IT manpower
Challenge
and
Response

Interim Report of the Task Force on HRD in IT

Contents

I. Background

Constitution of Task Force

1.1 In pursuance to the announcement made by the Prime Minister of India in the First National Conference of IT Ministers on 15th July, 2000, a Task Force on Human Resource Development (HRD) in Information Technology (IT) was set up vide notification no.460/31/C/27/2000-E & SI dated 1.8.2000 *(Copy at Annexure I).* The Task Force comprises of the Minister for HRD as its Chairman and the Finance Minister, Minister of Information Technology, Chief Ministers of Andhra Pradesh, Madhya Pradesh, Karnataka and Uttar Pradesh, Director (IIT Delhi) as its members. The Task Force was serviced by the Department of Secondary & Higher Education with the Secretary of the Department as its Member-Secretary. Secretary, Department of Scientific and Industrial Research; Secretary, Ministry of Information Technology; Secretary, Department of Telecommunications and the Secretary, Department of Expenditure are Permanent Special Invitees. In view of the crucial role of the Planning Commission in HRD in IT, the Deputy Chairman and the Secretary of the Planning Commission were included in the Task Force as Member and Permanent Special Invitee respectively with the permission of the Chairman of the Task Force in terms of para 4 of the notification.

Terms of Reference (ToRs)

1.2 The Task Force had four specific Terms of Reference (ToR) as under:

(i) To draw up a plan to optimally use the existing infrastructure of the IITs, RECs, other engineering colleges and educational institutions to double their student intake in IT from the next academic year and triple it in the next two years.

(ii) 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.

(iii) To suggest measures necessary for enduring that good quality IT education does not remain a preserve of the rich and the English-education, and is also available to students from poor and rural families, especially those from the Scheduled Castes, Scheduled Tribes and OBCs.

(iv) To suggest measures necessary to improve teaching of non-IT subjects by using computers and the Internet for all students.

The Task Force could be assigned such other functions as may be found necessary from time to time. The Task Force was expected to submit its interim report on ToR (i) and then the final report on the remaining ToRs.

Discussions & Consultations

1.3 The Ministry of Human Resource Development constituted a '**Committee for IT Manpower (CIM)'** in the country. A copy of the order constituting the Committee on IT Manpower is given at *Annexure – II.* This inter-ministerial committee met on 26th July 2000 and again on 17th August 2000 to deliberate on the issue of long term planning for IT manpower in the country. Based on the views that emerged from these consultations, a '*Discussion Paper'* for the first meeting of the Task Force was prepared. The paper was based on the understanding of the Ministry of the issues relating to HRD in IT with particular reference to the specific ToRs of the

Task Force. Keeping in view the time schedule given to the Task Force, there was a detailed coverage of ToR (i) whereas for other ToRs, only issues were flagged for the time being with indicative course of action. The paper was discussed in details in the first meeting of the Task Force on 24th August 2000.

1.4 Inputs were received from the Ministry of Information Technology, Ministry of Communications, Department of Scientific & Industrial Research, Department of Elementary Education & Literacy, Directorate-General of Employment & Training, All India Council of Technical Education (AICTE), UGC, NAAC, IITs, particularly IIT (Delhi), IIITs and some of the RECs. Based on these inputs and also the suggestions received in the first meeting of the Task Force, a 'Draft Interim Report' was prepared and placed for consideration of the Task Force in the second meeting held on 16th September 2000. Based on the deliberation in the meeting, the 'Interim Report' was finalized in a meeting of officials of the concerned Ministries and Agencies on 19th September 2000. Consultations were then held with the Planning Commission and the Ministry of Finance on the financial implications of the report.

1.5 The Department has also started a consultation process for restructuring of the RECs to promote academic excellence. To promote PG education and research to meet acute shortage of faculty in engineering and technology and to provide competitive edge to Indian engineering and technology, the recommendations of the PG Review Committee have been accepted by the

Department in-principle. To facilitate non-governmental initiatives in higher science and technology education, provision in UGC and AICTE guidelines has been made for *de novo* institutions to be declared as 'Deemed to be Universities'. The recommendations of the Task Force therefore need to be viewed in the overall context of these initiatives to enable India to become a *'IT Super Power'*.
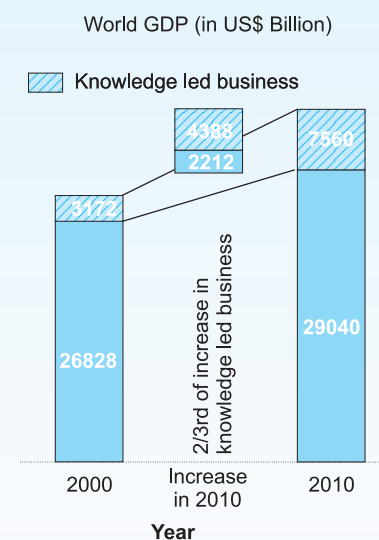
II. Introduction

Growth of Knowledge Led Business

2.1   Over the last few decades, technology has contributed very significantly in the rapid economic growth of many countries. Now the knowledge led businesses are set for rapid growth. It is estimated that the contribution of knowledge led business in global GDP will double in the next ten years and it will contribute to two thirds of growth in global GDP. India enjoys a comparative advantage in knowledge led businesses due to its very large pool of scientific and engineering manpower. Cost advantage due to low cost of our manpower complements the talent pool. The education and training infrastructure both in the formal and non-formal sector has been continuously feeding this pool. With these advantages, it is therefore not surprising that the country has witnessed rapid growth in IT software and services.

Indian software industries constitute a competitive challenge to the software industries in the developed world. There is however a concern that our competitive advantage may be lost unless our education and training system continues to supply IT manpower of requisite quality and ensures its periodic up- skilling – shelf life of IT skills and emerging technologies being very short.

Fig. 1: **Global Growth of Knowledge Led Business**

World GDP (in US$ Billion)

Knowledge led business

4388

2212

7560

3172

26828

2/3rd of increase in knowledge led business

29040

2000

Increase in 2010

2010

Year

Source: Reliance Research

Definition of IT

2.2 IT could simply be defined as '*the technology to exploit information the most efficient way*'. It encompasses computer science, telecommunications, electronics (including microelectronics) and computer applications. This could also include specialisations such as Artificial Intelligence, Computer Aided Manufacturing (Robotics, Flexible Manufacturing System, Numerically Controlled Machine Tools), Computer Integrated Manufacturing (CIM), Computer Aided Design etc.

Indian Software Industry

2.3 As per NASSCOM's HRD survey, there were 3,40,000 software professionals employed in the country as on 31st March 2000. A study of the Indian Software Industry by *Arora, Arunachalam & Others* reveals that 80% of the software professionals have engineering degrees and 12% have diplomas/certificates from private training institutions. Though the work in software industry is relatively non-technical and requires mostly logical and methodical work and a familiarity with software

development tools and languages, however the industry prefers engineering graduates because that instills in them a set of problem solving skills, method of thinking logically and learning tools. This trend is therefore likely to continue. However in the years to come, domain knowledge in addition to IT skills would become important. IT is making inroads in all fields of engineering education. Further the private training institutions are likely to increase their share. The study also reveals that Indian Software industry is characterised by low productivity and is still at the lower end of the value chain. Indian software exports consist largely of low level design, coding and maintenance services. Therefore the ***two challenges before us are to provide the required numbers and improve quality to raise productivity and moving up the value chain .***

Indian Hardware Industry

2.4 As per projections of the MIT, total equipment and components requirements in the hardware sector would be cumulative US $ 220 billion by year 2008. It shall generate direct employment of 16 lakh and indirect employment of 32 lakh. These requirements have been worked out on the basis of very ambitious growth targets in terms of telephone density (5 times the current level by 2008), PC penetration (10 times the current level by 2008), TV penetration (3 times the current level by 2008) and strategic and professional electronics (12 times the current production level by 2008). Not only this, 75 % of indigenisation in equipment
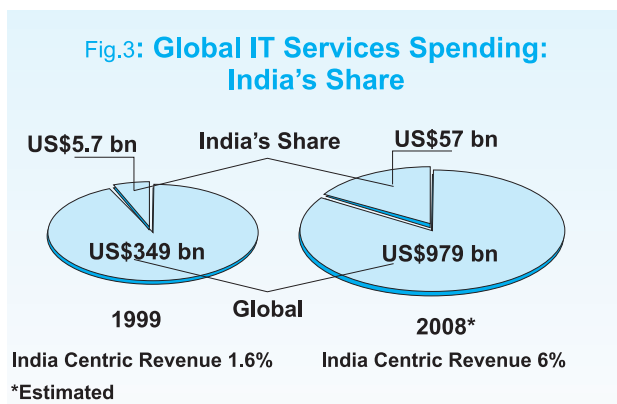
Fig. 2: **The Waterfall Model of Software Development**

Requirements Analysis

High Level Design

Low Level Design

Coding

Testing

Post Production Support
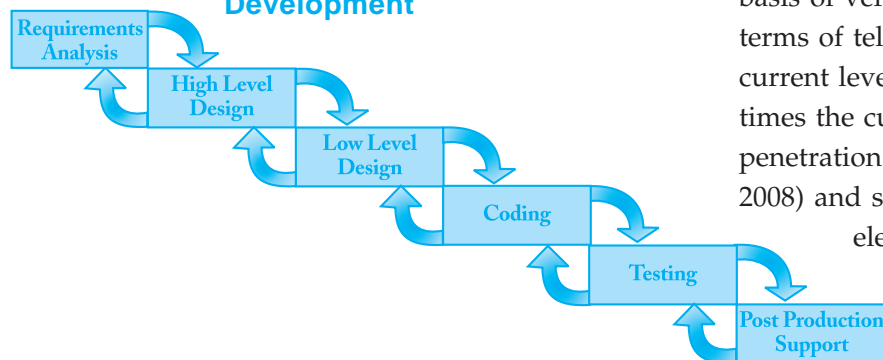
and 65 % in components has been assumed. Trends show steep shortfalls in these targets. Even if these targets are met, discussions with experts suggest that the requirement of formally trained manpower (university degree / diploma) would only be a small proportion of the manpower requirement projected. This would largely come from disciplines such as electronics, microelectronics, telecommunications and related engineering disciplines. The system broadly has the capacity to produce the numbers required. The issue of manpower requirement for the hardware sector would herewith require a more detailed study.

Manpower for IT Software & Services – National Demand

2.5 It is estimated that total size of IT industry in India will be over US $ 100 billion by 2008. A large part of it would be from the IT Services. By 2008, it is expected to become single largest contributor to the GDP of the country. One of the key issues in achieving and sustaining this level of growth will be the availability of high quality IT professionals in adequate numbers. As per

Fig.3: Global IT Services Spending: India's Share

US$5.7 bn   India's Share   US$57 bn

US$349 bn   US$979 bn

1999   Global   2008*

India Centric Revenue 1.6%   India Centric Revenue 6%
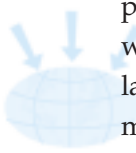*Estimated

Source: IDC, NASSCOM

NASSCOM study, this would require **22 lakh** IT professionals – 11 lakh in the **hard core IT sector** and another 11 lakh for the **IT enabled services**.

2.6 Ministry of Information Technology (MIT) has worked out a figure of **23.67 lakh** in three categories – 2 lakh IT professionals of 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 would mean 7.77 lakh professionals in the **hard core IT sector**, if we broadly fit in category A and Category B manpower here. This requirement is less than projected by NASSCOM largely due to assumptions of very ambitious growth in productivity.

2.7 Further, it is estimated that nearly 20,000 teachers in the formal tertiary education sector with PG or research qualifications would be required. Assuming a very realistic target of all secondary schools providing computer education by 2008, requirement of teachers for school sector would be in the range of 100,000. This would be largely fed by BCA and equivalent degree holders. It is expected that there will be significant use of computers and Internet even at the primary and pre-primary level by 2008. There would be additional teacher requirement for the purpose.

Manpower for IT Software & Services – International Demand

2.8 In addition to national demand, there would be international demand in view of intrinsic quality of Indian Software

Professionals and therefore premium attached to them. However, notionally, we could take it as 20% of the overall manpower requirements. The demand for IT professionals from USA under HIB Visa has been increased to around 2,00,000 from the present level of 1,14,000. Similarly Germany, UK, Ireland, Japan are likely to permit immigration at a level between 20,000 to 30,000 per annum for IT professionals. IT being English-Intensive, we presently enjoy an advantage due to our large English speaking population, but this may soon be lost in view of concerted efforts by other nations like China to catch on. Presently, many non-English speaking countries are forced to meet their requirements only from their local markets because of the language barrier. This offers immense opportunities in countries like – Japan, Germany, France and Korea, which could be exploited, if we are able to bridge the language and cultural gap. This could be done integrating training in language – cultural skills of potential countries in our regular engineering programmes in the 3rd and 4th year by tying up with the general university system and the foreign missions of those countries here in India.

Manpower for IT Enabled Services

2.9 Several Multinational Corporations, airlines, banks, hospitals etc., outsource a wide range of customer services to other parts of the world. This provides them with inexpensive skilled labour and quick response time in view of the difference in local times of these countries from that of India. Apart from the call centre and animation services, which account for 85% of the current global market, data search / integration services and remote education are gaining importance. India is making its mark in the IT enabled service area and is targeting services covering human resources, remote customer interaction and data management which are being increasingly outsourced by big companies in the US and Europe. According to a NASSCOM Report, India could earn up to $17 billion from IT enabled services over the next eight years, which would account for around 12% of the projected $142 billion global market. In view of our strong base of English speaking population and easy availability of professional skills, this target is not only achievable but we can expect to capture a much larger share of the global market. There is a great opportunity available for the country in e-services, where the human capital intensity is high and the service can be easily digitised. This could be in the area of product development and design, contract R & D, market data analysis, software modelling, *e-learning* and a wide range of customer services. For most of these services, a high level of IT literacy is not essential and short duration skill-based training is being provided by the '*IT Enabled Service Providers*' themselves. Therefore, it is realised that IT education in future would be more as an enabler having relevance in all fields of human activity. For this purpose, there is a need for broad-basing IT education and integrating it at all level in education.

Supply of IT Manpower

2.10 There are 1270 colleges (776 colleges awarding degrees in engineering and technology and 494 colleges awarding MCA as on 04.05.2000) in the country with a total

intake of 2,05,153(1999-2000). 1032 (81.25%) of them offer IT courses with an intake of 66,214 (32.17%). In addition, IITs, IIITs, IISc Bangalore have an intake of nearly 7,000 (1999-2000) – around 1200 of which is in IT courses. All these institutions also offer courses in electronics, microelectronics, and telecommunications. Whereas some of them go for hardware, it is estimated that a sizeable number of them today migrate to software services. Large numbers of graduates from other disciplines also migrate to IT. This is perhaps in response to significant new opportunities in these areas and also to the fact that the Software Industry is now looking for professionals with domain knowledge in other fields of engineering. *PG Review Committee* indicates that in case of IITs more than 90% of the non-IT graduates migrate to IT sector.

