ROLE OF IT EDUCATION IN INDIA
CHALLENGES AND QUALITY PERSPECTIVES

P.N. Gupta
Ajay Kr. Singh
Vaneeta Malhotra
Lavanya Rastogi

*I*NTRODUCTION

In the light of the information technology (IT) revolution, the paper deals with the changing role of educational institutions in promoting IT education in India, in order to generate qualitative and competitive human capital. It also analyses the challenges faced by both the formal sector i.e. the University system and the non formal sector i e. the private institutions, with a view to meeting the demand of the skilled manpower in the country. An inference has also been drawn that growing demand for IT professionals cannot be met by formal sector alone. The Non Formal Sector will play an increasing role in fullfilling the demand-supply gap of trained IT professionals. The participation of Government would be crucial in determining growth of IT education in India.

Information Technology revolution had a revolutionary effect on the lives of people in the 21st century. The global business environment is fast changing with technology permeating the functioning of businesses to a great extent. Information technology has started to affect all domains of business, be it customer relations or vendor management or research or marketing etc. The technology requirements are also changing fast as shown in graph 1. Some of the prominent trends that are influencing global business today and will continue to do so in future include *www.scopemarketing.com*, June 6, 2003:

1. Increasing E-enablement of businesses.

2. Greater interaction between customers and marketing channels (intermediaries).

3. Rapid convergence of the IT, telecommunication and entertainment medium.

4. Proliferation of numerous mobile devices, resulting in a slow decline of the PC.

5. Greater cost cutting initiatives and de-risking of businesses will result in a proliferation in outsourcing activities.

6. Application Service Providers (ASPs) will revolutionize the software industry by changing the pricing dynamics.

7. The rapid generation of data and the rising importance of the same will propel the growth in the storage segment.

Indian IT Industry

The Indian Economy has not remained unaffected from this global phenomenon, with IT industry, particularly software industry growing by leaps and bounds. India's prowess in Information Technology, more significantly in computer Software, has been recognized globally. The Indian IT industry revenue increased to 13510 Mn US$ (See Fig 1 Indian IT Industry) in the year 2001-02 where the share of Indian software industry was estimated at around US$ 8.3 billion (Rs. 377.6 billion*) as shown in Table 1. Domestic market revenues have grown at a lesser pace (46.8 percent) when compared to the export revenues that grew at over 62.0 percent per annum

Trends in Technology
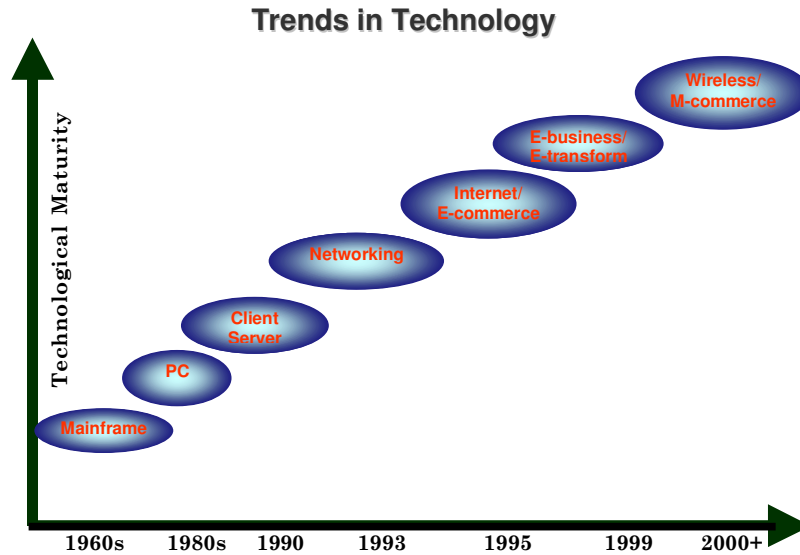
Graph 1 : Changing Trends in Technology

during the period 1995-2000 (IDC, NASSCOM – Strategic Review 2002).
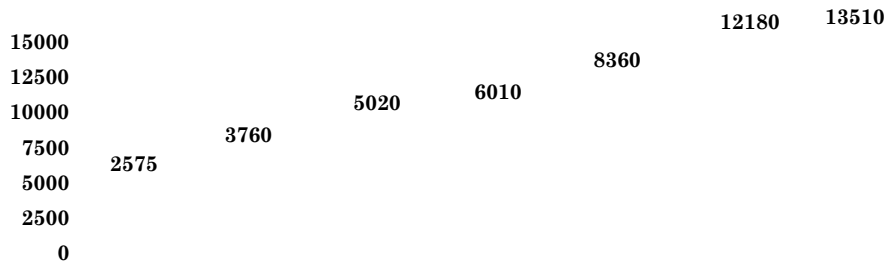

Figure 1 : Indian IT Industy

Source: **IDC, NASSCOM – Strategic Review 2002 includes : h/w, peripherals, networking, domestic and export markets for s/w and services and ITES.**

(Values in Million)

Category	1996-1997		1997-1998		1998-1999		1999-2000		2000-2001#	
	Rs	US$	Rs	US$	Rs	US$	Rs	US$	Rs	US$
Domestic Revenues	24,100.0	670.0	35,100.0	950.0	49,500.0	1,250.0	72,000.0	1,700.0	94,100.0	2,060.0
Export Revenues	39,000.0	1,083.0	65,300.0	1,750.0	1,09,400.0	2,650.0	1,71,500.0	4,000.0	2,83,500.0	6,200.0
IT Training	6,623.0	184.0	9,121.0	245.3	13,330.0	327.2	17,520.0	410.1	-	-
Total	69,723.0	1,937.0	1,09,521.0	2,945.3	1,72,230.0	4,227.2	2,61,020.0	6,110.1	3,77,600.0	8,260.0

(Source: NASSCOM, The IT Software and Services Industry in India- A Strategic Review 2001)

(Note: * For the year 2000-2001, the Rs-US$ conversion rate has been taken as Rs 45.71= 1US$)

Data for the IT Training revenues for the period 2000-2001 is unavailable)

