RDCI will be empowered to work with all government agencies to provide conducive regulatory and synergetic environment.
- 6.5 Purchase of these recognized R&D projects, process, products and services will entitle the users and

organization a tax break for example upto 30% of value of the purchase upto a specified ceiling. This will create demand for Indian R&D products, projects and products.

- 6.6 RDCI is expected to be a profit making corporation and will pay normal taxes thereby neutralizing all the tax incentives provided by the government in purchase/sale of R&D bonds and purchase of R&D products/projects/ services/processes patented.

7. Thrust Areas for Technology Development

It is recommended that all requirements for R&D in the country be grouped in the following areas:

- i) National Security and Safety which would also include disaster recovery and response;
- ii) Social Sector which will include, Indian Language Computing, Internet and Broadband Technologies, various technologies, for differently abled persons, initiatives like Media Lab Asia, ICT for Education, Healthcare, Enhancing Livelihoods etc.;
- iii) Strategic which will include Semiconductors since it is the base of success for so many other industries;
- iv) Cutting edge and emerging areas in both IT and Electronics;

The above are amplified in Annexure 3. The Government must review its thrust areas on a regular basis, remove such areas that have stabilized, and induct new ones that need to be supported.

As mentioned earlier, the delivery of all Research should be through Labs aiming to be Global Centres of Excellence or a well coordinated network of such Labs. Life should have the goal of achieving global leadership in a few identified areas.

While prioritizing fund allocation, it would be imperative that no compromise is made in allocation of funds by Government in respect of the National Security and Safety areas, Social Sector and next Strategic Sectors.

Even in respect of cutting edge and emerging areas, Government has to make forward looking, far-sighted allocation of resources as these build strong national capability in foundation technologies with potential for diffusion and multiplier effect benefiting the competitiveness of the industry itself in the long run. The successful lesson from other countries confirms the latter; Typically, most of the industry and entrepreneurs focus and spend energy on market opportunities and short term gains than long-term benefits, per se, at least till they reach a critical size to afford investments in research on foundation

technologies. Also, SME sector cannot afford to make such investments.

Some of the areas which can be prioritized include:

- 7.1 Setting up a Central Lab (what is normally referred to as a Society in DIT parlance) for Indian Languages and Speech Technologies along the lines of C-DAC etc. This should be supported by Regional Labs. Work being done in multiple other labs for Indian languages be brought under above, to avoid fragmentation and duplication of effort.
- 7.2 Development of appropriate technologies and solutions for the social sector, and their deployment on a large scale, requires long term commitment and support. Media Lab Asia is pursuing socio-economic programmes in the areas of - Healthcare, Education, Empowerment of the disabled, Village Livelihood Generation, and Rural Connectivity. Government must strengthen the Media Lab Asia Program and provide committed financial support for the eleventh plan. Media Lab Asia should also take the technologies from Lab to Land, and provide a test bed for rural products and technologies. For this purpose, it should strengthen its collaboration with the Government, industry and the NGOs.

Empowered with the power of ICT, rural India can participate effectively in resurgence of the nation to achieve equitable growth in the rural areas also. The skill improvement through vocational training will result in enhancing the village livelihood as well as meet the technological requirement.

In the Eleventh Plan, Media Lab Asia may focus on projects for development and pilot deployment in the areas of: a) Rural Telemedicine with cost-effective devices, b) Health Management Information System, c) e-Content and internet / satellite based systems for vocational courses, education of socially disadvantaged children including school drop-outs, d) education and empowerment of the disabled, e) capacity building for rural BPO, f) wireless Connectivity, g) IT applications for rural areas and agriculture applications, f) radio browsing for generating technical / civic / social awareness among rural people, and h) manpower training in rural areas.

- 7.3 Creating a national IPR Institute for Semiconductor Layout Design.
- 7.4 Creating a Centre for Computational Electromagnetics within Sameer.
- 7.5 Creating urban-rural connectivity through a combination of Wired and Wireless technologies.

7.6 Establish India as a leader in Open Systems research by creating a Centre for same. For this Government support will be needed in choosing Open Systems as a Standard.

The above are by no means an exhaustive list of focus areas.

8. Funding of the R&D for Eleventh Plan

The requirements for R&D funding comes to about Rs.5,280 crore as per Annexure 4. However, this only

represents a normative increase in the current level of R&D funding directly by DIT.

The Software Exports Study Group has recommended the R&D figure of Rs.70,000 crore for the XI Plan period, based on R&D expenditure of about 4-5% of the turnover. While there is a strong need to enhance the levels of investments in Research and Development, the actual mobilization of funds of this magnitude may require a longer time frame. For such funding to have full productive impact, necessary instruments have to be parallelly created and a national level well architected R&D execution plan has to be evolved.

Achievements in the Tenth Plan through R&D support by DIT

Research & Development in identified thrust areas is one of the major function of the Department of Information Technology. This support has helped in building infrastructure and competencies at a large number of academic and research institutions, produced the required manpower to take up Research and Development in the industry besides development of various products and packages.

In addition, the Department has also set up several institutions to take up Research & Development in identified thrust areas. During the last five year plan, several R&D societies in the area of ICT were merged under the brand of C-DAC (Centre for Development of Advanced Computing). This was aimed at bringing synergies in Research and Development.

The Department reviewed its thrust areas and provided enhanced focus to "Nano Electronics", "Nanometrology" and "Bio-informatics" and reduced the levels of funding in some sectors that have matured.

Major areas where success has been achieved are:

2.1 Sponsered R&D Projects

NEW PROGRAMS

1. Nanotechnology

Recognising importance of Nanotechnology, DIT initiated Nanotechnology Development Programme in the year 2004 with an objective to create infrastructure for research in nanoelectronics and nanometrology at the national level and also to fund small & medium level research projects in specific areas such as nanomaterials, nanodevices, carbon nano tubes (CNT), nanosystems etc. Ten projects with a total budget outlay of over Rs. 126 crore have been initiated. These include two major research infrastructure projects at national level. (i) Nanoelectronics Centres – a joint project at IISc Bangalore & IIT Bombay with an outlay of Rs.99.80 crore for a duration of 5 years; and (ii) Nanometrology Centre at NPL, New Delhi with an outlay of Rs.11.308 crore for a duration of 4 years. The Nanoelectronics Centres at IIT Bombay & IISc Bangalore is a unique experience of two leading academic institutions involving 55 multidisciplinary faculty working together on different

components of the project. The project also includes teaching and research at PhD, M.Tech and B.Tech level. The Nanometrology Centre at NPL, New Delhi will provide calibration & traceability for line width, step height, surface texture measurement; and calibration of low voltage (nV), low current (pA) and electric charge (fC). The centre will participate in international inter comparisons and round-robin tests. The facilities available at these Centres would also be available to other researchers, institutions and industry.

2. Bioinformatics

In view of the global potential in the field of Life Sciences, enhanced thrust was given to Bioinformatics by way of creating a Bioinformatics Division in DIT during the year 2004. The objective of the Division is to support state-of-art research in Bioinformatics and to create infrastructure to facilitate Bioinformatics research by the industry. For the above, a Bioinformatics Resource and Application Facility has been created at CDAC, Pune wherein grid enabled infrastructure (Compute, Data and Software) will be provided to industry, academia and Research Community.

3. Indian Language Technology

Under the National Roll-Out Plan, CDs containing Software tools and fonts are being released in public domain for wider proliferation of benefits of Language Technology to masses. So far CDs for Tamil, Hindi and Telugu languages were released in the year 2005.

R&D projects in the area of Machine Translation, Optical Character Recognition, Text to Speech, Speech Corpora, Software Tools and Fonts in Indian Languages were initiated at various R&D an academic institutions. The technologies and standards developed in the Indian Language technologies are made available through a journal and on the web site.

Operating System in Indian Languages – INDIX , an open source operating system has been developed and is available for Hindi & other 11 Indian languages namely Assamese, Bengali, Gujarati, Kannada, Malayalam, Marathi, Oriya, Punjabi, Sanskrit, Tamil and Telugu. This will provide Indian languages text processing, web page designing facility and also internet access in these languages.