Projections for 2008

2.11 Based on current availability of intake capacity at various institutions and *projected additions to the system considering linear extrapolation,* it is estimated that 2.63 lakh postgraduates (including MCAs), 7.85 lakh graduates and 7.42 lakh diploma holders in IT and related areas would be added to the system by 2008. The projections are based on the assumption that 50% of the students from electronics and communications and 30% from other engineering disciplines would work in the IT software sector. This would mean that 10.48 lakh IT graduates (PG, MCA and UG) will be available for the *hard core IT sector* and 7.4 lakh for the *IT enabled services* from the AICTE recognized institutions. It is noted that as a result of the special drive during the current year for

increase in intake/new courses in IT, nearly 35,000 seats has been added during 2000-2001 itself, which is more than 50% increase compared to the normal 15%. This will add to the numbers. Further other institutions (IITs, IIITs and IISc Bangalore) would add nearly 12,000 graduates by 2008. Therefore, a total of around 10.60 lakh graduates will be added to the system by 2008. When viewed against an additional requirement of nearly 7.6 lakh manpower for hardcore IT sector as per NASSCOM estimates (or 4.37 lakh as per MIT estimates), this presents a satisfactory picture – providing an adequate cushion for faculty requirement of the formal tertiary sector, international migration and attrition.

2.12 For the IT enabled services, non-formal sector itself has a capacity of 5 lakh as per Ministry of Information Technology (MIT) estimates (growing at a rate of 20%). BCA,

Fig.4**: IT Manpower Requirement-Availability Projection: 2008 (IT Hard core sector)**

(Figure in Lakh)
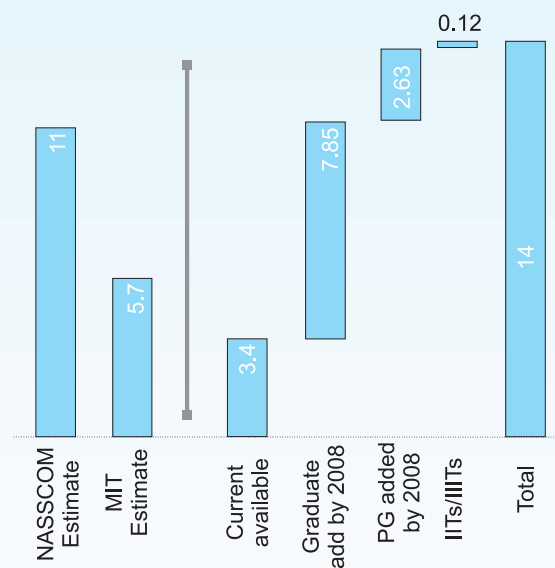
Source: AICTE, NASSCOM, MIT

BIT courses in recognised institutions, distance education programmes of open universities and correspondence course institutes add another 60,000 per annum (growing at 15%). All this together would add up to several times the actual manpower requirement projected for the IT enabled services including teacher requirement for the school sector.

Concerns

2.13 From the foregoing discussion, it is clear that there is no cause for panic as far as numbers are concerned, but there is no room for any complacency either. Though as per present demand projections the numbers appear to be adequate both for the hard core IT software sector and the IT enabled services, yet the rate of growth of IT sector worldwide cannot be predicted with absolute certainty. Also how much of our IT manpower would be attracted away by other countries is difficult to predict. Further there are serious concerns about the quality of IT manpower. At present only a fraction of the graduating students are acceptable to the industry. Low acceptance rate also results in underemployment and may have other serious repercussions.

2.14 Quality concerns emanate mainly from an acute shortage of quality faculty. Although, no detailed survey has been done, as per a sample survey for the AICTE approved institutions, teacher: student ratio varies from 1:39 to 1:52 (average being 1:45) for IT courses, against AICTE relaxed norms of 1:15. Almost all IT education institutions find it difficult to attract and retain good faculty. The available faculty are mainly graduates

Fig. 5: **IT Manpower Requirement for IT Enabled Services**
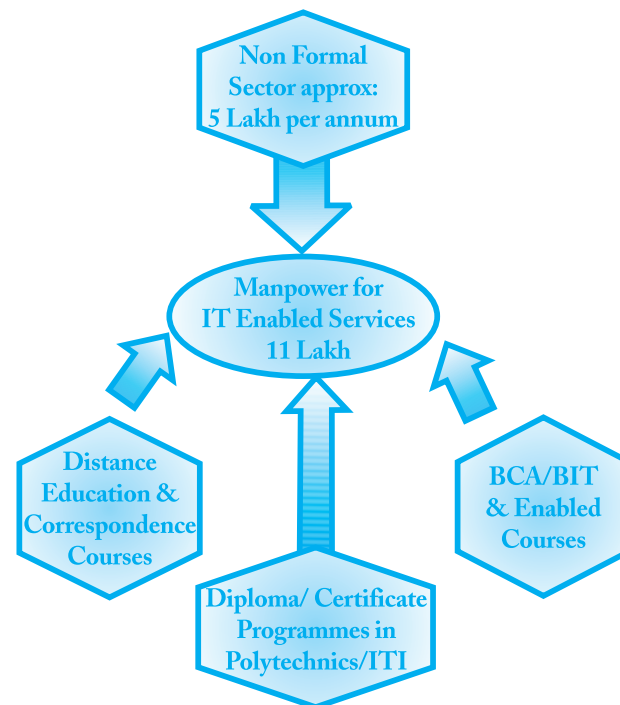
from the same institutions waiting for permanent employment. It is learnt that nearly one-fourth of the IT / Computer Science faculty positions even in the premier institutions are lying vacant. This is due to heavy demand from the industry and better salary and other perks offered by them. Faculty having PG or doctoral qualifications are difficult to find. Demand for PG and research programmes is also low and students do not normally opt for them because of better opportunities available elsewhere.

Need for Continuous Monitoring of IT Manpower

2.15 In high technology area susceptible to rapid change, the present may not be a true reflection of the future. Indian

software industry contributes only a tiny fraction of the around US $450 billion world software market presently. Targets set are not very ambitious. ***It is possible to record greater rates of growth, if we are able to move up the value chain by providing high skill manpower.*** Therefore there is a need for continuous monitoring of the job markets in IT and various alternative scenarios need to be developed. There is a need to undertake coordinated research and studies in IT manpower area and create public information. These studies could be conducted by existing education and research institutions with one of them responsible for overall coordination. There could be a '*Joint Forum of Education and Training Providers and the IT Industry*'. Apart from periodic interaction, there could be an annual meet, where Education providers and IT industry could meet to disseminate findings of research and studies and exchange notes on trends. This mechanism will help in matching of IT manpower needs of the industry on a continual basis and assess availability and absorption of IT manpower. The strategy shall be to make available larger number of better-qualified quality IT professionals for capturing larger share of global software and services market. This will also enable corrective action to be taken by all stakeholders periodically. This arrangement could ultimately form a part of the expanded '*National Technical Manpower Information System (NTMIS)*'.

2.16 Among other strategies, we could develop a ***IT Manpower Database*** at the National

level through e-identity for IT professionals. '*Self-Declaration*', '*Authentication*' and '*Validation*' through a competency test may be three sequential steps for entry to this database. This could be continuously updated and the colleges/institutions and the alumni associations could be associated with this exercise. Having some mechanism at the time of exit from /re-entry into the country at the International ports could monitor international migration of IT professionals.

Different Initiatives

2.17 Different State Governments have also taken a variety of initiatives to promote IT education and address related issues including those covered under the ToR of this Task Force. Some of these initiatives have been very successful. Task Force, therefore, recommends that successful initiatives be endorsed for their replication at the All India Level. In addition, several innovations are taking place outside the Government system. In most cases, replication of such innovations is neither time consuming nor expensive. It would, therefore, be desirable that such innovative use of IT tools and Internet could be popularised by the Government for the entire system to emulate through a system of awards and rewards.

2.18 It is proposed that an exhaustive list of all such initiatives is compiled and put up on the Web for replication by other states. Central Government could pick up a few of these initiatives for replication at an 'All India Level'.

III. Capacity Enhancement of Institutions

Term of Reference (i)

To draw up a plan to optimally use the existing infrastructure of the IITs, RECs, other engineering colleges and educational institutions to double their students intake in IT from next academic year and triple it in the next two years.

Background

3.1　The Task Force decided that 1999-2000 be treated as the base year and doubling could be achieved by the next academic year i.e. 2001-2002 and trebling by another two years after that i.e. 2003-2004. In case, some of the institutions had taken major initiatives in starting IT programmes or increasing intake in IT programmes even prior to 1999-2000, the same could be taken into consideration while planning for future expansion in these institutions. There has already been an increase of 50 % seats in IT programmes this year. In addition the IITs and RECs have made special efforts to increase seats in IT programmes. All these efforts are to be harmonised and further accelerated to achieve the mandate provided under ToR (i). ***There is need to give special focus on increase in intake in 'Quality' Institutions and efforts to improve quality in others.***

Government Initiatives

3.2 Government has taken a number of initiatives in the last few years both to increase intake in IT programmes and start new IT programmes in Government and Government aided institutions and self-financing institutions. Whereas, self-financing institutions have been very eager to expand capacities in IT programmes and often at the cost of quality, most Government institutions have been more prudent. In spite of this, many IT / IT related programmes have been introduced in the Government institutions and many others are proposed to be introduced in the coming years. Such increase in capacity in IT / IT related courses in these institutions has been done by not only optimally using the resources, but also stretching them to a limit. Also the Government funded institutions have to be 'Role Models' in the technical education system. *Any further expansion would require additional resources with associated costs. For this, additional investment over and above the existing plan outlays would be required.*

Self-Financing Institutions

3.3 There is need for a more cautious approach in case of self-financing institutions, since expansion of intake in these institutions is not necessarily accompanied by improved facilities and increased availability of quality faculty. Inspection driven approach for ensuring quality in these institutions has also not helped, because of lack of commitment for quality amongst some promoters of such colleges. Overall capacities being still low compared to the

Fig. 6: **Growth of Technical Institutions**

Self financing institutions
Govt./Govt. Aided institutions

172

165

853

223

1990   2000*
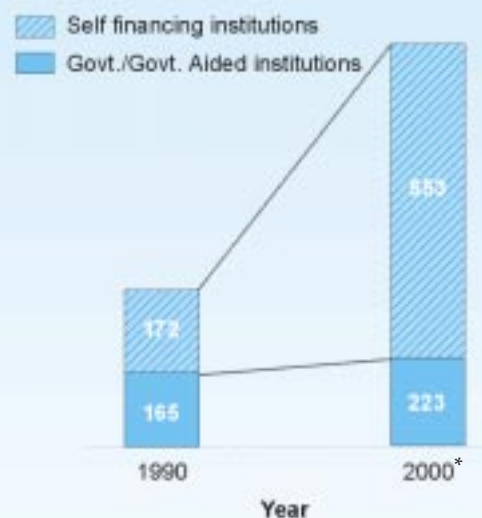
Year

Source: AICTE (*As on 4.5.2000. Total number on 30.11.2000 is 836)

demand and due to lack of public information, even substandard institutions have been flourishing. In the years to come this high cost, low quality education from many of the self-financing institutions is likely to create social problems.

3.4 Notwithstanding the apprehensions, it must be realised that major expansion in the technical education system in the last two decades has taken place through self-financing institutions. Many of these institutions have come up in recent years and would take some time to mature and develop. It would, therefore, be imperative to nurture them in the initial years of their existence. After giving adequate time and opportunity to them, AICTE need not hesitate to withdraw approvals in case of proven wilful default in meeting the facilities and faculty requirements and commercial considerations outweighing the
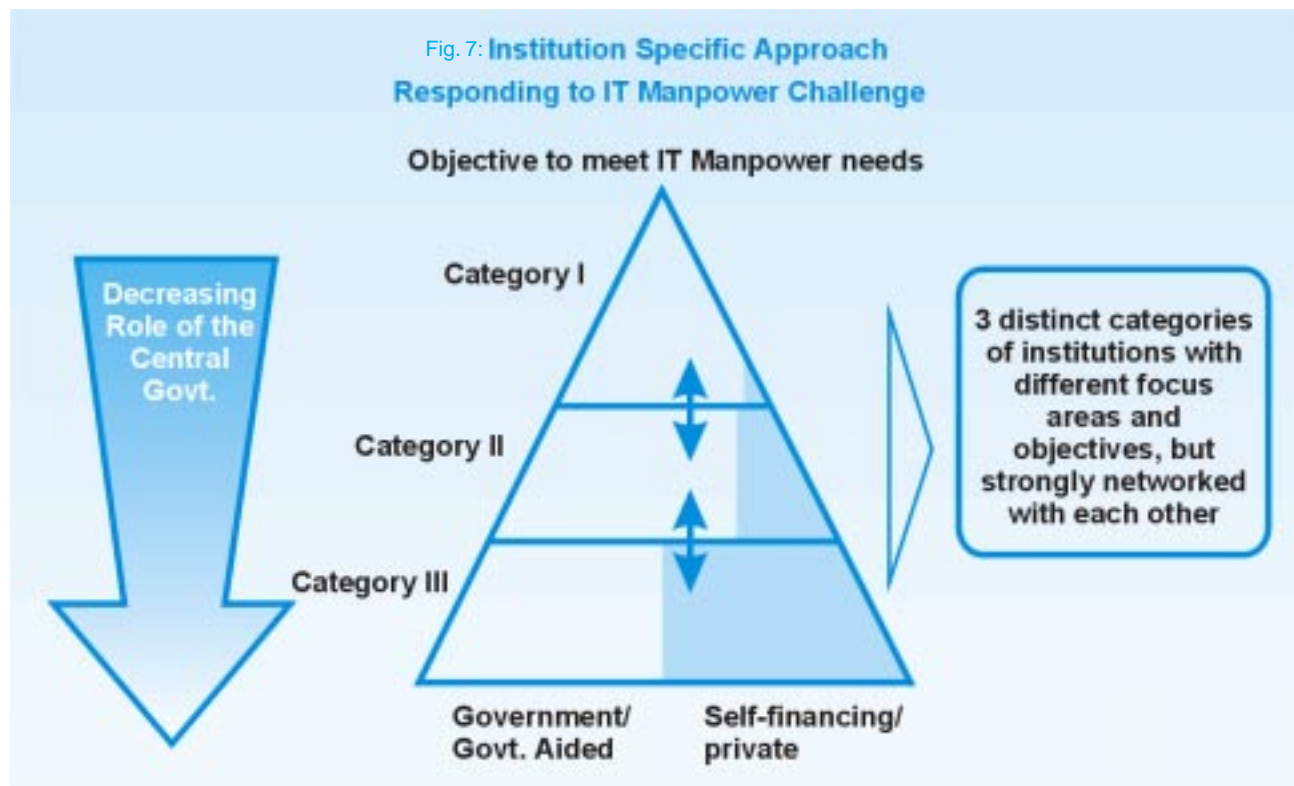
academic considerations in their operations. There is also a need for creating public information for ensuring better-informed choices by the students and parents about the programmes and institutions. For this purpose, facilities and faculty status should be made available by the AICTE on the Internet along with date of review/inspection and the names of the members of the review team.

