Opportunities for Capitalizing on the Software Development Industry Growth through Appropriate Manpower Training

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Abstract

Worldwide, software industry has witnessed unprecedented growth during the last decade and the trend is expected to remain so during the next few decades. Since manpower in Asia possess the key ingredients required for the software industry there was a significant shift of the industry from USA and Europe to Asia during the 90s. Based on the industry survey conducted in Sri Lanka, the main factors stifling the growth were identified as, the scarcity of suitably trained manpower and information infrastructure facilities. However, Sri Lanka possesses a large pool of trainable educated youth and a privatised telecommunication sector, which can provide the necessary infrastructure facilities in a short time. The education and training providers lag far behind meeting the manpower needs of the industry. Shortage of trainers is the main impediment for development of manpower. In the short term, India would be an ideal source of obtaining trainers. The article 'Growth prospects for the software industry in Sri Lanka and an appropriate policy frame work' by the same authors discusses in greater detail the measures to meet the manpower and other needs of the software industry in Sri Lanka.

Introduction

Information Technology (IT), which has evolved from the merger of computer, telecommunication and office automation technologies, is one of the most rapidly growing industries in the world (Choudhury, 1997). It is acknowledged worldwide, for the above trend to remain so over the next few decades. IT industry's growth related needs can be segmented into three distinct spheres: hardware, software and education & training (Infoline, 2000).

The last two decades have witnessed unprecedented advancements in almost all spheres related to IT. Technological developments related to hardware, particularly, the advent of cheap and powerful Personal Computers, the introduction of Internet to the business world, rapid advancements of telecommunication technology, enhancements of multimedia technology and a number of other factors have contributed to a drastic reduction of costs involved and made feasible the use of IT for almost any activity. This has resulted in an increased dependence on IT and a dramatic increase of the demand for IT from both business and domestic spheres in the developed countries. It has also transformed the ways in which many activities, particularly, the business transactions are carried out. Therefore, it is increasingly difficult for developing countries to make transactions or to compete with the developed countries without embracing the advancements of IT. Most developing countries have therefore announced very ambitious programmes to develop the IT sector. All these factors have compounded the growth and today IT is the fastest growing sector worldwide. The global market for software is expected to grow at rates exceeding 14% annually, while some sub sector categories are expected to grow

even at faster rates of around 20%. Over the 1990 to 1996 period, the software sector of the USA recorded a growth rate of 12.5%, which was 2.5 times the growth rate of the overall US economy (Jaber, 1999).

Software is a vital ingredient of all activities related to IT and forms a major segment of the vast IT industry. Being by and large a service industry, software development is very much manpower intensive (Infoline, 2000). Thus, factors such as competence and skill levels, availability, cost, productivity, turnover and work attitudes of manpower are vital for success of any software development industry (Hashim, 1999). Candidates with good numerate skills and a working knowledge in English are easily trainable in software development. Both hardware and software technologies are advancing at very rapid rates. Therefore skills of the existing manpower too have to be upgraded almost every 18 months (IDA, 2000). Worldwide, the expenditure on software and related services have witnessed a sharp increase and stood in the range of 2% to 7% of total revenue in 1999 (Infoline, 2000). These reasons in turn have caused huge demands on the software development manpower and made the availability of manpower extremely scarce (Hashim, 1999).

Trends of Manpower Requirements

USA has been the driving force behind the strong growth in the software market (Currie, 2000) and in 1996 it employed over 600,000 professionals in the software industry (Infoline, 2000). To meet the skill supply shortfall in 1997-98, about 150,000 Indian software professionals were employed in the USA. Initially, India was mainly engaged in body shopping and onsite contracts. Body shopping is placing programmers at establishments in the client country where Indian companies merely acted as placement agencies. In onsite contracts, though responsibility of development was at the hands of Indian companies, the developments were done at client sites. Visa restrictions and the need to pay the programmers global rates, increasingly threatened both body shopping and onsite contracting. This resulted in a gradual increase of the offshore share, and in India the percentage of offshore services increased from 5% in 1992 to 42% in 1999; while onsite services decreased from 95% in 1992 to 58% in 1999 and the trend is continuing (Nasscom, 2000).