The Indian software industry is increasingly getting a bigger percentage of business that comes out of the US in terms of out-sourcing and markets like Europe and Japan are also relying more and more upon India to fulfill their IT services requirements. As a result, the software exports growth rate is recorded over 50% (albeit from a low base) for the past several years. The Indian software industry is gearing up as the largest foreign exchange earner for India. The projections show that Indian software industry will be grossing up to 100 thousand crore in a decade (Consulting firm McKinsey's projects, that software export revenue would reach $87 billion in a decade, Figure 2).
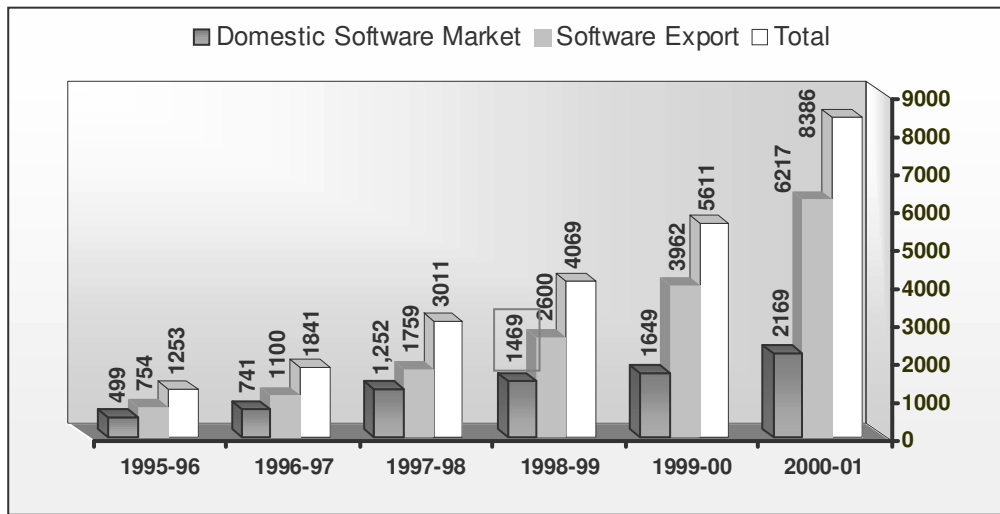

Figure 2 : Indian Software Industy

Source: **IDC, NASSCOM – Strategic Review 2002.**

"Software Industry is the only industry from India which can destabilize an industry anywhere else in the world" – Prahalad and Stuart (2002).

The study of the statisctics related to Indian Software Industry reveals that there will be a large demand for IT qualified software professionals, who not only have the understanding of the basics of computer technology and science, but who are also exposed to the latest tools and technologies being applied in the software industry.

Current Scenario of IT Education in India
At present, IT education and training in the country can broadly be classified as falling into formal education system or non-formal education system.

Formal Education System
Formal sectors in IT education includes Universities which are approved by statutory bodies i.e. AICTE, UGC like Delhi University, Punjab Technical University, IIT etc which provide various courses of Computer Science, information technology like B.Tech (Bachelor of Technology), M.Tech (Master of Technology), B. Sc. (Bachelor of Science), M. Sc. (Master of Science), in Information Technology or Computer Science, MCA (Master of Computer Application) Etc. The formal education institutions that teach courses in IT-related disciplines can be grouped into four categories, as shown in Table 2 & 3.

There are nearly 7500 colleges for general education affiliated to 237 universities in the country. In the area of technical education, the total number of engineering colleges are in excess of 700 whereas the total number of polytechnics are in excess of 1500 (Table 2 & 3). Out of over 700 Engineering Colleges in the country, about 500 are conducting B.Tech in Electronics and/or Information Technology. The annual output of trained labor force from these institutions in the formal sector during 2000-2001 is given in table 3. While the MCA programme is extremely well established in over 300 universities/colleges, the BCA/BIT and equivalent, a three year programme after 10+ 2 has been introduced of late in various universities including IGNOU. However, the overall IT environment in colleges and universities is still relatively poor and providing Internet access is essential for making a meaningful effort in upgrading IT education as a whole.

Table 2 : Instiutions offering Formal IT Education in India

Category	No. of Institutions
National Institutions	9
Engineering Colleges	776
Colleges/Universities offering Master of Computer Applications Degree	494
Diploma Colleges	1300

Source: **Report on Indian Software Industry by Scope Marketing & Information Solutions Private Ltd., Chennai, India, October 2001, also accessed by www.scopemarketing.com on June 6, 2003.**

Table 3 : Supply of IT Manpower: Formal Sector

Colleges Awarding Degrees in Engineering	776	(As on 4.5.2000)
Colleges Awarding MCA	494	(As on 4.5.2000)
Total	1270	(1032 for IT Courses)
Total Intake (Students)	2,05,153	(1999-2000)
IT Courses Intake	66,214	(32.17%)
+ IITs, IIITs, IISc.	7,000	(1,200 in IT Courses)
Total IT	73,214	

Source: **X Plan Study team of HRD – Ministry of Information Technology, India**

The success of the Formal sector has been limited, in meeting the growing demand for the IT professionals due to the following constraints:

● Shortage of qualified teachers in the IT sector.

● Financial constraints.

● Long gestation periods needed to start new courses

● Inability to match course curriculum with changing market requirements.

● Limited exposure to the latest tools and techniques employed by software developers for increased productivity and reliability.

● Limited project management experience.

● Not enough exposure to industrial problems.

● Rigid curriculum structure, which does not cater to fast changing, trends in technology & practices.

The students not able to pursue courses in information technology through formal system have to move to non conventional stream i.e. the non formal sector.

Non Formal Education System

The Non Formal education system comprises private training institutes offering flexible intakes and customised training. Non Formal Sectors of IT education include private organizations like NIIT, APTECH, TATA INFOTECH, Jetking, STG, IBM, DCIT etc and some of the bodies promoted by Ministry of Information Technology like, Department of Electronics Accredidated Computer Courses, ET&T, Centre for Development

of Advanced Computing (CDAC), etc. The growth of a large non-formal sector of computer education and training in the country in the last few years has been a very encouraging (see graph 2). The non-formal sector, particularly, agencies like NIIT, Aptech and the DOEACC scheme are playing an increasingly important role in providing IT education to a large segment of the college/university sector's students.