Institution Specific Approach

3.5 A uniform approach for enhancing capacities is neither feasible nor desirable. Interventions required therefore would be contingent upon the situational parameters. Different initiatives would be required for different categories of institutions to strategically address the issue of quality IT

manpower in the country. Institutions could broadly be categorised as under:

- **Category-I Institutions:** 6 IITs, IISc (Bangalore), 2 IIITs and 6 IIMs (with focus on management of IT) could broadly fall in this category. In these 15 Institutions, there could be a greater focus on PG / Research programmes for moving up the value chain for increased productivity, dual mode programmes *[Refer to para 3.17]* to cater to large numbers and providing quality faculty for *'Category-II Institutions'* for multiplier effect. Thrust will be on sustaining and enhancing quality levels in these institutions to enable them to become *'Role Models'* for other institutions.

- **Category-II Institutions:** 17 RECs and 33 other university level / established technical

Fig. 7: **Institution Specific Approach**
Responding to IT Manpower Challenge

Objective to meet IT Manpower needs

Category I

Category II

Category III

Decreasing Role of the Central Govt.

3 distinct categories of institutions with different focus areas and objectives, but strongly networked with each other

Government/ Govt. Aided

Self-financing/ private

institutions could fall in this category. Some of the established non-governmental institutions could also be included in this category. In these 50 institutions, there could be focus on quality undergraduate programmes adding to direct IT manpower supply and on PG programmes for providing faculty to Category - III institutions. A suggestive list of 50 institutions is given in *Annexure III*. The list could be finalised after taking various factors into consideration, such as - special thrust to IT educationally backward states, responsiveness and readiness of an Institution to accept greater role for itself etc. A package of measures may be taken in all these institutions for their upgradation to Category – I level. Such upgradation will cost only a fraction of what a new IIT would cost.

- **Category-III(G) Institutions:** Balance 200 or so Government and Government Aided institutions (largely State Govt. institutions) could fall in this category. Here the focus shall be mainly to improve quality of engineering education in general and IT education in particular and enhance employability of the graduates from these institutions mainly at the higher end of the value chain. State Governments are expected to support these institutions. Part of the funding could however come from the Central Government.

- **Category-III(S) Institutions:** Remaining around 550 self-financing institutions could fall in this category. Bulk of the financial requirements in these institutions would have to be provided by the promoters. Government could however step in for

providing support for improving networking to enable them to benefit from the academic resources of the institutions in the system. Assistance provided to these institutions under various schemes of the AICTE could be enhanced and better targeted.

3.6 These are broad categories to define the kind of interventions that would be required. These do not necessarily grade the quality of the programmes offered by them. Some of the self-financing institutions could be better than many of the Government institutions. These are by no means water - tight compartments. Different category of institutions could strategically be used for different purposes to reach the overall goal of meeting quality manpower requirement of the country. A *'Technical Group'* could be constituted for categorisation of the Institutes. There is a need to evolve a hierarchical structure in terms of the networking between Category I, II and III institutions. Category I institutions could act as Resource Centres for the Category II institutions and therefore, represent the first tier of the hierarchy. Similarly Category II institutions could act as Resource Centres for the Category III.

New Institutions

3.7 Many States have come up with exclusive '*Institutes of Information Technology'*. These institutions can function as resource institutions at the regional / state level. Depending on the level of their development, the institution could fit in either Category-I or Category – II. These Institutions could also offer the opportunities for training in cutting edge technologies in

addition to offering bridge courses for the products of the Category – III institutions. All major states could be facilitated to promote an exclusive institute for IT with state / central funding (and possibly external funding) and industry collaboration. Possibility of setting up new institutions of category – I in the country could also be explored. There is a need for ensuring cost-effectiveness in planning new institutions. A *'Technical Group'* may be constituted to work on space norms for institutional buildings for educational purposes.

3.8 There is increasing demand of IT professionals having a proper mix of subject specific and IT knowledge. In this context, the efforts are being made by different academic institutions in re-orienting many of the traditional disciplines to offer IT related courses. It was noted that many institutions have taken up specialisation courses in IT/IT related areas in normal programmes facilitating students' easy migration to IT. Further, bridge courses could be specially designed for easy migration from other disciplines to IT. However, this will have to be done without compromising on the demand for graduates of those disciplines. Therefore, the focus may not be restricted only to increase in intake in IT courses, but there is need for special thrust on increasing bridge courses and encourage minor area programmes.

A System-Wide Approach

3.9 A practical and feasible strategy for enhancing capacity of our system would be an ***accelerated increase in intake and introduction of new IT courses in***

programmes and areas having multiplier effect in 'Select' Institutions (including IITs / RECs) without diluting the quality of the programmes and overall quality improvement for other institutes with normal increase in intake.

A system-wide approach would involve looking at the IT Education & Training System (IETS) from an overall perspective. Typical inputs for quality programmes in IT would be:

a. Quality Institutional Setting

b. State of the art computing and networking facilities.

c. Quality faculty.

d. Relevant and up-to-date curriculum with supporting courseware

e. Effective and efficient delivery.

Interventions required would therefore attempt to address these issues.

Institutional Setting

3.10 A quality engineer or IT professional can only come out of a quality institution. Quality of an institution is determined by a combination of factors. Whereas adequacy of infrastructure and financial support are essential, infrastructure and funds alone are not sufficient. More critical are academic autonomy with internal accountability, leadership, governance structure, quality of faculty (and also non-faculty support), quality of students, processes of teaching and learning and finally the level of

Quality IT Programme

(figure: building diagram with pillars and base)
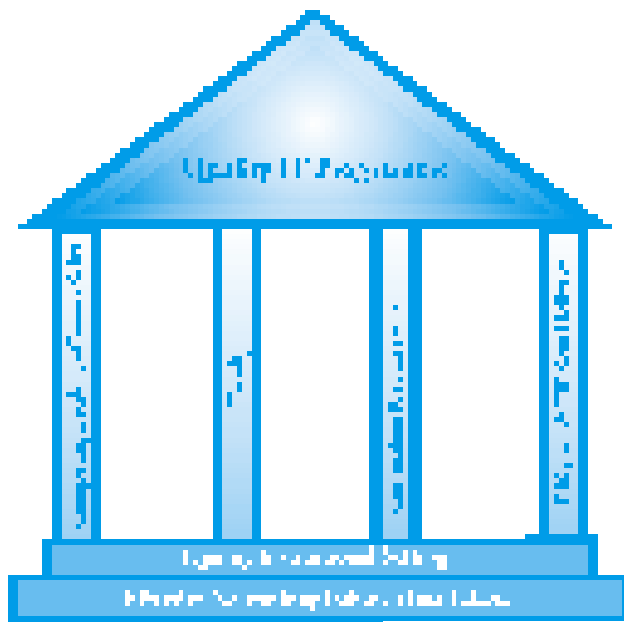
motivation and commitment of the stakeholders. A comprehensive restructuring exercise has therefore been taken up for the RECs based on the recommendations of a High Powered Review Committee. This includes change in governance pattern, providing academic autonomy, change in funding pattern (by bringing them under the block grant scheme) etc. Other institutions, particularly in Category-II would have to take up a similar exercise to become quality institutions. To maintain standards and prevent trauma and harassment of students and parents, all category I and II institutions could be brought under the purview of a single admission test conducted on an '*All India*' basis from the year 2002 onwards without, however, disturbing the existing reservation system / domicile requirements. This could be a pre-condition to providing them support under these initiatives.

3.11 There is great potential for improving institutional performance particularly in the tertiary sector beyond teaching and learning. IT can effectively be leveraged for enhancing administrative efficiency, increasing transparency, promoting cost effectiveness by cost reduction of labour - intensive and routine operations in support services. Unfortunately, this aspect has not been given enough thought in our educational institutions even those having adequate IT infrastructure. A thrust is therefore, required to be taken to develop custom applications for routine type of institutional management functions like admission, fee collection, budgeting, inventory management, space management, maintenance of campus and essential services, students placement services, alumni associations, hostels management, use of laboratories and sharing of inter-university resources etc.

Infrastructure Support – Computing and Networking Facilities

3.12 It is proposed to take up all category I, II & III (Govt. funded) institutions (nearly 250) for upgradation in a phased manner over the next seven years (Till the end of the tenth five-year Plan). Focus shall be on upgrading computing and networking facilities. These Institutions shall include all 205 Government / Government aided institutions and selected self-financing / Private institutions, which have demonstrated excellence over the years

in the area of technical and engineering education. An amount of Rs.8 to Rs.10 crore per institution would be required for upgrading computing / networking facilities for Category-II institutions (nearly 50). A brief outline of the proposal for strengthening IT infrastructure in these institutions is given in *Annexure III*. All category-I institutions either have or are going to have state of the art computing facilities. An amount of Rs.90 crore has been sanctioned for the IITs for the purpose. IIITs and IIT (Guwahati) are still in project mode and requisite computing facilities are being created. Category-I & II institutions for enhanced intake may require additional hostel and classroom facilities. Since such requirements may vary from institution to institution, a lump sum amount of Rs. 200 crore is proposed for the purpose. Investment required for upgrading the computing and networking facilities in category-III institutions (nearly 200) would be in the range of Rs. 6 to Rs. 8 crore. This could be shared between the Central Government and the State Governments in the ratio of 50:50. It is expected that the recurring expenditure for the purpose will either be internally generated or met by the main funding agency of the institution. ***It is proposed that scheme for Upgradation of computing and networking facilities in Category - II institutions and for strengthening of other physical infrastructure in Category I & II institutions be immediately taken up on priority basis.***

3.13 Each institution should apportion at least 20 % of its fee revenue for replacement and upgradation of its IT infrastructure, so that

it does not become obsolete. There could be a *'Procurement Policy'* for procurement of the IT resources and specification benchmarks established at the State level or by the funding agency, so that precious time is not lost in long drawn tender proceedings and the institutions are not burdened with dated equipment. Instead of direct procurement, possibility of leasing equipment with provision for periodic upgradation and evolving a system of software consortium could be explored. There is also a need to encourage institutions to assemble equipment for education and training purposes in-house (wherever possible) to provide hands on training and impart practical skills rarely found in our qualified manpower.

Networking of Institutions to Synergise Strengths

3.14 Networking of the institutions is envisaged to synergise the strengths of the participating Institutions. There could be sharing of faculty, courseware, good instructional resources, and information resources. National Network could comprise of around 65 institutions in category I & II. Apart from knowledge networking for quality improvement, there should be focus for increase in intake and introduction of new IT/IT related programme in these institutions. Attempts need to be made for using the physical infrastructure optimally through extended and flexible working hours and staggered schedules. Similarly states can also identify other state / self-financing institutions for similar networking. Even Category - III (Self-financing) Institutions could be
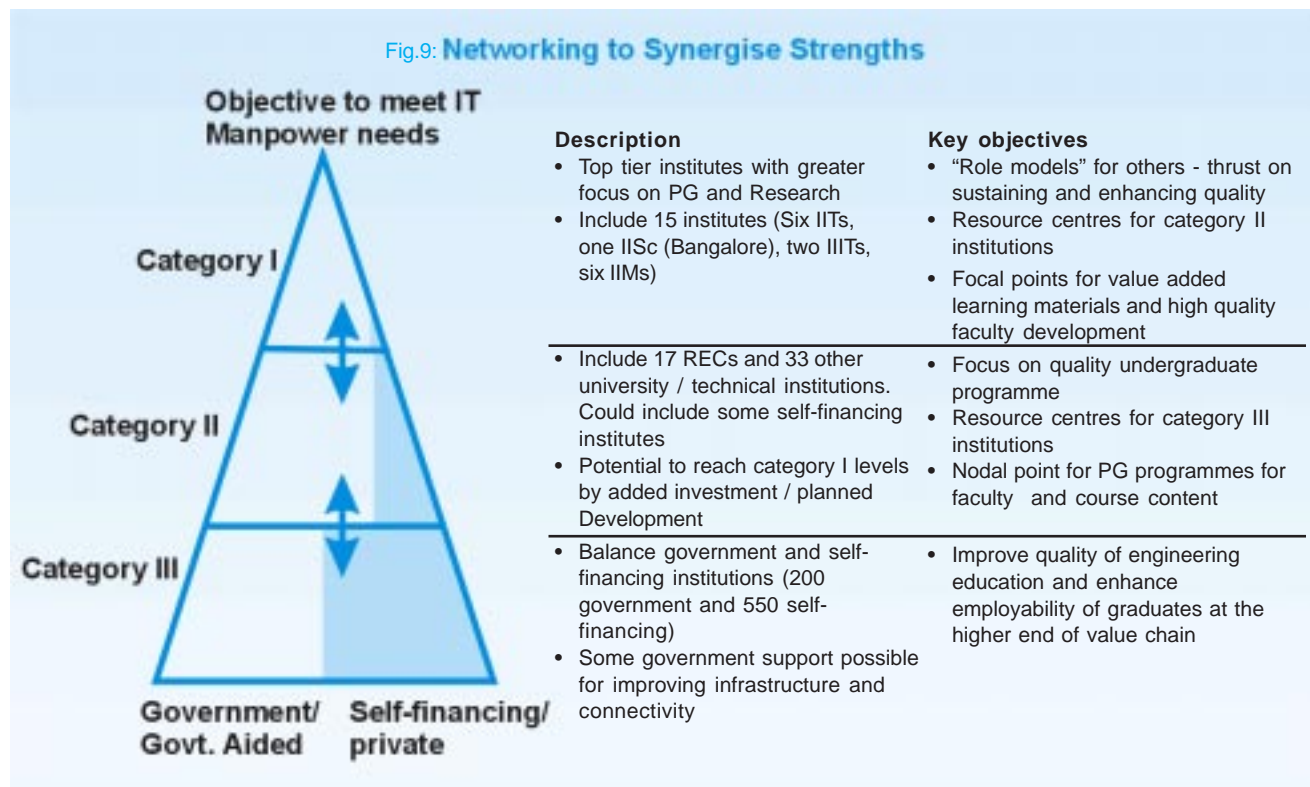
provided support for networking infrastructure. Linkages of the state level networks with the national network could be facilitated. A better synergy could come about if additionally regional networks could be set up. This approach will bring a synergy between these Institutes and the major and minor Engineering Colleges in their respective regions through exchange programmes, joint R&D, etc.