Web contents and Web based application in Hindi were developed at seven Centres. UNICODE compliant e- content of approximately 16000 HTML & Dynamic pages in the domains of health, education, tourism and agri-business have been developed and made available to concerned agencies. Masters level Programme in the domain of Knowledge Engineering / Computational Linguistics has been introduced at four national level institutions and Post Graduate Diploma programme in Localization has been introduced at four institutions.

W3C Initiative – Project “Web Internationalization Initiatives” has been initiated with the objective of adequate representation of Indic languages in the Web Technology Standards being evolved by World Wide Web Consortium (W3C).

4. Technology Development Council

The aim of Technology Development Council (TDC) is to facilitate research and development in IT, promote Free and Open Source Software and to promote applications of IT for indigenous, efficient and cost effective solutions for product and processes developments in the industrial sectors. Other areas considered and supported under TDC includes Bio-informatics.

Some of the major achievements under this programme include (i) development of common specifications, test suites, and reference implementation of Smart Card Operating System for Transport Applications such as Driving Licenses and Vehicle Registration; (ii) development and deployment of proof of concept of i-Grid computing facility at 45 institutions; (iii) incubating 19 technology start up companies under the technology incubation support program at six premier academic institutions; (iv) development of security system for vehicle identification, authorization and inspection using computer vision and smart cards; and others.

a) Open Source Software

In view of the opportunity in the area of open source software, DIT has established a National Resource Center in Chennai jointly with C-DAC and AU-KBC. The center, among other things, is bringing out an Indian Linux distribution targeting to Indian requirements including Indian language support. Work is also in progress in e-Governance framework using OSS.

The Open Source Resource Center an IBM-IIT-C DAC initiative is playing a catalytic role in nurturing

Free Open Source System (FOSS), its eco-system with a special focus on education and health sectors.

b) Power Sector

Distribution Automation Technology with indigenous RTU, application packages, communication protocols, etc. have been developed and applied in Trivandrum city under KSEB which is being used as a regular system. Pilot projects were earlier developed and applied under the erstwhile APSEB and also in WBSEB. Suitable hardware like Distributed Control Nodes (DCNs) and an integrated control system has been developed and applied for retrofit in mini hydel stations. The successful system is working at the Teesta Canal Fall Hydel Project under WBSEB.

National Mission on Power Electronics Technology (NaMPET) has been initiated under a collaborative arrangement with C-DAC (Thiruvananthapuram) as the nodal agency and a number of academic institutes and industries as partners. A complex electronics hardware system to improve quality of electric power, namely, the STATCOM (Static Compensation) based on IGBT devices, DSP controllers and state-of-art embedded software with a rating of 750 KVAR has been developed and made operational at a mini steel plant in Kerala.

Flexible AC Transmission Systems (FACTS) – a high-end application of Power Electronics technology to enhance transmission capability of existing AC lines - has been successfully developed in the country for the first time. This has been implemented on the Kanpur-Ballabgarh 400 KV AC line working jointly with M/s Powergrid and BHEL.

c) Transportation sector

Advanced Traffic Control System (ATCS) technology incorporating DSP based traffic signal controller, embedded vehicle detectors, ATCS application software, leased line based communication network, data base management system and a central control room has been successfully designed, developed and implemented in the Pune city by C-DAC, Thiruvananthapuram.

d) Industrial Control Systems

A complex engineering software developed at IIT-Bombay which allows collaborative design and remote

CNC machining using the internet – a step towards tele manufacturing.

5. Info Security and E- commerce

For deriving economic benefits from an IT led society, E-Commerce and Information Security received high priority during the X plan. Besides bringing an appropriate legal regime in place, promotional measures were taken to build up capabilities/expertise in core areas of E-Commerce and Information Security. Products emerged have met the technology needs of public key infrastructure including digital signature, firewalls and intrusion detection systems. For the security agencies, products developed include network monitoring tools, brain mapping of suspects as well as forensic tools to image and analyse hard disks. The programme has also resulted in establishment of security management certification system in line with BS7799. The initiatives have also helped a number of organizations to improve skill in the development of multimodal biometric identification system, steganography, cryptography and network security solutions.

6. Telemedicine

Using the telemedicine technology, during the tenth plan, telemedicine network has been established by interconnecting SGPGI Lucknow, AIIMS New Delhi and PGIMER Chandigarh and medical colleges at Cuttack, Rohtak and Shimla, by C-DAC Pune and Mohali. The technology has also been employed to set up a number of telemedicine networks connecting remote health centres with specialty hospitals.

In West Bengal, Tele-medicine facilities have been setup for diagnosis & Monitoring of tropical diseases by linking up the School of Tropical Medicine Kolkata and two district hospitals using low speed WAN. More than thousand consultations have already taken place over this network. Deployment of Telemedicine facilities at five referral hospitals and nine district hospitals of West Bengal is also being carried out.

ONCONET network for providing consultation and follow up treatment for cancer patients has been established in Kerala State by connecting the Regional Cancer Centre, Thiruvananthapuram with a number of peripheral hospitals. More than 5000 patient consultations have taken place over this network benefiting them in terms of saving on expenses and avoiding hassles of traveling long distances.

7. Convergence, Communications, Broadband Technologies and Strategic Electronics

A number of technology development projects supported at various institutes across the country were successfully completed. These are TETRA based digital Mobile Radio, Set top box for conditional access, Tele TV conferencing system, Call center equipment with application software and multilingual capability, Voice over IP telephone, Design and Development of Agricultural expert advise dissemination system, etc. A number of strategic applications like Global Positioning System (GPS) receiver, non linear junction detector, conveyorised parcel viewer were also developed.

As part of India Wireless initiative, a Center for Excellence in Wireless Technology for developing Next Generation Mobile wireless system was set up in collaboration with IIT, Chennai. Issues like standards, protocols, and spectrum requirement will be considered for indigenously designed system manufacture and deployment.

8. Photonics

Photonics development programme has helped in building-up of the necessary expertise and infrastructure in the area of Optoelectronic technologies essential for the fibre optic based components and devices. Some of the technological developments i.e development of 980 nm pump laser and special fiber i.e Erbium doped fiber which have resulted in 2 international patents held jointly by DIT and CSIR

A collaborative project “Design and development of VBG for optical communication” has been initiated at CDIT, Trivandrum with NeST, Cochin as the industry partner. Considerable simulation work has been completed. The Design and Engineering Centre for Integrated Optics (DECIO) devices at SAMEER-Mumbai has successfully developed both Glass based as well as Lithium Niobate based technologies for routing elements useful in optical networking and essential in WDM systems. Industry and Defence organization have entered into MOUs with SAMEER for utilisation of both the integrated optics expertise and packaging infrastructure.

A patent has been filed through DIT cell for “An optical material exhibiting high laser damage threshold, an optical limiting device using the same” based on work carried out under the project “Nanoscope Optical Limiters” at IIT (Madras).

9. Microelectronics /Semiconductors

Five R&D projects viz Development of a Digital Programming Hearing Aid (DPHA), Design & Development of 8-Bit Microprocessor for Electronic Voting Machine Application, Coordinate Rotation Digital Computing (CORDIC) based Array Processor Ultrasonography System, Development of MEMs based Gas Sensors and Ferroelectrics for high density memory applications were initiated. Further, India Chip Programme for providing foundry services to the designers/developers in the country to siliconize their designs at Semiconductor Complex Limited (SCL) was also started. This programme involves Multi-Product Wafer Runs at M/s SCL.

For the execution of Semi Conductor Layout Design Act, registry known as Semiconductor layout Design Registry has been established for the registration and protection of design layouts in this area.

10. Medical Electronics

The following major projects were initiated in the Xth five year plan :

Development and deployment of integrated medical linac for cancer treatment: This project was initiated under Jai Vigyan mission with an objective to develop state-of-art 6 MV linac machine and deploy in six cancer hospitals in the country to promote the market for the indigenously developed linac and transfer of technology for commercial manufacture. One linac machine has been installed in Mahatma Gandhi Institute of Medical Sciences, Wardha. The other machine is going to be installed shortly in RCC, Adyar.