Market Size amongst the Organized Sector : 309Mn USD

NIIT	Aptech	SSI	Tata Infotech	CMC	Datapro	LCC
144.2	86.0	37.5	17.5	12.3	4.2	3.1
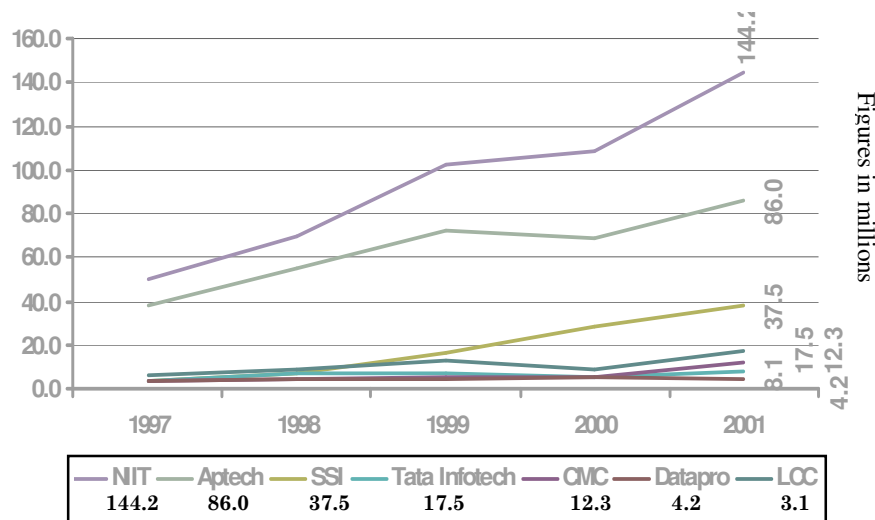
Graph 2: Non Formal IT Education in India

DOEACC has played a very important role in revolutionizing IT education in the under Non Formal Sector. It was set up as an autonomous organisation under the Deptt. of Electronics (now Minstry of Information Technology) Govt. of India, with the prime objective to bring the most updated global industry relevant computer education, within the reach of more and more unprivileged masses. The society has revolutionised computer knowledge dissemination, by offering its meticulously prepared curriculum through the non-formal sector. DOEACC's holistic quality policy entails the creation and regular upgradation of curriculum by the country's leading academia and IT professionals; offering these courses through painstakingly screened accredited institutes; regular staff training at the institutes to ensure knowledge updates; centralised examinations at several centres across India to ensure seriousness both at the institute's and individual's level. Right from a familiarisation certificate Course on Computer Concepts (CCC) to the foundation (O) level, Advanced Diploma (A) level, MCA Degree equivalent (B) level and M.Tech Degree equivalent (C) level, the society offers to the students, who couldn't qualify for engineering colleges, a lifetime opportunity to acquire knowledge and qualifications at par with the best in the country. A unique feature of the scheme, is its facility for horizontal entry to students from non-accredited institutes - so a student with a certain minimum level of computer knowledge need not start at the foundation 'O' level. *(http://www.doeacc.org.in)*

Currently, there are 0.5 million students who are getting IT training through the non-formal sector per year. The non-formal sector has over 5000 training institutions which are still growing at the rate of around 20% per annum (**http://www.mit.gov.in**). These computer-training institutes (CTIs) in this sector provide short term as well as long-term programs, and have become extremely popular during the recent years. Although the majority of students in these institutes learns computer application and related activities, these institutes are becoming a major point for upgrading knowledge of students coming out of formal stream of education, as the formal system of IT education was not in a position to keep its infrastructure and technological resources at state-of-the-art levels. A large number of engineering graduates and other students are joining these private training institutes to obtain up-to-date specialized knowledge in high-end applications such as ERP, Java, and software engineering, Web designing, networking, data warehousing, etc. Many specialized training schools have been opened during 1997-98 to train in Y2K-related issues. Some leading national CTIs have introduced 2-3 years' integrated programs. The details about the different institutes offering training programs in various fields of Information Technology is given in Table 4.

Table 4 : Educational Institutions offering IT Education in the Non Formal Sector

Name of Institute	Number of Centers	Training Areas
Aptech Ltd.	Has more than 1,200 centers in about 20 countries.	The three training initiatives are: Aptech Computer Education for general computer students; Arena Multimedia for multimedia professionals; and Asset International for software professionals. It launched a course on E-commerce in alliance with IBM.
BDPS Ltd.	With over 150 software training centers. It has joined hands with ECIL to set up ECIL-BDPS centers in 11 states. Also in the pipeline is a hardware lab in Bangalore.	BDPS offers courses right from MS Office to high-end training on AS/400 client-server.
CMC Ltd.	Has about 180 centers across the country.	The government of India enterprise started with customized training for multinationals and finally got to career training Besides the short term and specialized courses, CMC offers DAST-Diploma in Advanced Software Technology.
CMS Computer Institute	A division of Mumbai-based CMS Computers Ltd, it has about 60 branches all over India.	Besides the software courses such as DBMS, OOP and Front End tools, CMS offers networking training programmes like the new "CMS Millennium" on Novell Netware 5.
Datapro	Datapro InfoWorld is one of the oldest computer and consultancy organizations in India, providing IT products and services with 140 training centers all over India.	Datapro acts as ATC for Microsoft, Novell, IBM AS/400 and AutoDesk products.
ET & T Educational Telecommunications & Technology	ET&T, a division of the nation's largest regional education agency, provides exemplary, standards-based instructional and professional development programs to diverse population ET&T serves the County of Los Angeles (with K-12 enrollment over 1.6 million, almost 80,000 teachers and 94 school districts) as well as clients across the state and nation. Few centers of ET&T Computer Education, has accreditation for DOEACC's 'O' and 'A' levels.	Offers training in technologies including Web, multimedia, broadcast, videoconferencing and networking.
First Computers	Pioneering the end-user computing training concept in India, the ISO 9001 certified company has more than 150 centers all over the country.	About 80 percent of their business comes from courses such as First Accountant aimed at B.Com. and CA; and advanced diploma in computer integrated management.