3.15 Further the libraries in at least Category I and II institutions should be digitised providing not only bibliographic record of documents but also its full text electronic version digitised images and graphic digital audio and video component. Fragile and deteriorating old volumes and journals could be scanned. An education based information and storage and retrieval data

based system be developed for a better organisation and structured guide to electronic resources available in these institutions. An initiative of this kind would have a per institutional average cost of Rs.15 lakh.

Faculty

3.16 The most important parameter, which is going to affect the quality of education is through faculty. Unless measures are taken to recruit good qualified faculty it is not going to improve the situation. A major weakness in IT education that will be further aggravated on account of expansion of capacity is the non-availability of quality faculty. All IT education institutions are finding it difficult to attract and retain good faculty. This is due to heavy demand and

Fig.9: **Networking to Synergise Strengths**

Objective to meet IT Manpower needs

	Description	**Key objectives**
Category I	• Top tier institutes with greater focus on PG and Research • Include 15 institutes (Six IITs, one IISc (Bangalore), two IIITs, six IIMs)	• "Role models" for others - thrust on sustaining and enhancing quality • Resource centres for category II institutions • Focal points for value added learning materials and high quality faculty development
Category II	• Include 17 RECs and 33 other university / technical institutions. Could include some self-financing institutes • Potential to reach category I levels by added investment / planned Development	• Focus on quality undergraduate programme • Resource centres for category III institutions • Nodal point for PG programmes for faculty and course content
Category III	• Balance government and self-financing institutions (200 government and 550 self-financing) • Some government support possible for improving infrastructure and connectivity	• Improve quality of engineering education and enhance employability of graduates at the higher end of value chain

Government/ Govt. Aided   Self-financing/ private

better salary and other perks offered by the industry. This position is not likely to change unless specific interventions are made. In many institutions there are large numbers of vacancies, which are not filled due to non-availability of proper qualified faculty.

3.17 Meeting faculty shortages, improving their quality and retaining quality faculty are critical to improving the standards of IT education in the country. Therefore, the Task Force has identified this as a thrust area and recommends a package of measures that should be taken for increasing availability, improving quality and retaining quality faculty in IT. **An *'IT Faculty Development Initiative'*** is to be launched on a crash basis to address this problem. This initiative would include:

- Providing a *'Major Thrust to Post-Graduate and Research Programmes'.* This will have a multiplier effect in providing IT faculty to other institutions. Greater focus on PG and Research programmes will attract good quality faculty to teaching and also facilitate increased intake at UG level as many PG students can act as Teaching Assistants (TAs) in labs, and undertake tutorials, and preparation of pedagogical material. Even bright final year students in B.Tech could also be used as TAs.

- Scaling up of *'Early Faculty Induction Programme (EFIP)'* by increasing the number of host institutions (from present 5 to 50), quota for IT Programmes (from 40 to 1000 for only IT) both at the PG and the Doctoral level. Procedure needs to be streamlined involving host institutions.

Total annual financial outlay required would be of the order of Rs.0.50 crore during the year 2000-2001 increasing gradually to Rs.13.6 crore by 2006-2007.

- Scaling up of *'Quality Improvement Programme (QIP)'* by increasing the number of host institutions, quota for IT Programmes both for M. Tech. and Ph.D. programmes. To encourage institutions to sponsor faculty for QIP, the Institutions may be allowed to fill up the posts temporarily so that the academic schedules are not disrupted. Younger persons need to be given opportunity. There should be an obligation to serve the sponsoring institute. Annual financial outlay required would reach up to Rs.15 crore in 2006-2007.

- Introduction of *'Sequential PG Programme in IT'* for working faculty with core course work completed in vacation breaks over three years and project work done in their own institutions. Individuals to be encouraged by reimbursement of fees and host institutions to be encouraged through a one time library / equipment grant.

- Starting *'PG programmes in IT in 'Dual Mode'* (i.e. a proper mix of web-based and multimedia tools with adequate provision for periodic contacts). In the dual mode, while we are able to reach out to larger student numbers, problems faced in pure web-based education - absence of verbal interaction, evaluation problems are also addressed. This is expected to be a low cost option and would be self-sustaining. 15 Resource institutions and 50 participating institutions could be identified.

Fig. 10: **IT Faculty Development Initiative**
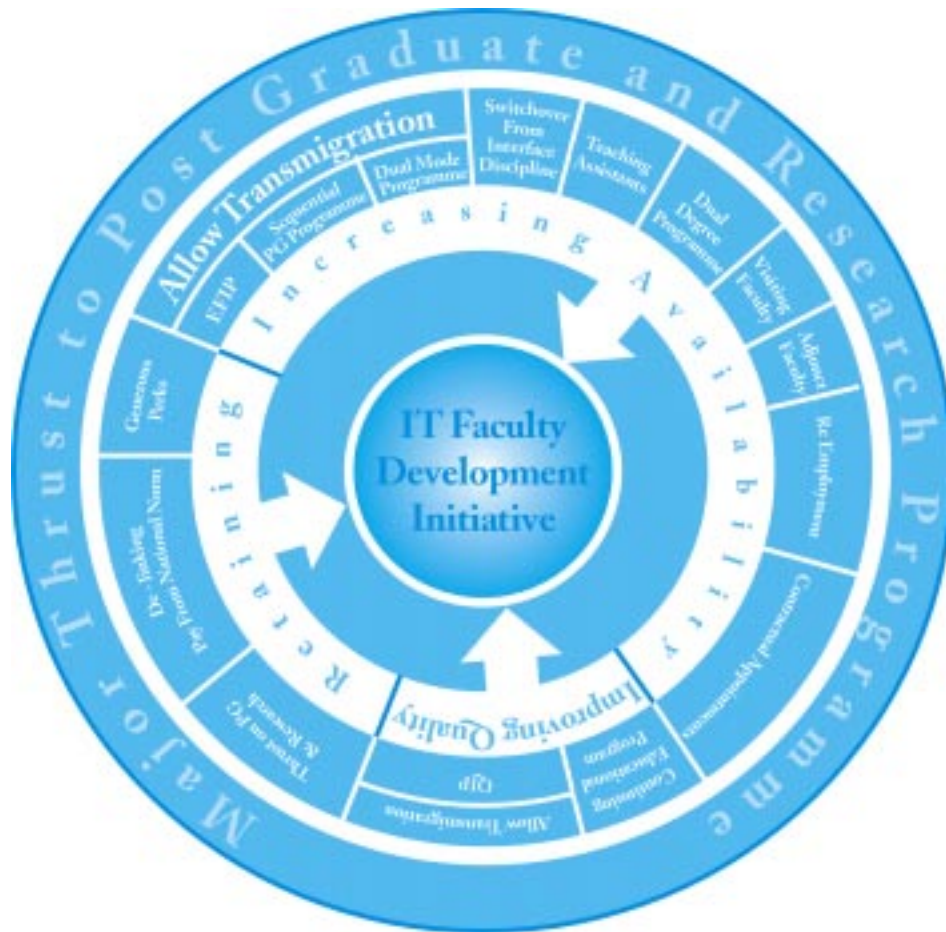
Supplementary funding for improving their Education Technology (ET) infrastructure is to be provided. With a class size of 40, it should be possible to create 2000 positions at PG level in IT targeted at faculty development.

- Faculty of premier institutions could teach other institutions to supplement efforts of local faculty for **improving teaching learning in other disciplines**. Video and CDs and development of learning resource material on web would enhance the reach

of the premier institutes to a greater number of institutions.

- **Allowing transmigration** in all postgraduate and research programs for faculty development (including EFIP, QIP, Dual Mode) from interfacing disciplines like - physics, mathematics etc. Graduates of other engineering disciplines could also be offered direct entry into Ph.D. (in IT or computer science). The entry norms into such programme can be relaxed while keeping the same exit norms.

- *Allowing switchover of faculty from interfacing disciplines* like - physics, mathematics etc. through short-term training and skill-upgradation programmes by making provision for joint appointments. There has been a problem in this cross-migration scheme. Faculty from other disciplines trained in IT, when they return to their parent institution continue in their own discipline defeating the very purpose of cross-migration. Remedial steps for this would be essential.

- *Encouraging concept of Teaching Assistants (TAs)* in all institutions. Top 5% of a graduating batch could be offered teaching assistants' position directly to attract them to teaching career and help obtain higher qualification with a view to offering them regular faculty position eventually. All institutes should leverage TAs for using senior faculty time more productively by using them for tutorials and grading assignments.

- *Encouraging Dual Degree Programmes with PG in IT related fields though minor area programmes* could be very effective to develop experts in niche areas and persons with domain expertise. Such faculty would provide a multi-disciplinary focus to teaching of IT and would be useful for training in industry specific needs.

- *Visiting faculty* from industry, C-DOT, C-DAC, reputed institutions from India and abroad for a semester or two or part thereof could be invited. Procedures can be simplified and such offers made more attractive. In case of Persons of Indian Origin, possibility of waiving requirement

for Government clearance could be explored in consultation with the MHA & MEA. For all of these categories the process of government clearances need to be streamlined.

- Persons from industry with M.Tech /Ph.D. qualifications or B.Tech with relevant experience be given *'Adjunct Faculty'* status in engineering colleges and attractive compensation package / honorarium be offered per lecture in specialist's categories with flexibility in scheduling of classes to suit them. Better incentives, openness and cooperation among selected institutes and IITs may be fostered by inviting faculty on weekends, vacations, sabbaticals etc. on special topics of mutual interest and those relevant for competency building in IT courses. Institutions need to develop enabling environment for implementation of this scheme.

- To attract quality faculty, there could **be generous perks** such as – greater flexibility in secondment to industry during vacation and opportunity for undertaking consultancy (without however compromising on teaching), liberalised leave rules for sabbatical and attending conferences. A professional development fund could be considered. Efforts should be made to provide excellent work environment, ambience and housing. This is particularly important, as industry has started offering packages, which can be too tempting even for a very devoted faculty to consider moving to industry. There could be fiscal incentives for work beyond normal teaching loads.

- **Re-employment** of IT faculty beyond age of superannuation as a temporary measure can also be allowed till the shortages continue.

- **Contractual appointments** could also be made by the Institutions to attract faculty from the industry for short periods of 2-3 years.

- For select premier institutions, possibilities of **de-linking salary structure from the national norms** to attract quality faculty could be explored.

- There should be greater focus on **continuing education programmes for skill upgradation** of the faculty in IT departments. Fast obsolescence of existing courses and emergence of newer areas are the order of the day. Such skill upgradation need to be done in a collaborative mode with IT Industry and IT Industry Associations. Training could take place flexibly through existing framework of academic staff colleges in universities or QIP programmes in engineering colleges etc., summer training camps for IT teachers through ISTE and other Agencies. Many private institutes are effectively providing quality education in IT, particularly in use of IT tools. Tie-up with these institutes may be helpful. Faculty of the engineering institutes may be provided some support to attend a course at these private institutes for skill upgradation. It has been observed that due to lack of properly skilled faculty at local engineering institutes, many students are attending classes at private IT-institutes for acquiring practical skills. Training the faculty in the first place and providing them incentives for supporting the students can reverse the trend. This could be supplemented by contribution from the parent institution. Institutions could be encouraged to apportion a part of their fee income (say 10%) for faculty skill upgradation.

For operationalisation of these initiatives, a **Faculty Development Fund** is proposed to be created.

Curriculum

3.18 Regular updating of curriculum would also be critical. It is seen that in most institutions, the process of curriculum revision is very inflexible and time consuming. This bottleneck is caused particularly by the affiliating system. Therefore, wherever possible these institutions are being declared deemed to be universities. Whereas, All India Board of IT Education could coordinate and monitor curriculum issues, there could be a network of institutions, which may take up the job of working closely and continuously to evolve IT curriculum, pedagogy and effective delivery methods. These Institutions (may include private education and training providers) may evolve a curriculum framework in IT embracing all levels right from certificate to postgraduate level. There is need for in-built mechanism for revision at least every three years. The curriculum framework need not be too rigid and should provide adequate scope for innovation and initiatives by individual institutes. Possibility of working out a mechanism to ensure that both the public and private sector units adhere to this

frame of reference could be explored. Such curriculum framework should be circulated throughout the system, particularly to Category-III institutions for adoption.

Qualifications Framework

3.19 If the entire curriculum is prepared on a modular and credit form, the flexibility of student mobility and transfer of credits between these two categories of institutions can be further facilitated, though mutual recognition (including awards from the private education and training providers). There is a need for a 'National Qualifications Framework' for IT education embracing all levels.

Courseware
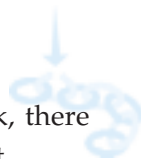
3.20 Based on the curriculum framework, there could be 'Courseware Development Initiative' including web-based courseware. Particular emphasis need to be given to laboratory textbooks – identified as a weak area. This could be a shared activity. There could be a web-based forum for facilitating curriculum and courseware development efforts for widest possible consultation. Financial support would be required for this initiative. This would include documentation and publication of courseware.

Promoting Technology Enhanced IT Education

3.21 Number of resource persons and centres of excellence is limited. To enable these limited resources to reach out to the large number it would be essential to use the latest

technology for delivery depending upon the requirements. The delivery network could be one way or interactive. An optimal mix of these technologies would be required to meet the needs of faculty development and resource sharing. The Internet itself could be an important delivery mechanism. A number of institutions are already offering courses on the net. This would meet only part of the needs. Conferencing networks could be established amongst institutions, and existing networks could be utilised. The Training and Development Communication Channel (TDCC) could be utilised for providing one way video and two way audio teleconferencing with minimum investments. Data broadcasting networks using multimedia dissemination systems could be effectively utilised for distribution of learning materials to classrooms with provisions for live explanation and conduct of lectures. Such a network would use little bandwidth and could provide an effective networking between the resource centres and the classrooms. A mix and match of these technologies would be needed to provide the best solution in a given situation. The top institutions could use the Internet with TDCC for classroom delivery. The second tier institutions could use TDCC and or DSDB with digital talkback. The lower may have to start with DSDB and talkback only due to bandwidth constraint. Content creation would require major efforts and have to be tailored to each system so as to best utilise the features of each system. Interaction will have to be partly online and largely offline with generous use of Frequently Asked Questions (FAQs).

3.22 Institutions of excellence could be encouraged to video record courses running on the campus, digitise and provide them through the servers, where high bandwidth is available and wherever this is not possible, the same can be sent on DVDs or CDROMs. Educational institutions should be facilitated by providing them concessional tariff for connectivity. This methodology could be used for faculty development as well as other programmes.