Braille literacy in Indian languages with the application of IT: This project was initiated under Jai Vigyan Mission project. The objective of the project has been to develop software and hardware products which would enable the visually impaired to access reading and learning material easily. The products developed have been deployed in 30 blind schools in the country and they are being used extensively by the visually impaired. M/s. WML, Kolkata is manufacturing the products.

11. Material Development

Four projects were successfully completed during this period. The outcome of the projects on ITO coatings and Recovery of copper and regeneration of etchant from the spent etchants of PCB units have been used to further upgrade the process/technology to pilot/demonstration

level. The Technologies for the projects on tantalum powder for tantalum capacitors and lead free solders are ready for transfer. During this period four International patents have been filed for the processes developed under the project on G& I line photo-resists for semiconductors. A technology developed on solder paste is being transfer to industry by C-MET, Pune, where the metal powders used are imported.

2.2 Research Activities in DIT Societies

2.2.1 Society for Applied Microwave Electronics Engineering Research

Sameer is the only institute in the country doing work in RF and microwave. During the tenth plan period, Sameer has successfully implemented a number of projects sponsored by agencies such as Department of Space, Department of Science and Technology, Department of Lighthouse and Lightships, India Meteorology Department and many industrial agencies.

Successful endeavors include Antennas, Atmospheric Instrumentation, Communication Systems, EMI/EMC, Linear Accelerator, Navigational electronics, Signal Processing, Photonics, RF and Microwave High Power Systems , Electronic Packaging / thermal Engineering etc. Some area wise achievements are summarized as below;

Antennas: Wide band EW antenna for DRDL, broad beam width antenna for Space, cosecant square antenna for search radar, altimeter antenna for Jaguar, bare sight reference antenna for ISRO, polarized antennas for DRDL etc

Atmospheric Instrumentation: UHF wind profiler RASS for IMD, Sodars for various user agencies

Communication Systems: C-band transponder for ISRO, Microwave data link for Air Force, Telemetry Receiver for ISRO, GPS receiver for CABS, Band stop filter for microwave link for Eastern Railways, Phased lock source at Ku band for BEL etc.

Electromagnetic Interference/ Electromagnetic Compatibility (EMI/EMC)

The EMI/EMC facilities at Chennai, Mumbai and Kolkatta centers of Sameer were augmented during the tenth plan to enable testing to European EMC directive and to give CE/EMC certification. The Chennai center also caters to the testing for automotive sector.

During the period 2002-2005, EMI/EMC test and design services were offered to 350 industries/ agencies for 972 assignments. 377 assignments were completed for 250 industries resulting in revenue of Rs. 1.49 crores.

EMI/EMC test facility has been qualified by TUV Sudeuchland and TUV Rheinland to carry out testing as per international standards. Indira Gandhi Center for Atomic Research, Kalakappam has also approved Sameer's test facility for safety related instrumentation system supplied to them. About 40 products by various manufacturers have been evaluated using this facility. Sameer also has implemented a number of turn key projects for petroleum, automotive and health sector.

Navigational Aids and Signal processing

Installation and commissioning of the automation system including micro controller and UHF data link of 42 light houses in Saurashtra and Kachchh regions has been completed for the Department of Lighthouse and Lightship. Installation and commissioning of auto computation system for monitoring of upper atmosphere for 32 locations all over India including Andaman and Lakshdweep islands was done for IMD.

2.2.2. Centre for Development of Advanced Computing (C-DAC)

During the X Plan, consolidation took place by the merger of four Scientific Societies under DIT. C-DAC, NEST, ER&DCIs, and CEDT Mohali became one society which has now 14 Labs in 10 locations.

Along with the above, the expertise of C-DAC in Research, Development, Projects, Technologies, IP Services and deployment became more broad based and strengthened in the area including High Performance Computing and Grid Computing, Language and Speech Technologies, Software Technologies, Information Security, solutions for Healthcare, Broadband and Wireless, Power Electronics, Scientific applications including Bioinformatics and Atmospheric Sciences, Education & Training.

In High Performance Computing and Grid Computing, as indicated above, C-DAC has built up a capacity indigenously to deliver systems upto 10 Teraflop during the plan period from 100 Gbps during the last plan period. Suitable system software capability have also been upgraded accordingly. Terascale facility (CTSF) was set up and made available to the research community in early 2003. Scientific Applications groups developed

competence and worked closely with various sectoral users in the fields of Atmospheric Sciences, Computational Fluid Dynamics, Bio-informatics, Seismic Data Processing, Structural Mechanics and Genetic Algorithms. A Public-Private partnership also blossomed under NIMTLI, under which multimedia server for Video-on-Demand (VOD) and Interactive TV (ITV) was developed.

Proof-of-Concept National Grid Computing Initiative of C-DAC opened a major new technology application and infrastructure initiative for collaboration by premier academic and research labs.

In Multilingual Computing, C-DAC has played a very comprehensive role in developing technologies, products, solutions, standards and initiated research in emerging areas during the X Plan period. Corpora, Spellcheckers, Language Kits, OCR, Machine Translation, Text-to-Speech, CLIR, Lexical Analysis, Natural Language Processing represent many topics in which C-DAC has increased its portfolio of products, technologies and research progress in all the 22 languages. A noteworthy item has been its major contribution along-with private and public players in rolling out a National initiative on Indian Language software and fonts released for public. This planned period would cover all the major Indian languages providing much boost to broadbased use of Indian Languages by Developer Community and integration with applications in various sectors including that of e-Governance.

In respect of Cyber Security, R&D in the area of Intrusion Detection System, Cyber Forensics, Staganography, are some areas where specific results have been obtained and products developed. In respect of solutions for Healthcare, Telemedicine, Hospital Information System and back-end integration with e-Governance infrastructure, are some areas where product development and deployment progressed significantly during the planned period. In respect of software, work on contemporary topics, both on open source and re-useable components, have been carried out along with deployment in critical and flagship e-Governance applications. In respect of broadband and wireless, base station and hand-held products have been developed and exported. In Power Electronics, National Centre has been set up and a number of devices, technologies and systems developed and delivered as for instance in Distribution Automation, etc. In Industrial Electronics also, SCADA Industrial Control are some areas where specific work has been continued. In respect of VLSI and Embedded Systems, ARMCO

has been developed and delivered to BARC and a number of other products such as Digital Portable Hearing Aid developed.

ICT for Development is another area where focused efforts were put in, in the areas of development of technologies and deployment. In Education & training, e-Learning modules and products have been developed and implemented

2.2.3 Media Lab Asia

Media Lab Asia was conceived with a vision of leveraging the information and communication technologies and other advanced technologies for the benefit of the common man. Media Lab Asia is engaged in research and innovations in technology and applications that benefit people in the villages and demonstrate the power of such technologies in the field by test deployment.

Media Lab Asia took up projects for development of technologies and applications and their pilot/test deployment in the field. The application areas included use of ICT for primary healthcare, education, livelihood generation and empowerment of physically & mentally challenged persons. The projects included long range point to multipoint and mesh based broadband wireless technologies for connecting villages; asynchronous store and forward data transfer systems for remote places where online internet is not available; agro-advisory system to provide personalized advice to the farmers; question and answer platform for agriculture and livelihoods in local languages; rural telemedicine systems; efficient health data collection and health awareness systems in villages using handheld computers with links to digital healthcare management systems; low cost and portable water quality measurement equipment; content creation tools for the benefit of teachers; technologies for offline internet access; low cost and localized design software for Chikan and carpet design workers and industry; audio and icon based IT tools for physically and mentally challenged people etc. Some of these technologies have

been deployed for field testing and revenue models are being established.

Some of the initiative of Media Lab Asia have started yielding very positive results in the field. For example, the e-Sagu project is delivering personalized agro advice to about 5000 farmers for their crops of cotton, paddy, chillies, fish etc. The project Ashwini is delivering quality services to about 3 lakh people in the areas of education, training, healthcare, agriculture etc using broadband wireless technology.