Name of Institute	Number of Centers	Training Areas
IIS Infotech Ltd	Operates through its 15 centers in Delhi, Hyderabad, Secunderabad and Ahemedabad. Has an alliance with ENPC, France, IIT Delhi, etc.	Trained more than 1.5 lakh professionals so far. Launched "Websity" course in 1998 teaching basics of Internet and multimedia technology, Web page designing, 2-D and 3-D animation, Web publishing, etc.
Lakhotia Computer Centre	Started in 1985, LCC has 500 centres across the country.	From the short term certificate courses to career-oriented programme (ADCS & MSE), the institute offers all sorts of infotech courses.
Pentafour	Pentafour communications Ltd has been providing high-end training in India for over a decade.	The firm specializes in training on AS/400, E-business, besides the client/server courses like Oracle 8, VB 6 and VC++. In Chennai, it offers training in SAP, Synon and multimedia.
NIIT Ltd	From its first centre in Mumbai in 1982 to 750 centers in 20 countries in 2002 over 1, 50,000 students on its rolls. NIIT's bench marked training is available at 2342 learning centers in 27 countries including China, Malaysia, the USA, Thailand, South Africa, and Zimbabwe. Global business intelligence and market research major, International Data Corporation (IDC), has rated NIIT among the Top 15 IT Training Leaders Worldwide.	The family of courses offered by the institute include a four-year omnibus GNIIT programme; SWIFT, short courses for professio-nals; CATS, high-end courses such as redevelopment courses for Y2K; and LEDA, multimedia courses for the whole family.
SSI	Software Services International offers IMPACT-a professional software course especially designed for college students. The curriculum has been designed by ISO 9001 certified SSI Global R&D division.	The professional software courses offered by the institute includes OLE, GUI and ODBC, among others topics. The institute also offers diploma in RDBMS and Trilogy 2000, which covers SQL Server from Microsoft, Advanced Visual Basic and Active Server Pages (ASPs) Web page development tool.
STG International Ltd	One of India's foremost training organisations in advanced software tools and development with over 100 training centers. It is Certified by Microsoft and Lotus for training.	Offers training in new emerging technologies like OOP and Java, Oracle, SQL Server, GUI tools like Visual Basic, Developer/2000 and Web-related technologies like HTML, Java Script, FrontPage, VRML, CGI and Perl, among others.
TULEC (Tata Infotech Ltd)	With over 180 centers in 60 countries, the company was the first educational establishment in India to receive ISO 9001 certification for "courseware design, development and conduct of career, professional and short term course in the Information Technology area."	The organization specialises in concept courses such as visual programming, database management systems, object oriented technology and Internet programming.

Characteristics of Non Formal Sector of Education in India

- Standards of teaching greatly vary from institution to institution, with only a few offering fairly good teaching.

- Generally provide skill – based courses.

- Lack of standardisation, experience.

- Unqualified/ untrained staff (from conventional sense).

- Less emphasis on conceptual aspects.

- Inability to provide in-depth courses.

- However, these institutions have strength in imparting knowledge as per the market demand,

- Some Institutions have contacts with prospective employers, infrastructure & capability to implement technology based education such as CBT & WBT.

- Wherewithal to produce instructional material in an appropriate format in a short time.

Requirement of IT Manpower

The workforce growth projections, as estimated by NASSCOM, indicate that the number of IT professionals required by 2008 will be 2.2 million *(http://www.mit.gov.in)*. Of this, 1.1 million will be required to have a formal degree in an IT-related discipline. This implies that the country must plan for producing 760,000 hardcore IT professionals from the formal stream in the coming years. In view of the large demand for Indian IT professionals in a number of countries – such as the United States, Japan, Germany and the United Kingdom – it is estimated that an additional 20% additional workforce will need to be generated to fulfil this demand. This brings the total requirement of IT professionals by 2008 to 912,000. The academic system i. e. formal sector, in the country is expected to add around 1.06 million graduates during this period (Table 5).

The Supply Side Dynamics of IT Manpower

Over the years, India has witnessed a constant increase in the supply of IT professionals. From around 6,800 employees during the year 1988-1989, the supply has increased to over 0.4 million in December 2000 (Heeks, 1998 and Deseai, 2000). Over 0.1 million professionals (of the total 0.4 million) are employed by the software and services export industry. On the supply side, NASSCOM estimates for the year 2000-2001 are at around 122,000 workers and in the subsequent year, around 140,000 workers. In terms of institutes that offer IT related courses, India has 6 IITs', 1 Indian Institute of Science and 4 IIITs'. Apart from these colleges, there are around 43 Regional Engineering Colleges (REC). However, in recent times, the number of colleges that offer courses such as Bachelor of Computer Applications (BCA), Master of Computer Applications (MCA), Bachelor of Sciences (B. Sc.) and Bachelor of Engineering/ Bachelor of Technology (B.E/ B.Tech) has increased. During the year 2000, there were nearly 2,900 colleges that offered IT-related courses in the country (Figure 3).