3.23 Fifteen (15) 'Resource Institutions' could be identified. This could include the seven institutions (including 5 IITs) already covered under the '*Nationally Coordinated Programme on Use of Education Technology*'. In addition existing facilities in the 4 TTTIs could be utilized. Fifty (50) Participating Institutions (PIs) could be identified as the receiving institutions. Most of these institutions are expected to have the requisite facilities. Upgradation of facilities could also be covered under the scheme of strengthening computing and networking infrastructure. However, some supplementary funding to upgrade the Education Technology (ET) infrastructure would be required. This is expected to be a low cost option and self-sustaining. Management of IT and software and services is becoming equally important. Therefore, at least two of the Resource Institutions could be from amongst the Management Institutions and 8 of the 50 PIs could offer special programmes on subject areas related to management of IT. This would enable the finest faculty from the premier institutions to teach and reach out to a much larger number of students. This could also evolve into joint degree programmes offered by multiple institutions that share their academic and faculty resources and content and allow larger class sizes by effective use of multimedia and tutorials without loss of effect.

3.24 As distance learning is becoming popular and gaining acceptance, it has raised other issues like adding interactivity to boost student's attention level and interest. This is being done by adopting different technologies such as satellite broadcasting, computer based and web base methods, pre-recorded tapes and video-conferencing, etc. Indira Gandhi National Open University (IGNOU) has taken lead in this direction by launching the '**Virtual Campus Initiative**'. Two IITs at Kharagpur and Mumbai have also initiated IT programmes in the Distance Mode. Using Interactive Technologies through a combination of VSATs and Leased/ISDN Lines and additionally exploiting chat rooms and bulletin boards specially set up on internet, many of the core courses and advanced PG courses in IT can be made available to students as well as working professionals across the country. All Category I and II Institutions should be encouraged to become resource centres in IT Distance Education while category III Institutes and specific Industry centres should become participants. Three to four major centres should emerge as focal points for this important effort over next two years. All Institutes (up to say 100) that show interest in quickly participating in the programme should be facilitated for setting up receiving / interacting equipment. Each Institute / college should charge appropriate fees from students / working

professionals so that the schemes not only becomes self-sufficient in its annual recurring expenditure, but also generate some surplus to support the academic and research programmes of the Institutes.

3.25 IT enabled Distance Education, i.e., Imparting high quality education in conventional fields to remote villages and towns using the powerful interactive mechanisms of modern IT would constitute a very important and immediate initiative. While Open universities, classical universities and conventional colleges can work towards multimedia and local language content creation for different subjects, the technical Institutes should operate as resource centres for managing the servers and networks that support this activity. All category I and II Institutions (65) could each be provided assistance for the purpose for high disk capacity web server, network / modems and some technical manpower. These resource centres will have the responsibility of synchronising / catching contents across servers and supporting retrieval by other colleges/schools in the city/region. The support for content creation and actual execution of the education programme could come from respective states. Category I and II Institutes could receive conditionally other grants, if they agree to provide this service. Such "Interlocked" grants would force Technical colleges to open up and be sensitive and supportive of the other educational system. Investments mentioned in this and the preceding para would largely come under strengthening computing and networking facilities and supplementary support for upgradation of ET infrastructure.

Improving Connectivity

3.26 It is learnt that ambitious plans are in the offing to offer higher bandwidth facilitating IT-enhanced learning. Whereas, it is learned that some ISPs are offering free Internet access. Bharat Sanchar Nigam Limited (BSNL) on its part has already decided to extend 50% concession on the port charges as well as 20% concession on the leased line rentals to educational institutions. Even with all this, it has to be seen, if educational institutions could afford the costs of such higher bandwidths. Internet access tariff is presently determined by the market forces. It is expected that due to pro-competitive policies of the Government in this sector, the tariff would go down. A brief note on the other initiatives taken by the BSNL for providing a stable and reliable networking infrastructure in the country is given in *Annexure IV.*

Postgraduate Education and Research in IT

3.27 10,000 Masters degree holders and 800 Ph. D. degree holders in computer science are produced in the USA every year. Compared to that, we in this country produce only 25 Ph. D. and 300 M. Tech. degree holders in computer science. *For the country to move up the value chain in software industry and to become a super power in knowledge led business particularly computer science and engineering/information technology, it is essential that we give greater importance to post graduate education and research.* This would be essential if we wish to graduate from mere users of IT to

generators of IT products and services and wish to become internationally competitive. Setting Up Schools of Advanced Studies and Special Research Groups, as recommended by the PG review committee, in IT areas would constitute a very important beginning in this direction. These should be set up in areas of local as well as global relevance such as man-machine synergy, multimedia contents in Indian languages, information security, Internet appliances, low cost hardware, embedded systems, bio-informatics and biometrics, digital design and software interface design, IT entrepreneurship etc. Each such centre could be a joint effort between a lead Institution from Category I and two other Institutes from category-II & III in that region. A total infrastructure and research funding of Rs. 100 crore could be provided in three-year initial period. After these Centres are expected to become self-supporting. Follow up grant over the subsequent four-year period could be provided if that does not happen. To attract outstanding research professionals, compensation package in these Centres could be more liberal and de-linked even from the host institution. Whereas these Centres would be immediate critical requirement, other interventions like increase in out-turn and increase in rate of assistance-ship and associated costs for implementation of the report of the PG Review Committee are being worked out and will be presented separately.

Role of the Regulatory Body

3.28 AICTE is a statutory body set up under an Act of Parliament for proper planning and coordinated development and maintenance of standards in the technical / professional education in the country. In a country of the size and diversity of India a regulatory body is needed to ensure minimum standards and quality of education, specially in view of the high mobility of students for higher education and employment within and outside the country.

3.29 With a large-scale increase in the size of the technical education system, AICTE has as a first step towards decentralisation, decided to devolve the approval functions connected with Diploma Level Institutions to the states. AICTE will however continue to function as an appellate body. Steps are also being taken to simplify and rationalise the existing procedures. Regional offices are being strengthened, and the affiliating universities and the State Boards of Technical Education assigned greater role to address the local needs. There is a need to evolve a nationwide coordination mechanism for maintenance of standards at all levels.

3.30 It was noted that many of the interventions proposed by the Task Force will have to be implemented through the instrumentality of the AICTE and hoped for its full support.

Educational Institutions - IT Industry Interface
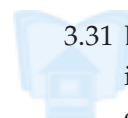
3.31 Both the educational institutions and the IT industry can mutually benefit through closer cooperation and collaboration. In spite of efforts made, such collaborations

have not been very successful in the past. There are wide differences in perceptions of educational institutions and industry. These act as barriers in effective cooperation. IT professionals are short on time and cannot be expected to devote too much of it on such interactions. Though, some of them could be available as adjunct or visiting faculty, institutions need to use them more for certain strategic activities. These could be - development of courseware relevant to the industry needs, assisting them in problem solving through on-going joint collaborative research initiative and using them as faculty for specific industry oriented modules. Top experts / specialists of IT companies could be linked through a video conferencing facility for devoting half an hour a week for delivering lectures on the campus. All such collaborations will, to a large extent, depend on both the educational institution and the industry partner.

3.32 The **Co-operative (Co-op) System,** involving a partnership in the process of education between Industry and Education institutions has become popular throughout the world over the last three decades. It involves **Academic-Terms** in the education institutions, interspersed with one or more **Work-Term(s)** in Industry. During the **Work-Term (s)** of nearly six months duration, the student is treated as a part of the work force and is suitably compensated by Industry. The student is jointly supervised by a teacher and an industry mentor. The Co-op model has shown remarkable results in improving the quality of education and employability of graduates. It has promoted interaction and collaboration between industry and academia. Co-op model is expected to be particularly effective in the field of Information Technology (IT), and may be adopted more widely and further strengthened.

3.33 To facilitate and promote this very desirable interface, there could be awards instituted for recognition of such initiatives at the national level.
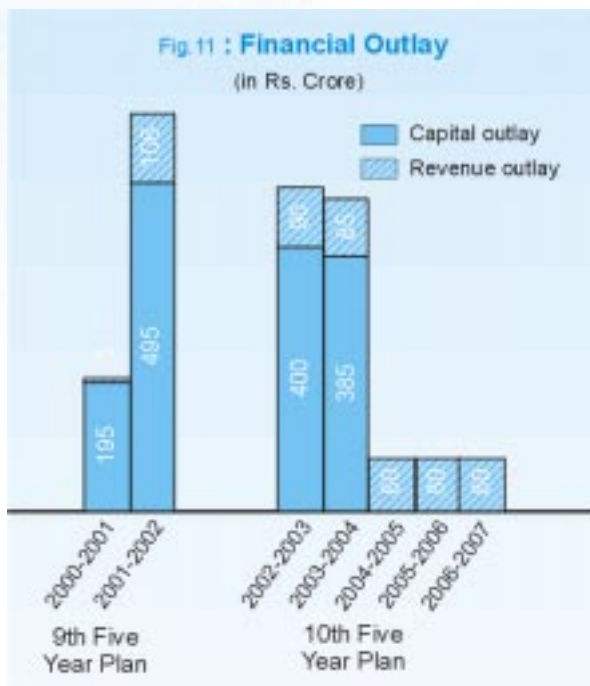
IV. Investments

Programme Outlay

4.1 For the interventions proposed in this paper, an amount of around 2000 crore (Central share alone) would be required over a seven-year period. Details of year-wise investment required are given in Schedule-A and Schedule-B for capital and revenue expenditure respectively. This would be in addition to the State Governments Funding / External Funding. This investment works out to be merely Rs.290 crore per annum (though bulk of the funding may be required in initial 3-4 years). This would be only around 1 % of the total earnings from software and services in the country. With very high rates of return, this investment is fully justified. Proposed investment of Rs.2000 crore will leverage further investment in IT education in the Technical Education sector. All these figures are, at this stage, broad projections and will need to be fine-tuned in consultation with the Planning Commission and the Ministry of Finance. The availability of funds in the budget of the Ministry of HRD will of course depend on the plan ceilings approved by the Planning Commission from time to time, as also for the 10th Five Year Plan when it is finalised.

Fig. 11 : **Financial Outlay**
(in Rs. Crore)

Capital outlay
Revenue outlay

Sources of Finance

4.2 Various possibilities of financing these investments could be explored. State Governments are expected to share part of the investment. Financing could also be done through soft loans from the

World Bank, Asian Development Bank and other multilateral funding agencies. In view of the high rates of return on this investment, there has been a lot of interest in the multilateral funding agencies for the same. Government could explore possibility for meeting the investment needs envisaged in the report through other innovative schemes.

4.3 Existing plan allocations of the Ministry for Technical Education sector have been only to the tune of around Rs.500 crore, total 9th Plan outlay is just Rs.2375 crore. This provision is made against earmarked all on-going and already approved schemes. The proposed funding, therefore, has to come over and above the existing plan outlay, if the overall resources so permit.

4.4 Recurring cost for various initiatives has been kept to bare minimum with the expectation that it would be largely met by the institution or the funding agency involved. Even provision for creation of additional faculty positions and gaps, if any, has not been kept to avoid unnecessary complication. However, the institutions or their funding agency will have to categorically state that critical gaps, if any, identified during the implementation of this programme, shall be filled in by them.

V. Implementation

Institutional Mechanism

5.1 All these initiatives could come under the overall umbrella of a *'National Programme for Human Resource Development'* in IT. The Task Force could function as the *'National Programme Advisory Committee (NPAC)'*. *'Committee on IT Manpower'* could function as an inter-ministerial *'National Programme Steering Committee (NPSC)'* and there could be an *'Implementation Committee'* within the Ministry. These Committees could meet quarterly, monthly and weekly respectively. This hierarchy of Committees would have different terms of references. There could a *'Programme Co-ordinator'* with a small *'Programme Office'* within the Department. There could be an *'Experts Group'* with experts drawn from all four categories of institutions to aid and advise the programme office on technical issues. Steering Committee could be an Empowered Committee with delegated financial powers to sanction funds within the overall parameters laid down in the report. It could also approve guidelines and modalities for release of funds and selection of institutions. The implementation committee may be responsible for taking decisions on day to day basis. This Committee may also have certain delegated financial powers. The Advisory
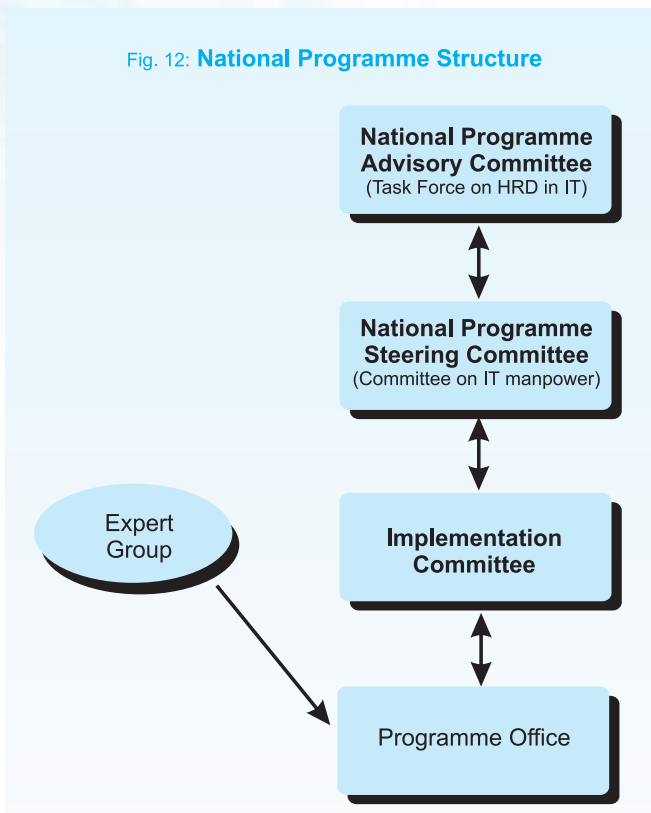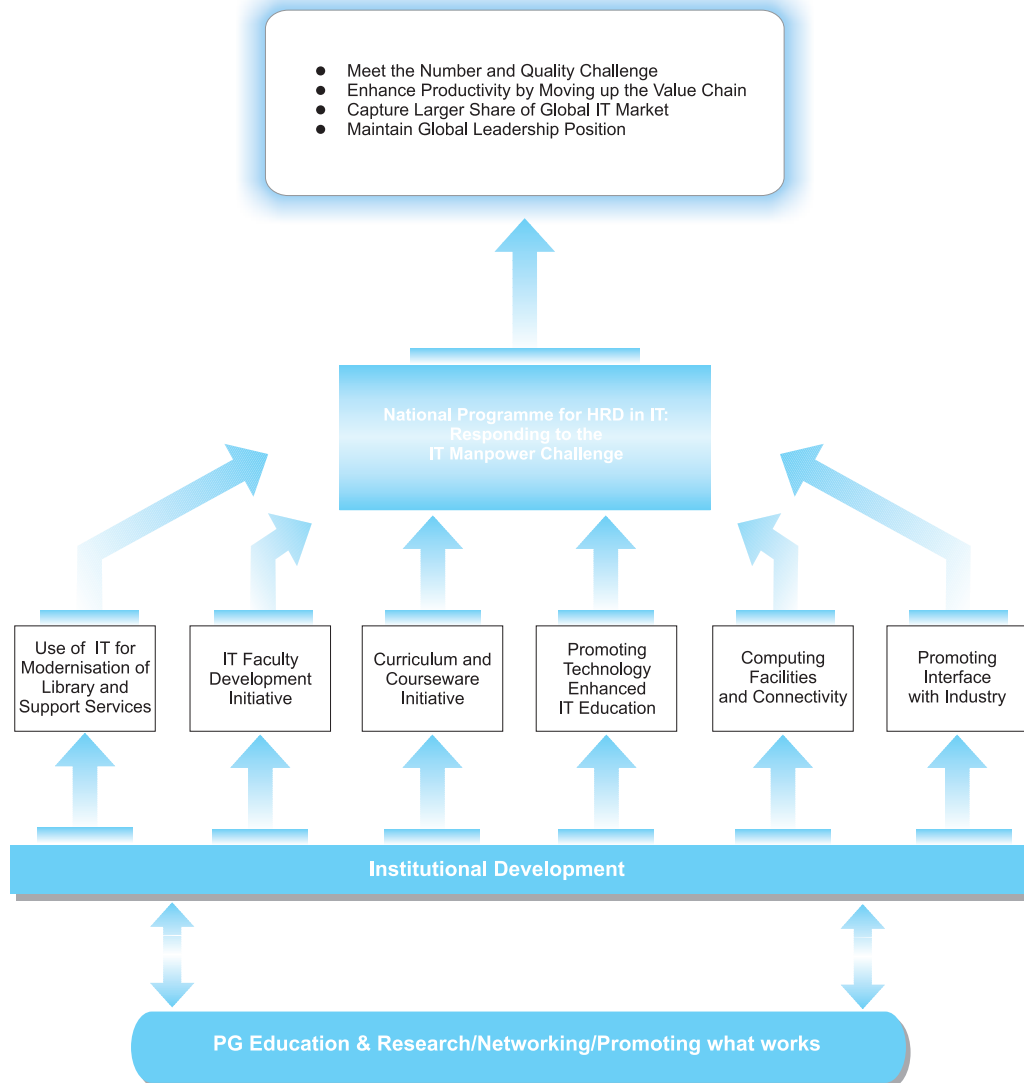
Fig. 12: **National Programme Structure**