2.2.4 Center for Materials for Electronics Technology (C-MET)

C-MET is a scientific society under DIT, set up with an objective of development of advanced materials and technology for electronic components and devices. This includes Semiconductors, Superconductors, Ferroelectrics, optical components, laser materials, photovoltaic, luminescent materials, dielectric materials, nano-structured materials, silicon & glasses and photosynthetic and respiratory proteins. It is expected that electronic component and Photonics materials will grow to a trillion dollar industry and will be the most dominating force in the emerging technologies. This society is under the Electronics material development council of DIT.

Outcomes through material development programs during the tenth plan include setting up a copper recovery and etchant regeneration unit at M/s NSP Electronics, Bangalore. Such environment protection projects will lead to cleaner production facility and help in waste management for electronics industry. A project on environment protection in Indian and IT industries has been implemented in collaboration with UNDP and second phase for the project is in advanced stage of approval.

Technology for solder paste was transferred to industry. During the tenth plan four international patents were filed for the processes developed under the project "Photo resists for semiconductors" A number of materials have been supplied to electronic component industry during the tenth plan.

Current Global R&D Models: Some Illustrative Examples

R&D models followed by countries, to be globally competitive, are dynamic in nature. The time variant nature of the model allows flexibility to address fast pace of technology development and innovation, and changing needs of time including changing strengths of the competitors, experience from the past, geo-political and economic scenario, etc. In order to enhance the global competitiveness of industries, some countries are creating enabling environments to bring synergies in R&D amongst industry, academia and research and training institutions. Currently models being followed by some of the leading countries are outlined below.

1. USA

R&D in USA is a model of close synergy of government-funded academic research with industrial research and product development. Intense university research has led to success of several venture capital funded start-up companies. The government funds academic research as well as create central facilities to promote competitive research. Funding is channelized through NSF, DARPA, NIH and DoE amongst others.

2. Japan

Emerging areas are continuously nurtured by Federal Government support to maintain global leadership in cutting-edge technologies. One of the recent models in ICT R&D in Japan is R&D theme driven Research Park where R&D laboratories from leading industrial units, leading universities, and government-supported laboratory such as NiCT and others work in one high priority area.

One such example is Yokosuka Research Park (YRP). YRP is an ICT research park town contributing to the global progress of radio and telecommunications technology. About 70 public and private laboratories (domestic and overseas-affiliated) are established, and approximately 6000 researchers are engaged in R&D activities on basic and advanced technologies.

The YRP is R&D theme driven. Keeping in view the fast pace of technology development and innovations, vision (theme) for next 5 years is defined for every 2 to 3 years. Mobile communications technology is at present the strategic subject of YRP R&D Promotion Committee.

Joint Research Groups have been set-up for New Generation Mobile systems, UWB Wireless Technology, Millimeter-Wave Broadband Wireless Access Systems, and 60 GHz Vertically connected Wireless Link System for Communications and Broadcast services. YRP provides an effective platform for cooperative activities between industry, academia, and Government. To increase efficiency in R&D work, YRP enhances its R&D platform by providing functional research/ test facilities, sharing and dissemination of the most up-to-date research information, and exchange of scientists. Furthermore, it makes available most of these research resources to provide graduate-school level practical training.

As R&D on ICT has become globalized, YRP is seeking technical alliance and friendship with other science parks and ICT related organizations around the world.

3. France

France has designed and implementing a competitive clusters approach bringing together players from industry, research, and higher education as well as local and regional authorities in identified technology areas. The cluster provides the framework to develop ideas very quickly. This model is open to other partnerships and cooperation networks at a Regional, National, European and International level. This helps the industry to come out quickly with innovative solutions and to give their product and services the competitive edge that is essential in a global economy.

Ten ICT clusters, each addressing an identified area, have been created across eight cities. The identified areas are Complex System Design & Management; Micro & Nano Technologies; Communicative & Secured Solutions: Component, RFID, Smart Cards; Pictures & Networks: TVHD, DVD, TV on ADSL, DTTV, VOD; Embedded Systems; Pictures, Multimedia, Digital Live; Digital Games; E-transactions & Smart Cards; Electric Power; and E-Commerce. Each cluster is located in a geographically close area.

These clusters have their own vision and mission statements. For example, for Complex System Design & Management cluster this comprises of to develop an overall strategic vision through the implementation of R&D

projects; to drive strategic exchanges around technological and economic issues, to select and validate cooperative research projects and follow-up their technological transfers to industrial players, to organize an annual conference showcase for the cluster members and projects, to conduct competitive analyses and provide economic intelligence, and to ensure involvement of SMEs in the cluster and its projects.

The model has inbuilt clear financial strategy and reliable financing sources. For example the Complex System Design & Management cluster has an annual budget of 200M Euro, which comprises of 20M Euro/ year from State Financing, 40M Euro/ year from Local Government Financing and 140 M Euro/ year from Players own financing.

This synergy has contributed to success in highly competitive markets and encouraged emergence of a number of start-ups in identified areas. Clusters have helped in reducing the time-to-market for new technologies, broaden the scope of their applications and potential markets resulting in cutting down unit costs.

4. Europe

European Commission in the year 2000 presented a Communication proposing the creation of a European Research Area (ERA). It aims to the creation of a genuine 'internal market' in research to increase pan-European co-operation and co-ordination of national research activities. The main financial instruments of the ERA are the EU's Research Framework

Programmes (FPs). FPs are the financial instrument to help make ERA a reality. FPs have been implemented since 1984 and cover a period of five years with the last year of one FP and the first year of the following FP overlapping. The current FP is FP6, which would be running up to the end of 2006. However, FP7 shall run for seven years, 2007-13.

The proposed 7th Framework Programme will be organized in four programmes corresponding to four basic components of European research, namely Cooperation, Ideas, People, and Capacities. A European Research Council (ERC) is proposed to implement the EU activities in the field of basic research.

The ICT objective under FP7 is to improve the competitiveness of European industry and enable Europe to master and shape the future developments of ICT to meet the demands of both society and economy. The activities covered would strengthen Europe's scientific and technology base and ensure its global leadership in ICT, help drive and stimulate innovation through ICT use and ensure that ICT progress is rapidly transformed into benefits for Europe's citizens, business, industry and government. The amount proposed in this area is Euro 11197 million.

The maximum overall amount for Community financial participation in the European Commission (EC) 7th framework Programme would be Euro 72,726 million for the period 2007-13. The EC and the member states are concerting efforts to increase investment in research and development activities to 3 per cent of GDP by 2010.

Eleventh Plan R&D - Thrust Areas

Indicative list of thrust areas for R&D in the XIth Plan, categorized broadly under Emerging technologies, Social, Strategic and Security sectors is given below.

Emerging Technology Areas

Information Technology

- Ubiquitous Computing
- RFID
- High performance Computing
- Grid Computing
- High Performance Networking
- Bioinformatics
- Open Source Software
- Software Engineering
- Web Technologies

Electronics

- Nanotechnology
- Photonics
- Microelectronics
- Industrial Electronics and Automation Technologies
- Embedded Systems
- Electronics Material Development Program

Services and Social Sector

- Media Lab Asia – ICT for Education, Healthcare, Enhancing Livelihoods, Empowerment of the Disabled, etc.
- Language Computing and speech
- Medical Electronics and Telemedicine

Strategic

- Applied Microwave Electronics Engineering and Research
- Convergence, Communications, Broad band Technologies and Strategic Electronics

- Components and Instrumentation for defense and metrology
- Materials and components for electronic devices

Security and Safety

- E-security
- Environment protection
- Secure business- e commerce

Some of the major tasks to be implemented under specific thrust areas are mentioned below. In addition to this, support for extramural R&D projects through DIT funding will be continued during the eleventh plan.