Period	Revenues (Rs Million)	Percentage Growth
1995-1996	4,581.0	37.9
1996-1997	6,623.0	44.5
1997-1998	9,121.0	37.7
1998-1999	13,330.0	46.1
1999-2000	17,520.0	31.0

Figure 3 : The Indian IT Training Market, 1995-2000

Source: NASSCOM

Table 5 : Requirement of IT Manpower

MANPOWER REQUIREMENTS SEGMENT-WISE FOR 2008			In Lakhs
SECTOR	SEGMENT	MIT STUDY	NASSCOM McKINSEY STUDY
HARD CORE IT	SOFTWARE PRODUCTS	2.00	
	IT SERVICES	5.77	11.00
	Total:	7.77	
IT ENABLED SERVICES SECTOR	E-BUSINESS	3.30	
	IT-ENABLED SERVICE	12.60	11.00
	Total:	15.90	
	TOTAL	23.67	22.00

Source: X Plan Study team of HRD – Ministry of Information Technology, India

IT MANPOWER PROJECTIONS - PROJECTIONS ON AVAILABILITY OF MANPOWER FOR 2008 TASK FORCE PROJECTIONS (FOR IT HARD CORE SECTOR)	
AVAILABILITY OF POST GRADUATES (INCLUDING MCA)	2.63 LAKHS
AVAILABILITY OF GRADUATES	7.85 LAKHS
IITs, IIITs, IISc	0.12 LAKHS
TOTAL AVAILABILITY (PG, MCA, UG)	10.60 LAKHS

ASSUMPTIONS:
50% from Electronics and 30% from other Engineering Disciplines migrate to IT.
Increase in intake/new courses 35,000 seats added during 2000-2001

... one of over-supply, when factors such as the following are

... Institutions

...ning Institutions

...d for IT skills due to Paradigm Shift in IT practices and ...he new technologies. The key change in the role of the IT ...ome the builder of the business. As distribution channels ...stems-dependent, products become digital and information

becomes the source of innovation and future value creation, the fixed fabric of e-business is IT. The demand for the kind of skills required has also undergone change, globally and continues to change, as has been shown in table 6. The table reveals that the demand for the Programmers/Engineers/Analysts/Computer Scientists is the highest in the software industry, taking 41% of the share of the total IT staff requirement.

Table 6 : IT Skills in Demand

Programmers/Engineers/Analysts/Computer Scientists	41%
Internet & E-Commerce Applications (Web Developers/Designer)	19%
Database Administrators/Developers	11%
Network Specialists/Developers/ Communication Engineers	14%
Digital Media & Technical Writing	5%
IT-Enabled Services	10%

Source: X Plan Study team of HRD – Ministry of Information Technology, India

The Much Needed Skill Sets

The demand for skill sets in the domestic industry during the short-term has always mirrored the trend in the overall information technology industry in the US and other markets. Consequently, in the mid 90s', courses focusing on ERP, database administration etc was much sought after. The dot com boom resulted in a drastic shift in demand to newer areas such as Internet, E-commerce technologies etc during the late 90s' and the early 2000. Subsequent to the dot Com crash, IT training majors have started to focus on a range of new platforms and technologies. Predominant amongst them is the Microsoft promoted .NET platform. Similarly, C# (C Sharp) is a new technology that is gaining prominence. The traditional courses such as C, C++, Unix, VC++, and Oracle, etc. staged a comeback. In terms of technologies, demand is strong in the areas of enterprise systems management, Linux, security and encryption.

The Internet-bubble burst has resulted in the demand for web-related courses falling out of favour in the current year, Internet programming and E-commerce courses focusing on web-designing, core java, scripting,
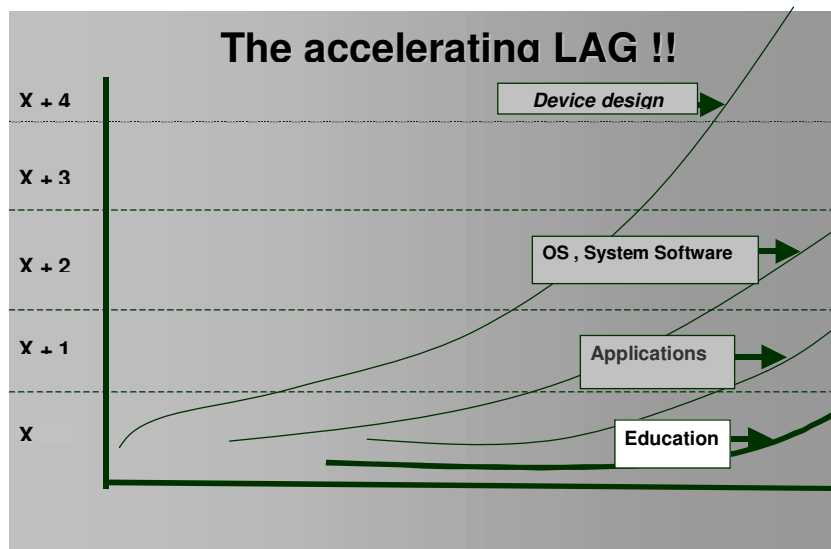
Figure 4: Lag between Demand and Supply of IT Manpower

E-commerce technologies, site server, WAP, XML etc are all witnessing reduced demand. Also, others such as Computer-Based Training (CBT) and those related to the areas of print and publishing, advertising, filmaking, games, virtual reality, entertainment, etc. are in demand.

The Formal relative to the Non Formal sector have not been able to revise their courses in line with the changing demand of IT skills which has resulted a further lag between the demand and supply of IT Professionals as shown in Figure 4.

Gap in Demand and Supply of IT Manpower

Issues in the Formal Sector
For various reasons like poor laboratory infrastructure, shortage of faculty, shortage of books, etc., the quality of technical education at a large number of institutions is poor. Therefore, while the combined output of these institutions at the B.Tech/MCA level is about 75,000 per year, only about 25,000 per year are of good quality and acceptable to the industry. Thus only about 2 lakh high level professionals will be groomed by 2008 against the demand of 7.6 lakhs if the current trend continues.

Issues in the Non Formal sector
Shortage of the Faculty

Due to large disparity in the salaries of IT professionals in acamedics and industry that prompts most IT professionals not to opt for a teaching career. This has lead to shortage of good faculty teaching IT programs.

Misleading Information to the Students

India's fly-by-night IT institutes have caused mayhem by making false promises to the students, by "guaranteeing placement" in India and overseas. The management institute pays little attention to student's complaints of inferior course content. And sometimes institutes disappeasr after collecting huge sum of money from the students. For instance, Case of Zap and Wintech have raised doubts in the minds of the students in general regarding the credibility of the private institutions.