National Programme Advisory Committee
(Task Force on HRD in IT)

National Programme Steering Committee
(Committee on IT manpower)

Expert Group

Implementation Committee

Programme Office

Fig. 13: **Operational Plan**

- Meet the Number and Quality Challenge
- Enhance Productivity by Moving up the Value Chain
- Capture Larger Share of Global IT Market
- Maintain Global Leadership Position

National Programme for HRD in IT: Responding to the IT Manpower Challenge

| Use of IT for Modernisation of Library and Support Services | IT Faculty Development Initiative | Curriculum and Courseware Initiative | Promoting Technology Enhanced IT Education | Computing Facilities and Connectivity | Promoting Interface with Industry |

Institutional Development

PG Education & Research/Networking/Promoting what works

Committee shall from time to time review the progress of implementation, make necessary amendments in the broad parameters laid down to adjust to changing realities and on the basis of open feedback received through the *'Programme Web-site'*. Expenditure on administrative services in the programme office shall be restricted to 0.5 % of the total outlay.

Plan of Action

5.2 A tentative *'**Plan of Action'** has been provided in Schedule C. This gives an indicative course of action for each of the recommendations and the *'Agency'* that shall be responsible for it. This has been done keeping in view the spirit of the ToR (i), which provides for drawing up a *'Plan'*.

VI. Anticipated Benefits

6.1 This programme is expected to provide strategic interventions in education and training system in the country in IT / IT related areas. These interventions are likely to increase availability of quality IT manpower in larger numbers in the country. This would help the Indian software & services sector to increase productivity and move up the value chain enabling the country to capture larger share of global markets in software services than projected. Increased employment opportunities in this sector would be immediate benefit and is likely to make a dent in the problem of unemployment in the country. This is an opportunity that the country cannot afford to miss.

6.2 The interventions are also expected to spur quality improvements throughout the education and training system with effective use of information technology. This will also help to resolve a dilemma which regulatory body often faces while monitoring quality in self-financing institutions due to poor facilities in the Government institutions. Investment is therefore mainly targeted to facilitate improvements in the Government institutions, though many of the initiatives shall benefit both the Government and the non-Governmental institutions. By enabling the regulatory body to more effectively monitor quality of IT education and ensure better compliance both from the Government funded and the self-funded institutions, there would be real improvement of quality of IT education in the country.

SCHEDULES

Capital Outlay

(Year-Wise Break Up)

(Amount in Rs. Crores)

	Component	2000-2001	2001-2002	10th FY Plan	Total Amount
1.	Strengthening Computing and Networking Infrastructure in Category – II Institutions (Nearly 50 Nos. @ Rs. 9 crore each)	100.00	185.00	165.00	450.00
2.	Physical Infrastructure Institutions for enhancing capacities for IT Education	-	100.00	100.00	200.00
3.	Strengthening of Computing and Networking Infrastructure in Category – III Institutions (Nearly 200 nos. @Rs.7 crore each- Rs.3.5 crore – Central Share; To be shared between the Centre & the States)	90.00	130.00	480.00	700.00
4.	Leveraging use of IT for Modernisation/ Digitisation of Libraries and computerisation of administrative support services in Select Institutions (capital Outlay)	3.00	6.75	-	9.75
5.	Strengthening of ET Infrastructure in select institutions for promotion of technology mediated IT Education	2.00	13.00	-	15.00
6.	Setting up of Schools of Advanced Studies and Special Research Groups in IT for promotion of PG Education & Research	-	60.00	40.00	100.00
	Total	**195.00**	**494.75**	**785.00**	**1474.75**

(Nearly Rupees One Thousand Four Hundred and Seventy Five Crore only)

Revenue Outlay
(Year-Wise Break Up)

(Amount in Rs. Crores)

Component	2000-2001	2001-2002	10th FY Plan	Total Amount
1. Networking Services - National Network	-	20.00	50.00	70.00
2. Networking Services - State Networks: 20 Networks with 15-20 institutions each. (To be shared between the Centre and the States on 50:50 basis)	-	40.00	100.00	140.00
3. Faculty Development Fund - National Level Initiative	2.00	13.00	125.00	140.00
4. Curriculum & Courseware Development Initiatives	2.00	12.00	35.00	49.00
5. Leveraging use of IT for Modernisation/ Digitisation of Libraries and computerisation of administrative support services in Select Institutions (Capital Outlay)	1.00	3.00	10.00	14.00
6. Promoting Interface with IT Industry for creating public information IT manpower issues and enhancing institutional effectiveness for design and delivery of IT programmes.	-	3.5	35.00	38.50
7. Innovations/Initiatives in IT Education/Setting up of a clearinghouse of such innovations/Seed Money for Replication (Rs. 10 crore per annum)	-	15.00	60.00	75.00
Total	**5.00**	**106.50**	**415.00**	**526.50**

(Nearly Rupees Five Hundred and Twenty Six Crore only)

Grand Total	**Rs. 2000 crore (approx.)**

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PLAN OF ACTION

Recommendations	Indicative Course of Action	Agency
Creating Public Information on IT Manpower		
1. Conduct studies, research, seminars and workshops on IT manpower issues through a network of institutions / consultants.	Identification of institutions. Selection of subject areas of study and award of studies etc.	Programme Office
2. *Set up a* 'Joint Forum of Education and Training Providers and the IT Industry' *for periodic interaction – highlight being an* 'Annual Meet' *for dissemination and exchange of notes, findings and review of trends for creating public information for enabling corrective action*	Hold consultations with the stakeholders in education and training sector and IT industry. Finalise the composition of joint forum in consultation with the MIT / ESC / NASSCOM / MAIT etc. and service the Joint Forum.	Programme Office
3. *Develop* 'IT Manpower Database' *at the National level through a system of unique e-identity for IT professionals.*	Hold consultation and explore possibility.	Programme Office
4. Monitor international mobility of IT professionals by evolving a suitable mechanism at the port of exit / re-entry.	Hold consultation with MEA / MHA and evolve a mechanism.	Ministry
5. Expand reach of Indian IT professionals to non-English speaking countries by integrating language / cultural skill with the regular engineering curriculum.	Identify potential countries. Work out a programme in consultation with Category I & II institutions to begin with.	Ed.CIL / ESC
Promoting What Works		
6. Compile initiatives of States, evolve a clearinghouse mechanism and create facilitating environment for replication of initiatives and innovations that work.	Request States to furnish information, compile it and put it on the web.	Programme Office
7. *Promote non-governmental initiatives in HRD in IT with focus on bridging the digital divide, innovations in pedagogy and delivery of educational contents etc. by recognising such initiatives through a system of* 'National Awards'.	Finalise scheme of awards.	Programme Office
Monitoring Intake and Out-turn		
8. Monitor capacities of institutions periodically (both intake and out-turn) with 1999-2000 as the base year. Objective shall be to double intake by 2001-2002	Devise standard formats for collecting information through a consultative process. Wherever possible online collection of	Programme Office / AICTE / ISTE

Recommendations	Indicative Course of Action	Agency
and triple it by 2003-2004 for the system as a whole with strategic use of various institutions for different purposes.	information to be encouraged.	
Categorisation of Institutions 9. *Categorisation of institutions to be done by a* 'Technical Group' *for adopting different strategies for different categories of institutions contingent upon the situational parameters.*	Constitute a technical group for first cycle of categorisation of institutions.	Ministry / AICTE
New Institutions 10. *Set up exclusive* 'Institutes of Information Technology' *with the State and Central Government funding (and possibly external funding) and industrial collaboration. These shall function as* 'Resource Centres' *and* 'Finishing Schools' *particularly for category III & IV institutions.*	Hold consultations with the stakeholders.	Programme Office
11. Explore possibilities of setting up of new IITs in the country.	Hold consultations with the Planning Commission and the Ministry of Finance.	Ministry
12. *Ensure cost effectiveness in planning new institutions. A* 'Technical Group' *to rework on space norms for institutional buildings for educational purposes.*	Constitute a 'Technical Group' with representatives of the Ministry of Urban development, Council of Architects and Educational Institutes.	Ministry
13. Facilitate bridge courses and minor area programmes in IT for easy migration to IT keeping in mind the impact IT is making on all disciplines of tertiary education and in every industry	Identify institutes where bridge courses in minor area programmes have been run successfully over the years. A paper highlighting their experiences be circulated to all the institutions and hold a National Workshop.	NIEPA
Improving Institutional Quality 14. Bring about improvement in overall institutional setting through a package of measures with focus on Category-I & II institutions at the National level. States to be facilitated to take up similar efforts for other institutions.	A consultation paper on re-structuring of RECs circulated. On receipt of feedback further action to be taken. Similar exercise could be taken up for other Category II institutions.	Ministry
15. Leverage IT for improving institutional performance by computerization of support services.	Evolve mechanism using experiences of Institutions.	Programme Office

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Recommendations	Indicative Course of Action	Agency
Improving Infrastructure 16. Strengthen computing and networking facilities in category I, II & III (G) institutions (around 250) with 100 % financial assistance for category I & II institutions (around 65) and 50 % financial assistance for category III (a) institutions (around 200) – balance 50 % to come from the State Governments.	A brief outline for strengthening computing and networking facilities is provided in Annexure-III. Based on this, institutions shall be invited to submit their proposals for upgradation.	Programme Office
17. *Create an* 'Equipment Replacement Fund' *at the Institution level for upgradation and replacement of obsolete equipment periodically earmarking 20 % of the fee revenue for the purpose.*	This could be a pre-condition for sanction of funds.	Programme Office
18. Improve of physical infrastructure – such as additional classroom, hostel, and laboratory facilities to cater to increased capacities in Category-I & II institutions.	Based on overall targets for increase, proposals to be invited from Category I and Category II institutions.	Programme Office
Networking 19. *Promote Networking of institutions (both horizontally within a category and vertically across categories) to synergise strengths by forming* 'National Level Cluster' *and* 'State Level Clusters' *for effective resource sharing and academic collaboration with 100 % financial assistance for* 'National Network' *and 50 % financial assistance for* 'State Networks' *– balance 50 % would come from the State Governments.*	A workshop to be held to work out operational strategy for national level networking. Similar workshops could be held at the Regional / state levels.	Programme Office
20. Digitisation of libraries of original works (thesis, research publications) and old and expensive journals in category I & II institutions.	Broad guidelines for Digitisation of libraries be circulated and evolve a mechanism to support such schemes.	Programme Office
IT Faculty Development Initiative 21. Launch an 'IT Faculty Development Initiative' with a multi-pronged approach to address critical shortage of IT faculty, retaining quality faculty, and their periodic up-skilling and create a 'Faculty Development Fund' for the purpose. (Specific components of this initiative are from serial no. 22 to 35)	Monitoring and coordination of different initiatives, measurement of the outcomes and keeping the initiatives on-track.	Programme Office

Recommendations	Indicative Course of Action	Agency
22. Attract quality faculty by greater thrust on Post-Graduate and Research Programmes in IT.	Early implementation of the recommendations of the PG Review Committee.	Ministry / AICTE
23. Scale up Early Faculty Induction Programme (EFIP) in IT.	Revise the scheme suitably and implement	AICTE
24. Scale up Quality Improvement Programme (QIP) in IT.	Revise the scheme suitably and implement	AICTE
25. Introduce Sequential PG Programme in IT.	Working Group set up to provide operational details.	Ministry/AICTE
26. Start PG programmes in IT in Dual Mode.	Identify Resource Institutions and Participating Institutions, hold consultations and finalise the scheme.	Programme Office / AICTE
27. Supplement efforts of local faculty by using faculty of premier institutions.	Identify Resource Institutions and Participating Institutions, hold consultations and finalise the scheme.	Programme Office
28. Allow transmigration in all postgraduate and research programmes.	Review of detailed guidelines.	AICTE
29. Allow switchover of faculty from interfacing disciplines.	Review of detailed guidelines.	AICTE
30. Encourage concept of Teaching Assistants (TAs).	Issue of instructions by appropriate authorities.	Ministry / Funding Agency
31. Encourage Dual Degree Programmes with PG in IT related fields though minor area programmes.	Review of detailed guidelines on the basis of past experience of institutions.	AICTE
32. Create enabling environment to invite visiting faculty from industry, reputed institutions from India and abroad	Hold consultations with the IT industry & others.	Ministry / MIT
33. Encourage 'Adjunct Faculty' from IT industry.	Hold consultations with the IT industry & others.	Ministry / MIT
34. Re-employment of IT Faculty beyond the age of superannuation.	Issue instructions.	Ministry / Funding Agency
35. *Greater focus on continuing education programmes for skill upgradation with financial support from the Government also through a 'Faculty Development*	Training needs to be identified and institutions to be selected. Scheme for support may be finalised.	Programme Office