Cutting Edge and Emerging Areas in IT

Ubiquitous Computing/RFID

- To undertake research in areas such as Wireless Sensor Networks, RFID, Ad-hoc Networks, cellular Networks, Middleware, Embedded systems, Context Aware Computing, and Human-Computer-Interaction
- Setting up of Centre of Excellence (CoE) for undertaking research in the multi-disciplinary areas of Ubiquitous Computing (UbiComp), such as middleware, embedded systems, context-aware computing; resulting in development of research prototypes, tools, core technologies, and products to improve the quality of life in general and in business processes. CoE could be formed to have a centralized knowledge and resource sharing among domain experts for all the work carried out in Wireless Sensor Networks (WSN).
- To set up an Auto ID lab to undertake work on research in the field of RFID and application customization for RFID deployment for local usage

High Performance Computing (HPC)

- Setting up National Supercomputing Research Centre (NSRC) to focus towards India crossing the Petaflop (1000 TeraFlops) barrier by the year 2013
- Maintain and enhance India's HPC technological competence

- Pursue excellence and promote high-end R&D in various sectors of Science, Engineering and other areas with the use of HPC systems
- Reduce vulnerability and enhance self-reliance in strategic sectors

Bioinformatics

- Centres of excellence for research and training in the field of Bioinformatics. to be set up to carry out research in Bioinformatics as well as generate relevant skill sets to serve the needs of Bioinformatics industry . Centres of Excellence are to generate research projects to keep the country at the forefront in the global scenario in Bioinformatics. Human resource development in bioinformatics will be to provide skilled personnel for academic, research institutes and industry.
- Research Initiative in AgriBioinformatics will be taken up. Agri- Bioinformatics has a large potential in the Indian context. DIT along with ICAR may evolve a joint funding scheme for supporting Agri-Bioinformatics..

Grid Computing

Research in the following strategic areas of grid computing will be initiated:

- Knowledge and data management
- Programming models Architecture
- Grid management and monitoring
- Problem solving environment and Grid tools & services

High Performance Networking

- Set-up Nation's Very High Speed Backbone with multiple international peering
- Linking Top Universities, Educational Institutions, Research Labs to the national Very High Speed Backbone with appropriate access networks/mechanisms, Interconnection of Smaller Universities, Engineering Colleges, Medical and Science Colleges and secondary and primary schools
- Set-up of various test-bed across the country in wide area to nurture research capabilities in various areas of network research such as in the areas of security; migration to IPv6; Multicast, QoS; Self-Organizing-Networks, protocol engineering, measurement &

monitoring, Optical networking; mobile internet, wireless sensor networking etc. and contribution to IETF and international initiatives.

Open Source Software

- A nation-wide network of OSS resource centres to be setup to address many of concerns in OSS
- To pick up success stories from various groups in India and elsewhere, and scale it up to a national level initiative (in the model of the TDIL resource centres, but giving specific mandate to the various centers)
- To work towards localization of a defined set of software into select languages

Software Engineering

- Requirements Engineering,
- Verification & Validation,
- Software Quality Process,
- System Safety and
- Software Architecture
- Software design and productivity
- Formal Methods (also Light weight formal methods)
- Model Driven Software Engineering

Web Technologies

- Web services for speech recognition, language translation and speech synthesis in local languages
- Next Generation Web Technologies (web 2.0) and standardisation (eg. Semantic Web and Web Services)
- Secure Web Services and Privacy Issues
- New development and operations paradigms are required for service-oriented architecture
- Web Services Interoperability
- Ubiquitous Services
- Open Source and Web Services

Electronics

Nanotechnology

- Create infrastructure at national labs for conducting research and development in nanoelectronics and

nanometrology and development of trained manpower at all levels. Multidisciplinary centers of excellence at leading institutes and research labs will be created.

- Continue funding small and medium level research projects in specific areas such as nano electromechanical systems, thin films, nano sensors, nano devices, spintronics, nano computing, nano materials nano photonics, molecular electronics, plastic electronics etc including modeling and related software

Photonics

- A thrust and initiatives to be taken on India has a presence as an Optical Communication Technology Developer rather than just a market

Microelectronics

- Sound infrastructure base by way of setting up Centres of Excellence and to be created both in terms of quality manpower at all levels and necessary facilities including registrar office in the area of VLSI Design as well process technology through prolonged investment at leading academic institutions and national R&D labs
- Creating mechanism for the best young engineers and scientists to be attracted towards higher education and research by way of offering long term research career and competitive salaries.

Industrial Electronics and Automation Technologies

- Centre of Excellence for Automation Technologies is proposed to be embedded at C-DAC including areas of Intelligent Transportation System, Automotive Electronics and Automation of Power Sector. This will be on a national collaborative arrangement.
- National Mission on Power Electronics Technology – NaMPET (to be continued).
- Enhancement of IT/Electronics Application - in core industries, agricultural sector, water resource management.

Embedded Systems

- To develop infrastructural resources such as design and manufacturing tools, bring out a portfolio of

reusable IP products, and also network with our peer organizations worldwide for synergising the collective expertise and resources.

- Manpower development through sound HR practices to facilitate manpower continuity so essential for complex product development, with adequate system of incentives for achievement.

Electronics Material Development Programme

- To continue basic fundamental research/ cutting edge areas such as OLEDs, high density Optical Storage Discs, high density hard disc materials, photo-resist materials. Photoimagable and photodefinable would be further upgraded to pilot/ commercial level. These efforts would be to consolidate and strengthen R&D activities where capability and infrastructure have been developed during Xth Plan to bring the sub-optimal R&D efforts to pilot/commercial level.
- Considering that electronic materials area is a highly R&D intensive area which involves basic and applied research, attempt will be to evolve projects in the relevant areas where active research groups exist and get them to work on problems of immediate concern to the industry which will promote industry academia interaction to enable the academics to work towards elevating the technological status of the industry.
- Carry out basic research in futuristic materials areas leading to innovation and technology up-gradation

Services and Social Sector

Media lab Asia

- To work in leveraging the information and communication technologies and other advanced technologies for the benefit of the common man
- In the Eleventh Plan, Media Lab Asia may focus on projects for development and pilot deployment in the areas of: a) Rural Telemedicine with cost-effective devices, b) Health Management Information System, c) e-Content and internet / satellite based systems for vocational courses, education of socially disadvantaged children including school drop-outs, d) education and empowerment of the disabled, e) capacity building for rural BPO, f) wireless Connectivity, g) IT applications for rural areas and agriculture applications, f) radio browsing for

generating technical / civic / social awareness among rural people, and h) manpower training in rural areas.

- Media Lab Asia should also take technologies from Lab to Land

Language Computing

- Establishment of National Localization Research Centers (NLRC)
- Creation of Society for Indian Languages and Speech Technologies (SILST)
- Developing Multilingual solutions for machine assisted translation system, continuous speech recognition system, Text-to-Speech Synthesis System targeted towards small footprint devices and OCR systems
- Development of Fonts for TTF and OTF
- Continuation of ongoing activities of technology development in Indian languages

Medical Electronics and Telemedicine

- Setting up the National Telemedicine Grid with a strong collaborative effort, with MoH&FW and Ministry of Social Justice & Empowerment for large scale implementation/ deployment/ roll-out covering telemedicine, medical electronics, IT and electronics based products for the disabled and standardization
- Centre of excellence for R&D in Medical electronics & Telemedicine with linkages with hospitals for clinical trials of device and other R&D organizations. The center would take up projects in the frontier areas of medical electronics and Telemedicine systems. They would also take part in market promotion of the technology through deployment in a number of hospitals
- To work in the area of Ambient Assisted Living to prolong the time people can live in a decent way in their own home by increasing their autonomy and self-confidence, the discharge of monotonously everyday activities, to monitor and care for the elderly or ill person, to enhance the security and to save resources

Strategic, e-Security and Communications

Applied Microwave Electronics Engineering and Research

- Setting up Centre for excellence in EM
- To conduct R&D in Electron Tubes
- Setting up of Calibration Laboratory for EMC Test and Measurement Instrumentation