Case of Zap and Infotech (*http://www.the-week.com*)

There have been instances where the police swung into action after receiving complaints from students and arrested three senior executives of the company and charged the institute's management with siphoning off the huge sums they had collected as fees from student. "Whatever little information we have gathered is just the tip of the iceberg. Our preliminary investigation indicates that a group of people had planned the entire episode to made a quick buck by duping the gullible student," said Kewal Singh, Deputy Commissioner of Police (West Delhi). The episode marked the beginning of the end of the IT dream of thousands of students of Zap Infotech across the national capital, and even in places like Mumbai and in some cities in Uttar Pradesh. "It's a big racket and the group have managed to extend their reach in different parts of the country in a short span of time," Singh, who is heading the team investigating Zap InfoTech, told IANS.

Interestingly, the vanishing act of Zap InfoTech came to light just a week after another private computer training company, Wintech Computers, went bust, leaving students and franchisees in the lurch. Zap and Wintech, which launched a countrywide chain of computer institutes supported by a massive advertising and promotion blitzkrieg that is estimated to have been worth Rs. 3-4 million, were both managed by the three brothers, Arif, Abbassi and Murtaza Mithani. The brothers are reported to have left the country soon after the first branch closed down. Between them the two firms franchised about 300 centers across India's major cities and a few in Dubai called WinZap. Sources say the dimensions of the scandal could be in excess of Rs. 2.5 billion, considering only current enrolment. Ironically, the Wintech/Zap episode is nothing new in India's non-formal education sector. Many cases of such wannabe institutes closing shop overnight have been reported from Delhi, Mumnbai, Bangalore and Hyderabad and some other cities.

The US Slowdown and the Ripple Effect

While the effect of the US slowdown is already evident by the various earnings warnings issued by the software services majors, the training industry was generally thought to be immune to this phenomenon. However, recent trends indicate that even this segment of the knowledge industry has not been spared. The demand for short-term courses, generally buoyant when compared to the long-term courses has declined by around 60.0 percent in terms of volumes already. Furthermore, revenues contributed by such courses are likely to witness a decline of nearly 30.0 percent for the current year. On the whole, recent estimates indicate that training majors barring a few are expected to witness a decline in revenues by around 15.0 percent to 30.0 percent during the current year *(www.scopemarketing.com, June 6, 2003).*

Acceptance by the Industry

The industry both nationally and internationally, prefer qualified professionals like MCA's and B.Tech's in IT from formal sector to students trained from private institutes.

Government Initiatives in IT Education

The possibility of not meeting the demand projections in future has made the government to start thinking. Consequently, the Ministry of Human Resource Development has decided to double the IT students' intake in the premier institutes such as the Indian Institute of Technology (IITs) and the Regional Engineering Colleges (RECs) by the year 2001-2002 and triple the same by the year 2003-2004. Budget 2001 saw the government conferring the status of IIT on the University of Rourkee and agreeing the need to allocate more funds to IIT Guwahati. Furthermore, 43 Regional Engineering Colleges (RECs) are likely to be upgraded during the course of the year. Also, 100% tax exemptions to contributions made to Engineering Colleges.

The educational loan scheme formulated by the Indian Banks Association during the year 2000-2001 proposed a simplification of the existing loan application and documentation procedures. Furthermore, it also recommended zero security for loans up to Rs 0.2 million. With minimum eligibility criteria of a first class degree, the scheme takes care of the quality issue. The scheme has proposed a loan amount of Rs 0.75 million for studies in India and Rs 1.5 million for studies abroad. This is against the existing levels of Rs 0.5 million for the former and Rs 1.0 million for the latter. In case of applications for loans up to Rs 0.2 million, the scheme has proposed 100 percent financing. In case of loans exceeding this limit, applicants will be required to provide 15.0 percent of the loan amount in case of domestic studies and 25.0 percent income in case of overseas studies. The proposed interest rate is the prime lending rate (PLR) + 1.0 percent for a loan amount exceeding Rs 0.2 million.

Also, the government has made plans to invest over Rs 27.0 billion by the year 2003 and triple the intake of students in IT-related departments in engineering colleges. This is part of the government's Operation knowledge project that aims to make the country a global reservoir of human talent by the year 2008. This World Bank funded project seeks to increase the intake of IT engineering students to over 0.2 million from the existing 70,000-odd levels. Furthermore, the project also aims at enhancing the facilities in these institutions and providing superior infrastructure such as a bandwidth of around 2.0 mbps.

CLASS 2000- "No" Computers To "Know" Computers

The government initiated the Computer Literacy and Studies in Schools (CLASS) project in the year 1984-1985. The program was initiated on account of the aid offered by BBC Microcomputers. Around 12,000 computers were distributed to secondary and senior secondary schools across the country. The project was modified and converted into a centrally sponsored scheme in 1993-94. The Information Technology Plan (1988) which make significnt provisions for integenating computers into the schooling process has been adopted by the Govt. As a consequence Ministry of Human Resource Development launched a new school computing programme class 2000 during the year 2000. Class 2000 has thefollowing three components:

1. Computer literacy in 10,000 schools.

2. Computer aided learning in 1,000 schools.

3. Computer based objective of this scheme is to enhance computer literacy in schools across the country *(www.ibe.unesco.org).*

The State Efforts

With IT emerging as a major growth driver, most of the state governments have taken initiatives to promote the same. The focus has largely been on one hand to promote the growth of the industry in general across the states and at the same time increase the literacy levels across schools and educational institutions in the states. Here again, the southern states of Tamil Nadu, Karnataka and Andhra Pradesh have taken the lead to formulate policies to encourage the growth of computer literacy levels.

● *Tamil Nadu- The Silent Revolutionary*

From the year 1999-2000 onwards, the state government of Tamil Nadu has decided to offer Computer Science as an elective subject in all government higher secondary schools in the state. The Tamil Nadu government has been the first to initiate a statewide movement to incorporate IT training as a part of the curriculum in all government run arts and science colleges from the academic year 2000-2001. Such a move had already been completed in the cases of all government run schools in the state. This new project estimated to cost around Rs 750.0 million, will enable students to choose IT-related subjects as elective subjects. Estimates indicate that over 150 colleges with an estimated 30,000 students will be covered under this program.