Recommendations	Indicative Course of Action	Agency
Fund' *created at the Institution level with 10 % of the fee revenue.*		
Curriculum & Courseware		
36. *Evolve a network of institutions to work closely to evolve IT curriculum, pedagogy and delivery methods for all levels.*	Constitute expert groups and hold consultations with the stakeholders.	AI-BITE
37. Adopt modular, credit based approach in curriculum design at various for enhancing student mobility and facilitating transfer of credits.	Constitute expert groups and hold consultations with the stakeholders.	AI-BITE
38. Provide special attention to both horizontal and vertical mobility of students in the existing and the new programmes and work out equivalence mechanisms.	Hold consultation with the stakeholders.	Ministry/UGC/ AICTE/AI-BITE
39. *Launch 'Courseware Development Initiative' for development and publication of low-cost courseware – special emphasis being on courseware in Indian Languages, courseware for laboratory activities and other gap areas.*	Hold series of Workshops involving Publishers and private IT education and training providers.	AI-BITE / Programme Office
40. Create web-based forum for facilitating curriculum and courseware development efforts.	Assign coordination responsibility to one of the institutions.	AI-BITE / Programme Office
Promoting Technology-mediated IT Education		
41. Promote Technology-mediated IT Education using broadcast media, teleconferencing, web-based and other multimedia approach.	Identify Resource Institutions and Participating Institutions, hold consultations and finalise the scheme.	Programme Office
Improving Connectivity		
42. Make provision for concessional tariff for connectivity for educational institutions.	Hold consultations with Internet Service Providers.	Ministry of Communications
Promoting PG Education and Research		
43. Promote Post-Graduate education and Research Programmes by early implementation of the recommendations of the PG Review Committee.	Make budgetary provision for early implementation.	Ministry / Ministry of Finance

Recommendations	Indicative Course of Action	Agency
44. Set up of Special Research Groups and Schools of Advanced Studies in thrust and emerging areas.	Set up an Experts Group to identify emerging areas and institutions.	Ministry/MIT/ AICTE
Facilitating Interface with IT Industry 45. Facilitate educational institution – IT industry collaboration.	Hold consultations with IT industry.	MIT / Ministry
Investments & Implementation 46. Share investments for various initiatives between the Central / State Governments and the Industry.	Sharing mechanism already provided in the Report.	—
47. *All these initiatives can come within the umbrella of a* 'National Programme for Human Resources Development in IT (NP-HDRI)' *with suitable institutional arrangement* – 'National Advisory Committee' *and* 'National Steering Committee'.	Programme Office to be set up and different committees and Group constituted.	Ministry

Annexures

No.460/31/C/27/2000-E&S.I
Government of India
(Bharat Sarkar)
Prime Minister's Office
(Pradhan Mantri Karyalaya)
New Delhi

Dated 1.8.2000

Subject: Appointment of Task Force on Human Resource Development in InformationTechnology (IT)

In pursuance of the announcement made by the Prime Minister in his address to the National Conference of IT Ministers on 15.7.2000, Government has decided to constitute a Task Force on Human Resource Development in IT.

2.   The Task Force will have the following composition:-

(i)	Minister, Human Resource Development	Chairman
(ii)	Finance Minister	Member
(iii)	Minister, Information Technology	Member
(iv)	Chief Minister, Andhra Pradesh	Member
(v)	Chief Minister, Karnataka	Member
(vi)	Chief Minister, Madhya Pradesh	Member
(vii)	Chief Minister, Uttar Pradesh	Member
(viii)	Director, Indian Institute of Technology, Delhi	Member
(ix)	Secretary, Department of Secondary & Higher Education	Member-Secretary

3.   The following officers will be associated with the Task Force as permanent special invitees:

(i)   Secretary, Department of Scientific and Industrial Research
(ii)   Secretary, Ministry of Information Technology
(iii)   Secretary, Department of Telecommunications
(iv)   Secretary, Department of Expenditure

4.   The Task Force, with the permission of the Chairman, may co-opt or invite such other person(s) as it deems appropriate, to participate in any of its meetings as special invitee(s).

5.   The main objective of the Task Force is to prepare a long-term strategy for human resource development in IT. Accordingly, the terms of reference of the Task Force shall be as follows:

(i)   To draw up a plan to optimally use the existing infrastructure of the IITs, RECs, other engineering colleges and educational institutions to double their student intake in IT from the next academic year and triple it in the next two years.

(ii)   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.

(iii) To suggest measures necessary for enduring that good quality IT education does not remain a preserve of the rich and the English-education, and is also available to students from poor and rural families, especially those from the Scheduled Castes, Scheduled Tribes and OBCs.

(iv) To suggest measures necessary to improve teaching of non-IT subjects by using computers and the Internet for all students.

The Task Force may be assigned such other functions as may be found necessary from time to time.

6.   The Task force shall submit its interim report on the term of reference at S.No.(I) above within one month, and its final report on the remaining terms of reference with there months.

7.   The Task Force will be serviced by Department of Secondary & Higher Education. The Ministry of Information Technology will render all necessary assistance to the Task Force.

Sd/-
(N.K. Singh)
Secretary to PM

Deputy Chairman, Planning Commission and the Secretary of the Planning Commission co-opted as members and Permanent Special Invitee respectively by the Chairman of the Task Force in terms of para 4 of the Notification.

F.No.33-6/2000-TS.I
Government of India
Ministry of Human Resource Development
Department of Secondary Education and Higher Education

New Delhi the 7th July 2000

Office Memorandum

India enjoys a competitive advantage in the IT sector due to its low cost high quality talent pool. IT services are playing increasingly important role in the country's development and is emerging as the most important export earner. To sustain and further accelerate this trend, key requirement is availability of quality IT manpower in adequate numbers. This requirement is to be met by pooling together resources available both in the formal and the non-formal sector. Whereas, the out-turn of IT professionals from the formal sector has to increase more rapidly than the historical rates of growth, enabling environment needs to be created for the non-formal sector to function more effectively. A committee is therefore being constituted to look into the entire range of issues relating to provision for IT manpower for the growing IT sector.

2. The composition of the Committee shall be as under:

1) **Shri M.K. Kaw,** Secretary, Secondary Education & Higher Education   - Chairman

2) **Shri P.V. Jayakrishnan**, Secretary, Ministry of Information Technology,

3) **Smt. Kiran Agarwal,** Principal Adviser (Education)**,** Planning Commission,

4) **Prof. Ashoka Chandra,** Special Secretary, Department of Secondary Education & Higher Education.

5) **Dr. Hari Gautam**, Chairman, University Grants Commission

6) **Shri K.S. Sarma,** Additional Secretary, Department of Secondary Education & Higher Education

7) **Prof. N.C. Nigam,** Chairman, All India Council for Technical Education

8) **Prof. A. W. Khan**, Vice-Chancellor Indira Gandhi National Open University

Task Force on HRD in IT

9) **Shri Champak Chatterjee,** Joint Secretary, Department of Secondary Education & Higher Education

10) **Prof. C.S. Jha**, Chairman, DOEACC Society

11) **Prof. V. Rajaraman**, Chairman, All India Board of IT Education

12) **Shri Sanjay Narayen,** Financial Advisor, HRD

13) **Shri V.S. Pandey**, Joint Secretary, Department of Secondary Education & Higher Education

14) **Shri Pawan Agarwal**, Director, Department of Secondary Education & Higher Education – Secretary

3. The Committee shall facilitate in development of a long-term '*IT Manpower Plan*' for the country. It will help in creating enabling environment for its implementation through policy interventions, financial support, developing institutional mechanisms and building public-private partnerships.

4. This Committee will meet as and when required. The Committee may co-opt other officials / experts to facilitate it in discharge of its functions.

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Sd/-
(V.S. Pandey)
Joint Secretary to the Government of India

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Note: DG E & T and the Chairman, ESC have been co-opted as members as per advise of CoS.

Upgradation of Computing and Networking Facilities in Category-II Institutions

I. Objective

- To increase intake in IT and IT related courses by optimally utilising existing infrastructure.

- To introduce new courses in IT and IT related areas by weeding out obsolete courses with minimal additional support.

- To strengthen use of IT in various courses and disciplines for properly equipping an engineer for the evolving engineering industry of the future.

- To promote inter-institutional cooperation, collaboration by effective use of computing facilities and networking for resource sharing (both faculty and learning resources).

- To ensure continued curriculum renewal and faculty development through a 'Joint Strategy' involving networking.

- To enhance efficiency and improve transparency in institutional support services.

II. Process

- Provide state-of-art computing environment to all students and faculty.

- Provide high bandwidth connectivity (8 Mbps) to the Internet so that information and other educational resources at remote sites can be accessed with the same ease as local sites. These Internet based resources will be actively used in teaching and research.

- Use computers, appropriate software and accessories as tools for more effective classroom instructions which would significantly increase the impact on students as well as expand the reach of individual teachers;

- Modernise and automate the complete support infrastructure, namely – central library, academic, faculty students and R&D officers/functions, accounts, works, health, security telecommunications etc.

- Evolve a system for continuous and regular interaction for sharing good practices,

courseware, application software for support services, faculty resources, digital library resources / conventional library resources, workshop and laboratories.

III. Broad Specifications

- High performance computing and graphic servers at centralised location along with a few high performance servers in specific- departments

- Access stations - One Access station each for every 10 UG/PG students, every 2 Ph.D. scholars and every faculty member.

- High bandwidth WAN links for Internet access.

- Quality software with network licenses of adequate number.

- Well-equipped classrooms for conducting computer related course instruction.

- Setting up of an Institute wide Internet service.

- Setting up of a cell for distance education utilizing IT to the maximum.

- Automation of office and support functions.

- Digital sharable libraries.

[The exact requirement may very from Institution to Institution, based on their existing facilities.]

III. Funding

- For each Institutions Rs.8-Rs.10 crore would be required. Total requirements would be Rs.450 crore over 3 years.

- Nearly Rs.200 crore would be required for other physical infrastructure in all 65 institutions for increasing intake and capacities.

- The upgraded facilities are expected to generate enough revenue (through enhanced consultancy and conducting short term continuing education programmes) to cover recurring expenses.

IV. Time Frame

- This may be done in Project Mode with 3 year time frame.

V. Implementation

- *Based on these guidelines, information on existing and required infrastructure may be obtained from each Institution. Approval could be on Institution to Institution basis depending on their initiatives.*

Suggestive List of Institutions in Category - I

1. IIT Delhi
2. IIT Mumbai
3. IIT Kanpur
4. IIT Guwahati
5. IIT Chennai
6. IIT Kharagpur
7. IIIT Allahabad
8. IIITM Gwalior
9. IIM Calcutta
10. IIM Ahmedabad
11. IIM Bangalore
12. IIM Lucknow
13. IIM Indore
14. IIM Calicut
15. IISc Bangalore

Suggestive List of Institutions in Category - II

I. Regional Engineering Colleges
1. Motilal Nehru Regional Engineering college, Allahabad
2. Maulana Azad College of Technology, Bhopal
3. Regional Engineering College, Calicut
4. Regional Engineering College, Durgapur
5. Regional Engineering College, Hamirpur
6. Malviya Regional Engineering College, Jaipur
7. Dr. B.R. Ambedkar Regional Engineering College, Jalandhar
8. Regional Institute of Technology, Jamshedpur
9. Regional Engineering College, Kurukshetra
10. Visvesvaraya Regional Engineering College, Nagpur
11. Regional Engineering College, Rourkela

12. Regional Engineering College, Silchar
13. Regional Engineering College, Srinagar
14. Sardar Vallabhbhai Regional College of Engg. & Tech., Surat
15. Karnataka Regional Engineering College, Surathkal
16. Regional Engineering College, Tiruchirapalli
17. Regional Engineering College, Warangal

II. Other Institutions

18. PSG college of Technology, Coimbatore, Tamil Nadu *[Trust college]*
19. Assam Engineering College, Jorhat *[State govt. college]*
20. North-Eastern Hill University, Shillong *[Central University]*
21. BITS, Pilani *[Deemed University]*
22. Jawaharlal Nehru Technological University, Hyderabad [State University]
23. Anna University, Chennai *[State University]*
24. University of Roorkee, Roorkee *[State University]*
25. Jadavpur University, Calcutta *[State University]*
26. Banaras Hindu University, Varanasi *[Central University]*
27. Bengal Engineering College, Howrah, West Bengal *[Deemed University]*
28. Delhi College of Engineering, Delhi *[State govt. college]*
29. Netaji Subhash Institute of Technology, Delhi *[State govt. College]*
30. Punjab Engineering College, Chandigarh *[UT Govt. College]*
31. LD college of Engineering, Ahmedabad *[State Govt. College]*
32. Harcourt Butler Technological Institute, Kanpur *[State govt. College]*
33. MS University, Baroda *[State University]*
34. Bihar Engineering college, Patna *[State Govt. College]*
35. Birla institute of Technology, Ranchi *[Deemed University]*
36. Andhra University, Waltair *[State University]*
37. Govt. Engineering College, Thrissur *[State Govt. College]*
38. Jamia Milia Islamia, Delhi *[Central University]*
39. Thapar Institute of Engineering and Technology, Patiala *[Deemed University]*
40. VJTI, Mumbai *[State Govt. College]*
41. Govt. College of Engineering, Pune *[State Govt. College]*
42. Shri GS Institute of Technology & Science, Indore *[State Govt. College]*
43. University of Vishveshvariayya, Bangalore *[State University]*
44. SNDT Women's University (Mumbai) *[State University]*
45. ISM (Dhanbad) *[Central Institution]*
46. NITIE (Mumbai) *[Central Institution]*
47. SPA (New Delhi) *[Central Institution]*
48. NIFFT (Ranchi) *[Central Institution]*
49. SLIET (Longowal) *[Central Institution]*
50. NERIST (Itanagar) *[Central Institution]*

Category - I and Category - II Institutes

Legend:
- ■ Category - I Institutes
- ● Category - II Institutes

Typical Requirement for Category-II Institutions along with Costing

Specifications	Quantity	Estimated Cost (in Rs. Lakh)
Servers	04 Nos.	100.00
1. Server with 6 CPUs and 1 Tera-byte / 500 GB/300 GB Memory	02 Nos.	30.00
2. Ethernet Switch with Gigabit Ports		20.00
3. ATM Switch		20.00
4. UPS Support		20.00
5. Air-conditioning		10.00
6. Miscellaneous including electrical cabling etc.		
Sub Total		**200.00**
Clients		
1. State of the art Node (Pentium-III with 700 MHz and 128 MB RAM) @ Rs.0.60 Lakhs per machine	150 Nos.	90.00
2. 24 100-TX Port Ethernet Switches @ Rs.1.00 Lakhs per. switch	7 Nos.	7.00
3. UPS Support		30.00
4. Miscellaneous including UTP & Electrical cabling etc.		10.00
Sub Total		**137.00**
Application Software: Pro Engineer, VERILOG / VHDL, SYNOPSIS, ALTERA, AUTOCAD-2000, E-commerce Tools, Oracle Financial Package, Sybase/Ingress, FEM Package, GIS/Remote Sensing Software, CASE ToolsWAP Simulator		*30.00*
Networking: LAN, Intranet, Institute Automation: 1. Fiber Optic Cable 2. Modular Central Ethernet Switch with Gigabit Speed Ports 3. Layer-3 Ethernet Switches with 1 Gigabit Uplink 4. And 100 Mbps Fiber Ports 5. FDDI Ring 6. 622 Mbps ATM Working Group Switch		*250.00*
Office Automation: Computers for Offices: Pentium-III / Celeron Processors Automation Software		*50.00*
High-speed Internet Link for Inter-Institutional Connectivity - 8 MBPS Leased Line with Digital Leased Line Modems, etc.		*150.00*
Electronic Class Rooms:		
1. Electronic Boards	04 Nos.	09.00
2. LCD Projectors	04 Nos.	16.00
Sub Total		*25.00*
Total		**842.00**

Note: Both the specifications and the costing are tentative and will have to be worked out more specifically for each institution separately taking into account the state of the art hardware and software available at the time of implementation.