- Establishment of Facility for batch fabrication of Linac tubes and integration of Medical Linac machine
- To initiate high energy high power Linac program
- Flight data simulator

Convergence, Communications, Broadband Technologies and Strategic Electronics

- R&D in the area of Next Generation Communication, Broadcast and Convergence technologies (e.g. 3G, 4G Wireless Communications, Software Defined Radio/Software Radio, Ultra Wide Band transceiver and antenna, Data Compression Technology, Smart antennas)
- Convergence of wired/wireless networks, fixed mobile convergence consumer premises equipment (CPE) and converged access devices.
- ICT applications in strategic/ mission mode activities with focus on safety, security, and surveillance, communications during emergencies, Galileo Receiver for GPS Satellite Network, and customized strategic applications such as underwater surveillance communication/ navigational aids
- R&D in RF/Microwave devices-systems autonomous vehicle and robotic systems for disposal of hazardous /explosive devices.
- Initiate studies in cutting edge technologies and development of road map for the country.

e-Security/ e-commerce

The IT infrastructure provides for the processing, transmission, and storage of vast amounts of vital information used in every domain of society, and it enables government agencies to rapidly interact with each other as well as with industry, citizens, state and local governments, and the governments of other nations. The operational stability and security of critical information infrastructure is of vital importance for the economic security of the country. Fast shifting trends in both technologies and threats make it likely that the security issues of the critical information infrastructure will only intensify in the coming years. Consistent with the need to secure critical information infrastructure as well as country's cyber space, it is necessary to focus on preventing cyber attacks against the critical infrastructure, reduce national vulnerabilities to cyber attacks and minimize damage and recover time from cyber attacks. To address these issues, we should focus on :

-
1. **Security Policy, Compliance and Assurance:** Creation, Establishment and operation of Cyber Security Assurance Framework aimed at enabling Government, Critical Infrastructure Organisations and other key IT users of nation's economy
 2. **Security Incident – Early Warning & Response:** Creation of National Cyber Alert System for Rapid identification of & response to security incidents and information exchange to reduce the risk of cyber threats and resultant effects.
 3. **Security training** – To meet the specific needs of Law Enforcement, Judiciary and other users such as E-Governance project owners, catering for IT Security awareness, Skill & competence development and Advanced Manpower Certification Programmes.
 4. **Security R&D:** Facilitating Basic research, Technology demonstration & Proof-of concept and R&D test bed projects.
 5. **Security – Promotion & Publicity:** To promote awareness, participation and information sharing.

‘X’ Indicative Fund Requirements for R&D in ICT&E for Eleventh Plan

Areas	Sub-areas	Funds in Cr
Strategic, e-Security and Communications	Applied Microwave Electronics Engineering and Research	455
	Convergence, Communications, Braodband Technologies and Strategic Electronics	350
	e-Security and e commerce	750
Services and Social Sector	Language Computing	245
	Medical Electronics & Telemedicine	200
	Media Lab Asia	750
	IPR Promotion Programme	50
	Semicounductor Design Layout IPR	50
Cutting Edge and Emerging Areas in IT	Ubiquitous Computing/Emerging Areas (Including RFID)	180
	High Performance Computing & Grid Computing	800
	Bioinformatics	50
	High Performance Networking	100
	Open Source Software	100
	Software Engineering	200
	Web 2.0	150
	RDCI	100
	Extending Research Outreach	20
	Technology Innovation Promotion Scheme	50
Cutting Edge and Emerging Areas in Electronics	Nanotechnology	150
	Photonics	100
	Microelectronics	100
	Industrial Electronics and Automation Technologies	100
	Embedded Systems	120
	Electronics Material Development Programme	110
	Total	5280

Working Group on Information Technology for Eleventh Plan (2007-2012)

Terms of Reference

1. To evolve strategies to become world leaders in:
 - a. IT software and services including ITES
 - b. IT & Electronics hardware manufacturing
 - c. Provide highly skilled manpower for the sector
2. To review existing policies and evolve an approach for the Information Technology sector for the Eleventh Plan keeping in view the comparative advantage, strengths and weaknesses of Indian electronics and IT industry, international scenario and the national goal of making India IT and Electronics superpower. Also to examine the organizational structure under the Department of Information Technology and suggest measures to make it more relevant to the emerging needs.
3. To put in place the basic policy framework and fiscal incentives for making India a major regional hub for electronic/IT manufacturing including high-end. The H/w manufacturing hub should be coupled with R&D centers of excellence. IPR creation should be incentivised.
4. To assess and project year wise capacity, export and production potential for the different sub-sectors of electronics and IT industry taking into account domestic and international markets.
5. To drive the National e-Governance Programme with all stake holders for implementing the Mission Mode Projects in a time bound manner and put in place the requisite infrastructure for providing web enabled e-governance services before 2008.
6. To assess the impact of IT sector and suggest measures to improve use of IT in various fields for increasing productivity, bringing in socioeconomic development and services like e-medicine, e-education, e-entertainment especially to the rural areas.
7. Plan, assess and prepare a framework for manpower development by assessing the present and future needs of the industry including emerging areas in IT and IT related disciplines.
8. To identify gaps in existing skill sets in different ITES – BPO/KPO verticals and suggest programs for bridging them through formal and non-formal sectors.
9. Establish a state-of-the-art Info-Nano-Bio research institute for capacity building and to undertake R&D activities.
10. To develop a mission mode project for continuous upgradation of knowledge and skills of teachers in electronics, computer science & engineering, IT and related disciplines through e-learning and instruction design for capacity building.
11. To identify future technological areas of growth and evolve strategies to stay ahead of competition.
12. To work out strategies and evolve a mission mode programme to introduce technology into the educational institutions by converting the existing schools into smart schools and creating wired educational campuses in a phased manner.
13. To develop programs to facilitate software product development through active participation of industry and academia with adequate incentive framework.
14. To evolve mission mode approach towards creation of relevant content in Indian languages for wide scale applications and use of IT.
15. To work out an Action Plan, including organisational structure for obtaining recognition of non formal courses being offered by DOEACC.
16. To implement the digital signature regime to facilitate secured transaction in all sectors on a Mission Mode basis and to work out an action Plan for capacity building in cyber security field.
17. Any other item that the Working group deems necessary to be included for making recommendations useful.

Working Group on Information Technology for Eleventh Plan (2007-2012)

Composition

1. Secretary - Chairman
Department of Information Technology
2. Secretary
Department of Telecommunication
3. Secretary
Department Commerce
4. Shri M.M. Nambiar
Additional Secretary, DIT
5. JS & FA - Member Convener
DIT
6. Dr. G. D. Gautama
Principal Secretary, IT West Bengal
7. Dr. Sanjay Dhande
IIT, Kanpur
8. Prof. Rajeev Sangal
IIIT, Hyderabad
9. Prof. H S Jamadagni
IISc Bangalore
10. Adviser
C&I, Planning Commission

Non Official Members

11. Shri Ajai Chowdhry
HCL, New Delhi
12. Shri Ashok Soota
Mindree, Bangalore.
13. Shri Saurab Srivastava
TIE
14. Shri Rajendra Kumar
President, MAIT
15. Shri Vinod Sharma
President ELCINA
16. Shri Kiran Karnik
President, NASSCOM
17. Shri P. Balaji
President,TEMA
18. Shri N. Srinivasan
Director General, CII
19. Director General
FICCI
20. President
Internet and Online Association

21. Shri Rajesh Chharia
President, ISP Association of India
22. Shri Anoop Kumar
President, CETMA

Co-opted Members

23. Shri R.S. Pawar
President, NIIT
24. Representative, UGC
25. Representative, AICTE
26. Shri R. Chandrashekhar
Addl. Secretary, DIT
27. Director General (NIC)
28. Shri Pankaj Agrawala
Joint Secretary, DIT
29. Dr. A.K. Chakaravarti
Adviser, DIT
30. Dr. U.P. Phadke
Adviser, DIT
31. Dr. R.C. Chopra
Group Coordinator, DIT
32. Dr. S.L. Sarnot
DG(STQC), DIT