● *Gujarat- Showing the Way*

Gujarat is yet another state that has taken the initiative in encouraging IT education in the state. The government has made computer education a compulsory subject since the 7th standard and has also prescribed a detailed syllabus for each standard. Schools in the state have been permitted to collect additional fees of around Rs 50.0 per student. The hardware and the software are being supplied by the central government, while the recruitment of teachers continues to be the responsibility of the respective schools. Apart from such initiatives privately funded schools across various states have started to introduce computer education even from the elementary levels. Extra fees are charged from students opting for computer education. Furthermore, the Central Board for Secondary Education (CBSE) has introduced computer education as a part of the regular curriculum for students in the higher secondary classes. Also, some of the schools that have started Vocational Educational Programs (VEP) have incorporated computer education as a part of the 12th standard curriculum.

Efforts Made by Non Formal Sector

Market leaders including NIIT, Aptech and SSI have focused on creating greater brand equity and have leveraged their brand power to increase their student enrolments. Other strategies include rapid overseas expansions, strategic alliances with global majors thereby getting access to the latest technologies, curriculum etc and a steady transition to the software services segment. This transition has become imperative for majors to maintain above industry average growth rates and maintain their stock valuations.

● *Focus on Branding and Innovation By Market Leaders*

With a large number of players operating in the domestic market, it is crucial for majors to focus on branding. Indian majors have succeeded in branding and positioning their different programs across the populace. For instance, Aptech Ltd has spun off Arena Multimedia and Asset International from Aptech Ltd in order to differentiate its various brands. While Arena offers courses specializing in Multimedia-based design and creative courses, Asset focuses on software engineering career courses. Aptech on the other hand offers short-term certification courses. Aptech has also created its e-com@asset course in collaboration with IBM. Similarly, NIIT has also created its Swift, CATS and Futurz brands to differentiate its product offerings. SSI, the other major IT education provider in the country has also created its "Trilogy 2000" brand of courses. At the same time, majors have also started to realize the importance of training professionals in the area of business management and soft skills as well. Consequently, they have started to combine their IT education programs with their management programs as well. For instance, NIIT combines its SWIFT programs along with the management programs offered by NIS Sparta, a division of NIIT. Similarly, First Computers has created programs such as First Accountant, First Executive etc., that aims at this strategy. In the future, creation of prominent brands will enable majors to differentiate themselves from the run-of-the mill players and increase their market presence.

- *Software Services- The Greener Side of the Valley*

  With better margins and greater stock valuations enjoyed by software companies, more and more training majors have started to focus on this segment too. For instance, both the NIIT and teh Aptech have increasingly started to focus on their software services divisions. This shift in business model is occurring largely on account of the synergies possible between the training and software development segments. The training division offers a ready made in-house manpower base for the software development division.

- *Strategic Alliances- A Key Imperative For Success*

  With most of the software products and packages, operating systems, etc., being developed abroad, it becomes imperative to form alliances to procure the same. Furthermore, in order to facilitate the knowledge transfer of the same, alliances are highly required. Access to the latest technologies both in terms of courseware and in terms of delivery medium is highly crucial to succeed in this business. Also, this provides them with the option of expanding their business vistas abroad. Already most of the Indian majors including NIIT, Aptech, SSI and others have alliances with global leaders such as Microsoft, Oracle, Cisco, Novell, IBM, etc. In future, such alliances will increasingly become the norm in the industry.

- *Increasing Focus On Distance Education*

  While private institutions have witnessed a constant rise in their enrolments during the past, there still seems to be certain reservations about recruiting graduates from such institutes. Companies typically prefer engineering professionals or MCAs vis-à-vis graduates from private IT training institutes. Even IT training majors such as NIIT, Aptech, etc., have a large share of engineers as a part of their human capital. This has resulted in a situation where both domestic and international companies prefer graduates from the IITs, RECs and the IIMs. This in turn has resulted in training majors increasingly forming alliances with recognized universities and offering integrated IT programs.

  In addition, the likes of NIIT, Aptech, SSI, etc., despite their widespread presence are unable to reach a wider audience. This has thus enhanced the potential for distance education programs that offer the dual advantage of a recognized university degree coupled with a computer education degree.

(Volumes in Rs. Million)

Year	Software Services Revenues	IT Training Revenues
1995-1996	41,900.0	4,581.0
1996-1997	63,100.0	6,623.0
1997-1998	100,400.0	9,121.0
1998-1999	158,900.0	13,330.0
1999-2000	243,500.0	17,520.0

Figure 5 : Software Services & Education Segment – A Comparison

Source: **NASSCOM**

Suggested Mechanism for Streamlining IT Education

In order to streamline IT education in India both formal and non-formal sectors hve to work in uniform to meet the challenges of growing demand of the IT industry. The following measures have been suggested for the same.

Faculty Development
- There is a need for periodic faculty appraisal/ certification/ upgradation of the IT faculty in formal as well as non-formal sector of education/training.

- Instructor enhancement programme' for training faculty under project impact needs to be scaled-up as a national programme. Institutes specifically dedicated for the training of teachers 'in the field of IT' may be set up in different regions of the country.

- There is a need to train IT faculty in the application specific thrust areas as identified. Category-I institutions may conduct faculty enrichment programmes for the benefit of category-II and category-III institutions.

- Training the Teacher's programme 'of the DOEACC society' needs to be strengthened and made mandatory.

Enhancing the Quality and Content of the Courses

- A need for more emphasis on software quality control, software process engineering, software project management and software system life cycle.

- A need to identify course module by the IT industry for which course content may be created by experienced teachers.

- Need to initiate application oriented bridge courses for immediate employability in promising areas such as GIS, network security, embedded systems, VLSI designs, fibre optics communication, networking, data mining, digital signature verification, etc., to mention a few.

- Need for special attention for development of life skills for IT professionals.

- Need to introduce courses for IT professionals for development of skills in technical report preparation/translation by the institutions teaching foreign languages.