National Networking Infrastructure

(Source: Department of Telecommunications, Govt. of India)

A reliable network infrastructure is a prerequisite for the development of web-based education. This has to be affordable to the educational institutions and the individuals and available in a variety of forms such as - leased lines, ISDN, Internet, ADSL, ATM and with adequate bandwidth. Some of the initiatives taken in this regard are:

- Internet access nodes are being provided in all Secondary Switching Areas by December 2000. This will be based on a fiber optic cable connectivity, which will link the nodes with a higher speed network. It will provide high speed and countrywide interconnect points to the ISPs. National internet Backbone-I is being set up, which will help the remote areas of this country also to have access to the high quality Internet services.

- Followed by the National Internet Backbone-I the second phase of National Internet Backbone has already been started, which is expected to provide improved connectivity at the block level by March 2001.

- In terms of the Internet Policy announced in November 1998, more than 360 licenses to the Internet Service Providers have been issued so far. Procedures have been simplified. Clearances have been given for setting up 102 International Gateways. With the opening of this sector, the cost of Internet access will come down substantially, which is very crucial and will help to spread the IT education.

- *A National Technology Mission, 'Project Sankhya Vahini (PSV)' has been planned for establishing a very high bandwidth All India National Data Network through a joint venture company known as Sankhya Vahni India Limited (SVIL). The company will establish and operate nation-wide high bandwidth data network to provide high speed data access to educational institutions, private and public corporations, service providers, organisations and individuals, etc. for learning, training, research and other multimedia activities. SV Network can be used very effectively for distance learning, Teleconferencing, setting up universal digital libraries and hazard & disaster management. This network will be primarily a data network forming the National Backbone at speeds of 40 Gbps – 60 Gbps. The National schools, universities and also to commercial establishments such as financial institutions, industrial houses and software companies. It would be possible to access educational, training and digital libraries providing content that are available from universities around the world and also from outstanding educational and research institutions in India. The proposed network can accelerate the development of applications for distance learning, job-oriented training, upgrading and re-orientation of skills, healthcare, training of educators, and numbers other novel applications.*

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Executive Summary

1. In pursuance of the announcement made by the Prime Minister of India in the First National Conference of IT Ministers on 15th July, 2000, a *'Task Force on Human Resource Development (HRD)'* in Information Technology (IT) was set up with four specific Terms of Reference (ToRs). The Task Force was initially required to submit its interim report on the first ToR. The Task Force met on 24.8.2000 and again on 16.9.2000. On the basis of deliberations of the Task Force and written inputs received from the Members, Permanent Special Invitees and others, the Task Force has made Forty Seven(47) specific recommendations relating to ToR (i).

2. These recommendations are made with a view to integrate the core competencies / expertise of the country and innovative information technologies to create for it a sustainable competitive advantage. This will enable the country to maintain its '*Global Leadership Position*' in the knowledge led businesses. For this purpose, a re-engineering of the technical education and training system of the country with focus on IT education is proposed.

3. *All these recommendations could come under the umbrella of a 'National programme for Human Resource Development in IT (NP-HRDI)'.* These recommendations relate to strategic interventions under a definite plan of action rather than a mere statement of intention. Interventions proposed are the most cost-effective options with short gestation periods and with emphasis on critical infrastructure like computer and networking facilities, faculty, curriculum, courseware, promotion of innovations and initiatives throughout the system by an open exchange of ideas, and a system of recognition through awards and rewards. In exceptional cases, support for very pressing physical infrastructure such as hostels, classrooms and laboratories would be provided.

4. The recommendations relate to monitoring of the capacities of institutions (both intake and out-turn) periodically with 1999-2000 as the base year. Objective shall be to double intake in IT / IT related programmes by 2001-2002 and triple it by 2003-2004 for the system as a whole with strategic use of various institutions for different purposes. Whereas a cautious approach is proposed for self-financing institutions, the premier institutions shall be encouraged and facilitated to increase intake in IT / IT related programmes, introduce new programmes and use new technologies for increasing their reach and enhancing effectiveness through a networking approach. New '*Institutes of Information Technology*' have also been proposed.

5. A multi-pronged approach for increasing availability, improving quality and retaining quality faculty in IT is proposed. These initiatives would form the '*IT Faculty Development Initiative*'. A flexible and modular approach in curriculum design to facilitate student mobility both horizontally and vertically, developing a mechanism of equivalence of programmes / courses, special emphasis for courseware in Indian languages and for laboratory activities and web-based courseware has been proposed. The Task Force also recommends immediate implementation of recommendations of the PG Review Committee for promotion of postgraduate education and research in all fields of engineering and particularly in IT/ IT related areas.

6. Continuous review of trends in IT manpower, both for the IT hard core sector and IT enabled services is recommended.

This would create public information on IT manpower so that the system can make periodic adjustments. Instead of following a gap filling approach between demand and supply, there shall be a thrust on producing surplus IT manpower at the higher end, so that the country is able to record even better rates of growth in software and services than has been hitherto been projected by the capturing of a larger share of the global markets.

7. An '*Action Plan*' for implementation of these recommendations has been drawn up with an indicative course of action. Agencies responsible have also been identified. Institutional arrangements for implementation have been kept simple, transparent and effective based on an open consultative approach with a three layered committee mechanism.

8. Investment required would be to the tune of Rs. 2000 crore (central share alone) over a seven year period (up to the end of 10th Five Year Plan). Most of the capital outlay would, however, be required in first 3-4 years only.

9. These interventions would result in an overall increase in availability of quality IT manpower in larger numbers in the country. This will help the Indian software services sector to increase its productivity and move up the value chain, enabling the country to capture larger share of global markets. The recent developments in IT have offered a unique opportunity to the country befitting its natural advantage of having a large pool of talented manpower. The country cannot afford to miss this opportunity.

Recommendations

Creating Public Information on IT Manpower

1. Conduct studies, research, seminars and workshops on IT manpower issues through a network of institutions / consultants [para 2.15].

2. Set up a *'Joint Forum of Education and Training Providers and the IT Industry'* for periodic interaction – highlight an *'Annual Meet'* for dissemination and exchange of notes, findings and review of trends for creating public information for enabling corrective action [para 2.15].

3. Develop *'IT Manpower Database'* at the National level through a system of unique e-identity for IT professionals [para 2.16].

4. Monitor international mobility of IT professionals including evolving a suitable mechanism at the port of exit / re-entry [para 2.16].

5. Expand reach of Indian IT professionals to non-English speaking countries by integrating language / cultural skills with the regular engineering curriculum. [para 2.8]

Promoting What Works

6. Compile initiatives of States, evolve a clearinghouse mechanism and create facilitating environment for replication of initiatives and innovations that work [para 2.17].

7. Promote non-governmental initiatives in HRD in IT with focus on bridging the digital divide, innovations in pedagogy and delivery of educational contents etc. by recognizing such initiatives through a system of *'National Awards'* [para 2.17].

Monitoring Intake and Out-turn

8. Monitor capacities of institutions periodically (both intake and out-turn) with 1999-2000 as the base year. Objective shall be to double intake by 2001-2002 and triple it by 2003-2004 for the system as a whole with strategic use of various institutions for different purposes [para 3.1].

Categorisation of Institutions

9. Categorisation of institutions to be done by a *'Technical Group'* for adopting different strategies for different categories of institutions contingent upon the situational parameters [para 3.5].

New Institutions

10. Set up exclusive *'Institutes of Information Technology'* with the State and Central Government funding (and possibly external funding) and industrial collaboration. These shall function as *'Resource Centres'* and provide training in cutting edge technologies for the products of category III & IV institutions in particular. [para 3.7].

11. Explore possibilities of setting up of new Institutes of Category- I in the country [para 3.7].

12. Ensure cost effectiveness in planning new institutions. A *'Technical Group'* to rework the space norms for institutional buildings for educational purposes. [para 3.7]

13. Facilitate bridge courses and minor area programmes in IT for easy migration to IT keeping in mind the impact IT is making on all disciplines of tertiary education and in every industry [para 3.8].

Improving Institutional Quality

14. Bring about improvement in overall institutional setting through a package of measures with focus on Category-I & II institutions at the National level. States to be facilitated to take up similar efforts for other institutions [para 3.10].

15. Use of IT for improving institutional performance using computer support services for increasing efficiency and productivity [para 3.11].

Improving Infrastructure

16. Strengthen computing and networking facilities in category I, II & III (G) institutions (around 265) with 100 % financial assistance for category I & II institutions (around 65) and 50 % financial assistance for category III (G) institutions (around 200) – balance 50 % to come from the State Governments [para 3.12].

17. Create an *'Equipment Replacement Fund'* at the Institution level for upgradation and replacement of obsolete equipment periodically, earmarking 20 % of the fee revenue for the purpose [para 3.13].

18. Improve the physical infrastructure – such as additional classroom, hostel, and laboratory facilities to cater to increased capacities in exceptional cases in Category-I & II institutions [para 3.12].

Networking

19. Promote Networking of institutions (both horizontally within a category and vertically across categories) to synergise strengths by forming a *'National Network of Institutions'*

and *'State Level Networks'* for effective resource sharing and academic collaboration with 100 % financial assistance for servicing the *'National Network'* and 50 % financial assistance for servicing the *'State Networks'* – balance 50 % would come from the State Governments [para 3.14].

20. Digitise libraries of original works (thesis, research publications) and old and expensive journals in category 'select' institutions [para 3.15].

IT Faculty Development Initiative

21. Launch an *'IT Faculty Development Initiative'* with a multi-pronged approach, to address critical shortages of IT faculty, retain quality faculty and their periodic up-skilling and create a *'Faculty Development Fund'* for the purpose [para 3.17]. *[Specific components of this initiative are from serial no. 22 to 35]*

22. Attract quality faculty by greater thrust on Post-Graduate and Research Programmes in IT [para 3.17].

23. Scale up Early Faculty Induction Programme (EFIP) in IT [para 3.17].

24. Scale up Quality Improvement Programme (QIP) in IT [para 3.17].

25. Introduce Sequential PG Programme in IT [para 3.17].

26. Start PG programmes in IT in *'Dual Mode'* [para 3.17].

27. Supplement efforts of local faculty by using faculty of premier institutions [para 3.17].

28. Allow transmigration in all postgraduate and research programmes [para 3.17].

29. Allow switchover of faculty from interfacing disciplines [para 3.17].

30. Encourage concept of Teaching Assistants (TAs) [para 3.17].

31. Encourage Dual Degree Programmes with PG in IT related fields [para 3.17].

32. Create enabling environment to invite visiting faculty from industry, reputed institutions from India and abroad [para 3.17].

33. Encourage 'Adjunct Faculty' from IT industry [para 3.17].

34. Re-employ IT faculty beyond the age of superannuation on a temporary basis [para 3.17].

35. Greater focus on continuing education programmes for skill upgradation and create a 'Faculty Development Fund' at the Institution Level with 10% of the fee revenue flowing to it [para 3.17]

Curriculum & Courseware

36. Evolve a network of institutions to work closely to evolve IT curriculum, pedagogy and delivery methods for all levels [para3.18].

37. Adopt modular, credit based approach in curriculum design at various levels for enhancing student mobility and facilitating transfer of credits [para 3.18].

38. Provide special attention to both horizontal and vertical mobility of students in the existing and the new programmes and work out equivalence mechanisms under an overall *'National Qualification Framework'* for IT education [para 3.19].

39. Launch *'Courseware Development Initiative'* for development and low-cost publication of courseware – special emphasis being on courseware in Indian Languages, courseware for laboratory activities and other gap areas [para 3.20].

40. Create web-based forum for facilitating curriculum and courseware development efforts [para 3.20].

PromotingTechnology-mediated IT Education

41. Promote Technology-mediated IT Education using broadcast media, teleconferencing, web-based and other multimedia approach. [para 3.21 to 3.25].

Improving Connectivity

42. Make provision for concessional tariff for connectivity for educational institutions [para 3.26].

Promoting PG Education and Research

43. Promote Post-Graduate education and Research Programmes by early implementation of the recommendations of the PG Review Committee [para 3.27].

44. Set up Special Research Groups and Schools of Advanced Studies in high technology and emerging areas [para 3.27].

Facilitating Interface with IT Industry

45. Facilitate interface with IT industry collaboration by adopting CO-OP education model. [para 3.31-3.33].

Investments & Implementation

46. Share investments required between the Central / State Governments and the Industry [para 4.2].

47. Pool all initiatives under the umbrella of a *'National Programme for Human Resources Development in IT (NP-HRDI)'* with suitable institutional arrangement for implementation. [para 5.1].