Study Team of Electronics / IT Hardware Manufacturing Sector

Terms of Reference

1. To evolve strategies to become world leaders in IT & Electronics hardware manufacturing.
2. To review the present status of the Electronics and IT hardware industry in terms of capacity, production, consumption, imports, exports and S&T programmes and to compare what is likely to be achieved by 2006-07 with that projected in X Plan and analyse the causes of major deviations, if any, and suggest remedial actions in the appropriate areas.
3. To assess and project year wise upto 2011-12, export and production potential for the different sub-sectors of electronics and IT industry taking into account domestic and international markets with an indication of the perspective upto the year 2020 capacity.
4. To review the status of an estimate investment required to be made in the public and private sectors in the context of the projections for the Eleventh Five Year Plan.
5. To review existing policies and evolve an approach for the Information Technology sector for the Eleventh Plan keeping in view the comparative advantage, strengths and weaknesses of Indian electronics and IT industry, international scenario and the national goal of making India IT and Electronics superpower.
6. To put in place the basic policy framework and fiscal incentives for making India a major regional hub and attract investment including FDI for electronic/IT manufacturing including high-end products.
7. To examine and put in place the policy package and incentives for establishing mega-fab in the country and to work out its implementation strategy.
8. To identify the thrust areas where the country has potential to become internationally competitive for achieving significant exports.
9. To examine the adequacy to the existing general infrastructure facilities like Standardization, Testing and Quality Assurance Centres, R&D base.
10. To study the implications of convergence of Computer, Communication and Consumer Electronics technologies and its impact on Indian consumer electronics industry in terms of new products, applications, etc.
11. To review the availability of critical raw-materials and components for the industry and to recommend their indigenous manufacturing keeping in view the option of Make Vs Buy.

Composition

- | | | |
|-----------------------|---|----------|
| 1. Shri Ajai Chowdhry | - | Chairman |
| HCL Infosystems Ltd. | | |

Members

- | | |
|---------------------------------------|-------------------|
| 2. Shri M. Madhavan Nambiar | |
| Addl. Secretary, DIT | |
| 3. Shri Satish Kaura, | |
| Chairman, Samtel Group of Companies | |
| 4. Lt. Gen. (Retd) S.S. Mehta | |
| DG, CII | |
| 5. Shri Anoop Kumar | |
| President, CETMA | |
| 6. Shri B.S. Sethia | |
| ELIN Ltd. | |
| 7. Shri Vishnu R. Dusad | |
| Adviser, FICCI & MD, Nucleus Software | |
| 8. Shri Raj Kapur | |
| CEO, JCT Electronics Ltd. | |
| 9. Shri Deepak Puri | |
| Chairman, Moser Baer Ltd. | |
| 10. Shri Vinod Sharma | |
| President, ELCINA | |
| 11. Representative, BEL Bangalore | |
| 12. DDG(LTP), Department of Telecom | |
| 13. Shri Rajendra Kumar | |
| President, MAIT | |
| 14. Shri P. Balaji | |
| President, TEMA | |
| 15. Dr. A.K. Chakravarti | |
| Adviser, DIT | |
| 16. Dr. U.P. Phadke | |
| Adviser, DIT | |
| 17. Dr. R.C. Chopra | |
| GC, DIT | |
| 18. Industrial Adviser (Elec) | |
| DCSSI | |
| 19. Shri R.C. Sachdeva | - Member-Convener |
| Sr. Director, DIT | |

Study Team on Exports Computer Software and Services

Terms of Reference

1. To evolve strategies to become world leaders in development of IT software and services including ITES.
2. To review the present status of the domestic software and services industry and to compare what is likely to be achieved by 2006-07 with that projected in the X Plan and analyse the causes of major deviations, if any, and suggest remedial actions in the appropriate areas.
3. To assess the domestic software and services industry year-wise upto 2006-07 with an indication of the perspective upto the year 2020 and identify key areas for special thrust.
4. To examine the structural weakness of the Indian Computer Software Industry and suggest ways and means to improve them so that India becomes leading software developer covering the customized software development, packaged software development, technology levels, etc.
5. To review the status of and estimate the investments required to be made in the public sectors in the context of the projections for the Eleventh Five Year Plan.
6. To assess/identify the impact/application of IT in various sectors of economy and suggest measures to improve use of IT in various fields for increasing productivity, bringing in socioeconomic development and services especially to the rural areas.
7. To drive the National e-Governance Programme with all stake holders for implementing the Mission Mode Projects in a time bound manner and put in place the requisite infrastructure for providing web enabled e-governance services before 2008.
8. To suggest measures to address the issue of digital divide and taking the benefits of IT to the masses.
9. To evolve mission mode approach towards creation of relevant content in Indian languages for wide scale applications and use of IT.
10. To implement the digital signature regime to facilitate secured transaction in all sectors on a Mission Mode basis and to work out an action Plan for capacity building in cyber security field.
11. To identify emerging technology areas in software for taking up R&D and such suggest, methods, actions for building expertise.
12. To strengthen the industry-academic linkages for taking up research for developing expertise in cutting edge/emerging technologies.
13. To identify gaps in existing skill sets in different ITES – BPO/KPO verticals and suggest programs for bridging them through formal and non-formal sectors.
14. The issues of data protection and security including technological, managerial and legal frameworks which need to be addressed in a focused manner.

Study Team on Exports Computer Software and Services

Composition

- | | | | | |
|-------------------------------------|---|----------|--------------------------|-----------------|
| 1. Shri Saurabh Srivastava | - | Chairman | 16. Dr. A.K. Chakravarti | |
| | | | Adviser, DIT | |
| 2. Dr. Lalit Kanodia | | | 17. Shri S. Ramakrishnan | |
| Chairman, Datamatics Ltd. | | | DG, C-DAC | |
| 3. Shri Kiran Karnik | | | 18. Dr. S.L. Sarnot | |
| President, NASSCOM | | | DG(STQC) | |
| 4. Shri Pravin Bhasin | | | 19. Dr. B.K. Murthy | |
| Genpact Call Centre | | | Director, DIT | |
| 5. Shri Nalin Kohli | | | 20. Shri S.N. Zindal | - |
| Chairman, ESC | | | DG(STPI) | Member-Convener |
| 6. Representative | | | | |
| Ministry of Commerce from WTO angle | | | | |
| 7. Representative, CII | | | | |
| 8. Representative, FICCI | | | | |
| 9. Representative, ASSOCHAM | | | | |
| 10. Representative, ISPAI | | | | |
| 11. Representative, DOT | | | | |
| 12. Representative, MAIT | | | | |
| 13. Representative, BSNL | | | | |
| 14. Representative, Bharti Telecom | | | | |
| 15. Dr. N. Vijayaditya | | | | |
| DG(NIC) | | | | |

Study Team on Domestic Computer Software and Services

Terms of Reference

1. To evolve strategies to become world leaders in development of IT software and services including ITES.
2. To review the present status of the domestic software and services industry and to compare what is likely to be achieved by 2006-07 with that projected in the X Plan and analyse the causes of major deviations, if any, and suggest remedial actions in the appropriate areas.
3. To assess the domestic software and services industry year-wise upto 2006-07 with an indication of the perspective upto the year 2020 and identify key areas for special thrust.
4. To examine the structural weakness of the Indian Computer Software Industry and suggest ways and means to improve them so that India becomes leading software developer covering the customized software development, packaged software development, technology levels, etc.
5. To review the status of and estimate the investments required to be made in the public sectors in the context of the projections for the Eleventh Five Year Plan.
6. To assess/identify the impact/application of IT in various sectors of economy and suggest measures to improve use of IT in various fields for increasing productivity, bringing in socioeconomic development and services especially to the rural areas.
7. To drive the National e-Governance Programme with all stake holders for implementing the Mission Mode Projects in a time bound manner and put in place the requisite infrastructure for providing web enabled e-governance services before 2008.
8. To suggest measures to address the issue of digital divide and taking the benefits of IT to the masses.
9. To evolve mission mode approach towards creation of relevant content in Indian languages for wide scale applications and use of IT.
10. To implement the digital signature regime to facilitate secured transaction in all sectors on a Mission Mode basis and to work out an action Plan for capacity building in cyber security field.
11. To identify emerging technology areas in software for taking up R&D and such suggest, methods, actions for building expertise.
12. To strengthen the industry-academic linkages for taking up research for developing expertise in cutting edge/emerging technologies.
13. To identify gaps in existing skill sets in different ITES – BPO/KPO verticals and suggest programs for bridging them through formal and non-formal sectors.
14. The issues of data protection and security including technological, managerial and legal frameworks which need to be addressed in a focused manner.