- Need to develop specialised manpower in the area of security (certified manpower for information security area (CISA)).

Fiscal/Government Initatives

- Government procedures may be made flexible for enabling teaching faculty for working with private enterprises in software technology.

- Industrial houses to be given appropriate fiscal benefits for:

  – instituting chairs in educational institutions;

  – funding research in educational institutions;

  – offering scholarships in educational institutions;

  – upgrading facilities in educational institutions; and

  – committing to hiring a certain number of engineering graduates for a specified duration.

- Accreditation need to set up a nodal body to check the credentials of the computer training institutes in the non-formal /private sector and oversee their working periodically.

- Need to define a well laid down criteria on the lines of DOEACC scheme in terms of academic curriculum, infrastructure, teaching faculty and methodology for the institutions in the private/non-formal sector to prevent mushrooming of ill-equipped IT training institutes which do not impart quality education.

- Need to devise a system of certification or rating of the institutions in the private sector on the lines of aicte, upgradations of private engineering colleges.

- Need for evolving standards, practices and certification mechanism for recognition/accreditation of on-line training courses.

- DOEACC society should attempt to get wide acceptance of their qualifications by well known/large industrial houses for its students to enhance their employability prospects in the private sector.

- The accreditation mechanism for IT education may be strengthened, by among other things by way of decentralizing the power of the AICTE to the states.

Student welfare
- Need for educating students and public at large through print media about the aspects students have to look into before enroling in a training institute.

- Need to enforce a system in institutions in the non-formal sector whereby they can charge fees on monthly/quarterly basis rather on an annual or one time basis as a safeguard to prevent monetary loss to students in the event of institutions closing abruptly

Industry-academic interaction
- Need to set up a core group/committee from industry and educational institutions to assess the future skills required and suitably design and training programmes relevant to the needs of the industry.

- The core group will also assess IT manpower requirements on regular basis.

- Promote govt.-industry-academic linkages by supporting research and development of courseware engineering, instructional design, pedagogical issues, development of courseware, etc., aimed at continuing education/ skill updation at industry.

- Commitments from industrial houses to adopt educational labs/institutes needs to be encouraged.

- IPR sharing between industry and academic institutes may be encouraged.

- A national center for continuing education for the working professionals/engineers as a scaled up version of the continuing engineering education programme (CEEP) under project impact needs to be set up.

Basic and fundamental research
- Need for setting up of schools of advanced studies and special research groups in emerging areas.

- Need to promote/support open ended research including basic/fundamental research in frontier areas of IT with long-term benefits in view, in institutes of higher learning/R&D institutions like Tata Institte of Fundamental Research (TIFR), Indian Institute Technology (IITs),Indian Institute of Science (IISc) etc.

- Need to encourage research activities in frontier subject areas like robust software, human computer interface, evolutionary systems, quantum computing, bio-elements for computing, molecular computing, knowledge discovery, high-end computing, etc.

- Research chairs may be supported in higher learning institutions jointly with the industry.

Conclusion
The rapid growth of private teaching initiatives reflects inadequacies of the public educational system to the needs of the emerging IT environment, especially considering the high prices charged by private training institutes. The private sector is also suffering from inadequacies of shortage of good faculty, misleading information to the students, high prices charged from the students, etc. This requires the government to play a major role in regulating both the formal and non formal sector. Also, it would require both formal and Non Formal Sector to work in tandem with each other.

Further, there have been several private initiatives in the country to offer engineering education in general and IT education in particular, the IT industry has not taken adequate interest in the task. The IT industry is, by and large, assuming that educational system will fulfill its requirements and that the industry would be able to supplement the needs for upgrading skills of output from educational system by providing in-house training. However, there is an urgent need for the industry to play a much more direct role in IT education. One of the areas of serious concern is the large disparity in the salaries of IT professionals in academics and industry that prompts most IT professionals to not opt for a teaching career. If this problem is not addressed on priority, it will affect the quality of graduates being produced by the educational system. This, in turn, will affect the quality of products and services developed by the IT industry and will have an impact on their business in the long run. The industry

has, to start recognizing these issues. There have been recent attempts to forge much closer linkages between the industry and academic institutions, though at present it is confined to a smaller number of highly reputed institutions in the country. In view of mutual needs and benefits, it is expected that these linkages will spread widely and all IT education institutions would develop direct linkages with the industry to strengthen quality of their education on the one hand and to fulfill the industry's needs on the other.

References

Business Week (2001) India 3.0: Its Software Outfits Take on the World, February 26, p.44-46.

Desai, Ashok V. (2000) The Peril and the Promise: Broader Implications of the Indian Presence in Information Technologies, Working Paper, August, CREDPR, Stanford.

Heeks, Richard (1998) The Uneven Profile of India's Software Exports, IDPM Working Paper No. 3, October, University of Manchester.

Prahalad, C. K. and Stuart L. Hart (2002) The Fortune at the Bottom of the Pyramid.

Report on Indian Software Industry (2001) Scope Marketing & Information Solutions Private Limited, Chennai, India, October, can also be accessed by www.scopemarketing.com June 6, 2003.

Strategic Review (2001) The IT Software and Services Industry in India "NASSCOM".

Annual Report (2001) X Plan Study team of HRD – Ministry of Information Technology, Government of India, India.

Websites

http://www.doeacc.org.in accessed on May 30, 2003.

http://www.aicte.com, accessed on April15, 2003.

http://www.ncert.nic.in/itedu.htm, accessed on April 5, 2003.

http://www.ibe.unesco.org/National/China/New China pdf/11india.pdf, accessed on May 30, 2003.

http://www.mit.gov.in/itconf/IT%20Education%20in%20Schools.htm, accessed on June 5, 2003.

http://www.niit.com/niit/ContentAdmin/NWS/NWSPR/NWSPR4/12.htm, accessed on May 30, 2003.

http://www.the-week.com/21jun24/events1.htm, accessed on June 5, 2003.

http://www.unescap.org/itid/publication/chap5a_2138.pdf, accessed on June 7, 2003.