Study Team on Domestic Computer Software and Services

Composition

- | | | | |
|--|---|----------|---|
| 1. Shri Kiran Karnik
President, NASSCOM | - | Chairman | 17. Representative, Planning Commission |
| 2. Representative, CII | | | 18. Joint Secretary (Tech)
Ministry of I&B |
| 3. Representative, FICCI | | | 19. Shri R. Chandrashekhar
Addl Secretary, DIT |
| 4. Representative, ISPAI | | | 20. Shri S.R. Das |
| 5. Representative, DOT | | | - |
| 6. Representative, MAIT | | | Member-Convener |
| 7. Representative, BSNL | | | |
| 8. Representative, Bharti Telecom | | | |
| 9. Addl. Secretary, Deptt. of Admn. Reforms & Public
Grievances | | | |
| 10. Representative, TCS | | | |
| 11. Representative, Wipro | | | |
| 12. Secretary (IT), Andhra Pradesh | | | |
| 13. Secretary (IT), Karnataka | | | |
| 14. Secretary (IT), Delhi | | | |
| 15. Dr. N. Vijayaditya
DG(NIC) | | | |
| 16. Representative, IIT | | | |

Study Team on Human Resource Development

Terms of Reference

1. To evolve strategies to become world leaders in providing highly skilled manpower for the IT and Electronics sector.
2. To examine the adequacy of Manpower Development and training centres, etc. in the areas of information technology, electronics, computer networks and networking centres, etc.
3. Plan, assess and prepare a framework for manpower development by assessing the present and future needs of the industry including emerging areas in IT and IT related disciplines.
4. To identify gaps in existing skill sets in different ITES – BPO/KPO verticals and suggest programs for bridging them through formal and non-formal sectors.
5. To develop a mission mode project for continuous upgradation of knowledge and skills of teachers in electronics, computer science & engineering, IT and related disciplines through e-learning and instruction design for capacity building.
6. To work out strategies and evolve a mission mode programme to introduce technology into the educational institutions by converting the existing schools into smart schools and creating wired educational campuses in a phased manner.
7. To work out an Action Plan, including organisational structure for obtaining recognition of non formal courses being offered by DOEACC.
8. To recommend a strategy to develop manpower which is relevant to industry/user requirements and to suggest ways and means of ensuring active participation and support of the industry.
9. To examine the existing infrastructure and constraints for developing high quality manpower and to recommend measures to meet the needs of the industry in the global perspective including strategies for continuing education for professionals.
10. To review the academic curricula at different levels of engineering education and recommend specific changes/modifications required in the curricula, teaching methodologies, administrative mechanism for imparting industry relevant education at the institutions.
11. To study the role of new educational technologies, e.g., Distance Education, Multimedia etc. and to recommend modalities for their integration in the present educational/training system. To suggest measures necessary to improve teaching of non-IT subjects by using computers and the Internet for all students.
12. To make recommendations regarding the modalities for achieving mutually beneficial cooperation between educational institutions in IT in the formal sector and those in the private sector.
13. To assess the impact of IT sector and suggest measures to improve use of IT in various fields for increasing productivity, bringing in socioeconomic development and services like e-medicine, e-education, e-entertainment especially to the rural areas.

Study Team on Human Resource Development

Composition

- | | | |
|--|----------|--|
| 1. Mr. Phiroz Vandrevalla
Executive Vice-President, TCS | Chairman | 16. Representative, IIT Delhi |
| 2. Shri Pankaj Agrawala
Joint Secretary, DIT | | 17. Representative, Planning Commission |
| 3. Representative, Ministry of HRD | | 18. Dr. Y. K. Sharma, DDG, NIC |
| 4. Dr. (Smt.) Irina Garg / Shri Puran Singh
Director, Deptt. of Secondary & Higher Education,
MHRD | | 19. Dr. Gulshan Rai, ED (ERNET) |
| 5. Representative, AICTE | | 20. Ex. Director, DOEACC |
| 6. Representative -UGC | | 21. Shri G.V. Raghunathan
Director, DIT |
| 7. Representative, MAIT | | - Member-Convener |
| 8. Representative, APTECH | | |
| 9. Representative, NASSCOM | | |
| 10. Representative, C-DAC | | |
| 11. Shri S. Mitra
Representative, NIIT | | |
| 12. Shri Siddhath
Secretary (IT), Govt. of West Bengal | | |
| 13. Secretary (IT), Govt. of Maharashtra | | |
| 14. Secretary (IT), Govt. of Karnataka | | |
| 15. Secretary (IT), Govt. of Punjab | | |

Study Team on Research & Development

Terms of Reference

1. Review of X plan S&T status in electronics w.r.t.
 - a. Review of DIT S&T Programmes.
 - b. Other S&T Departments.
 - c. R&D in Electronics and IT Industry.
 - d. Review of Technology imported by industry from absorption and upgradation point of view.
2. To consolidate objective/aims and expected achievement of the XI plan.
3. To identify future technological areas of growth and evolve strategies to stay ahead of competition and make India a global R&D hub.
4. To identify the major thrust areas and to establish centres of excellence to generate IPR.
5. To suggest incentives for IPR creation in the country & suggest appropriate model for implementation of patenting/IPR.
6. To suggest mechanism of synergisation/cooperation amongst various supporting R&D in electronics to avoid duplication and creation of critical mass nationwide.
7. To suggest measures to raise R&D funds besides the Government support through R&D support and strengthening the mechanism for funding even private sector.
8. To suggest special incentives for innovative in-house R&D in public and private Sector.
9. Review the status of testing and calibration facilities available in the country and suggest additional facilities to be created / improvements to be made after taking into account current level of utilisation and to achieve national goals of Export of IT and electronic products in the light of changing global scenario in Europe and other developed nations.
10. Establish a state-of-the-art Info-Nano-Bio research institute for capacity building and to undertake R&D activities.
11. In the changed scenario of industrial/trade liberalization, to suggest an optimum strategy including organization structure of the Department of Information Technology, implementation methodology and monitoring mechanism to make it more relevant to the emerging needs.

Composition

- | | | |
|--|---|-----------------|
| 1. Shri Ashok Soota | - | Chairman |
| MindTree Consulting Pvt. Ltd., Bangalore | | |
| 2. Shri Rajender Kumar | | |
| President, MAIT | | |
| 3. Prof. S.Balakrishnan | | |
| Elect. Engg., IIT, Delhi | | |
| 4. Shri Mukul Sinha | | |
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| 6. Representative, DSIR | | |
| 7. Representative, ELCINA | | |
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| 9. Dr. Chandrashekhar | | |
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| 12. Shri Pradeep Kumar Gupta | | |
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| 13. Representative, BEL, Bangalore | | |
| 14. Shri S. Ramakrishnan | | |
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| 15. Dr. B.K. Gairola | | |
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| 16. Shri Sanjiv Kataria | | |
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| 17. Shri K.R. Kini, Director | | |
| SAMEER | | |
| 18. Dr. A.K. Chakravarti | | |
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| 20. Dr. R.C. Chopra | | |
| GC, DIT | | |
| 21. Dr. S.L. Sarnot | | |
| DG(STQC) | | |
| 22. Shri V.B. Taneja | | |
| Sr. Director, DIT | | |
| 23. Smt. Jatinder Khurana | - | Member-Convener |
| Director, DIT | | |