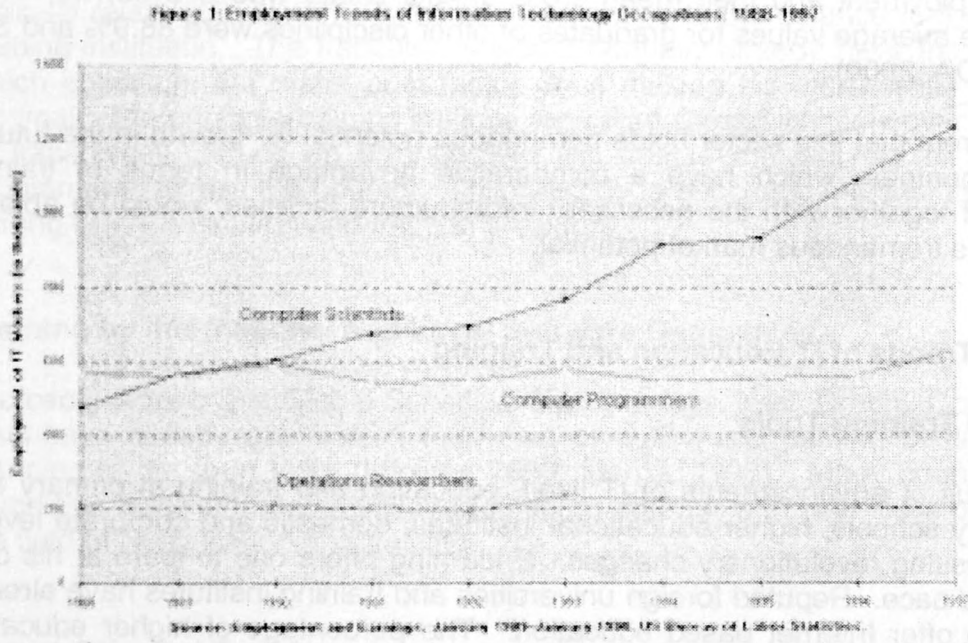
Since 1980s most analysts were predicting a rapid growth of demand for software manpower and Indian policy makers were wise to initiate large-scale training programmes. This left India with a substantial IT workforce and helped it to be competitive to make use of most of the opportunities that were available.

However, with the growing demand for personnel now emanating not only from the USA but also from countries such as Germany, Australia, New Zealand, the United Kingdom and even Japan, the availability of such personnel in India has suddenly dried up. Though there were predictions that the demand for manpower would taper off once the year 2000 bug and Euro conversions were completed by about the year 2002, it has now been proven otherwise. New demand areas such as web based e-commerce type of interactive services, networking, IT enabled services (remote processing) and animations have emerged and are likely to place the demand even at higher levels (Nasscom 2000). The global outsourcing market at present, is growing at a compound annual growth rate (CAGR) of about 20.1% (Currie, 2000: 238-254). In 1998 the capacity of low wage countries to absorb US offshore outsourcing was only 30%

(Rubin, 1998). In 1998, 350,000 vacancies in the IT sector remained unfilled in the USA (Lockwood, 1999; 251-256, ITDS, 2000). Looking at the most recent moves of the developed countries to attract IT professionals; the shortage of IT personnel does not seem to have eased much since 1998. To meet the national shortage of IT personnel, the German government has decided to issue 20,000 work permits to skilled personnel from outside the EU (Emerald, 2000). The USA has enhanced the quota of nonimmigrant H-1B specialist occupation visas by 195,000 for FY 2000 through 2002 to provide relief for the unprecedented demand for high-skilled, technically proficient workers in the US high-tech industry (SIIA, 2000-a). All the above factors indicate a severe scarcity of IT personnel in the developed countries, and therefore, the trend for international companies to move towards low cost regions will continue, provided that the most vital ingredient the trained manpower and infrastructure requirements are available.

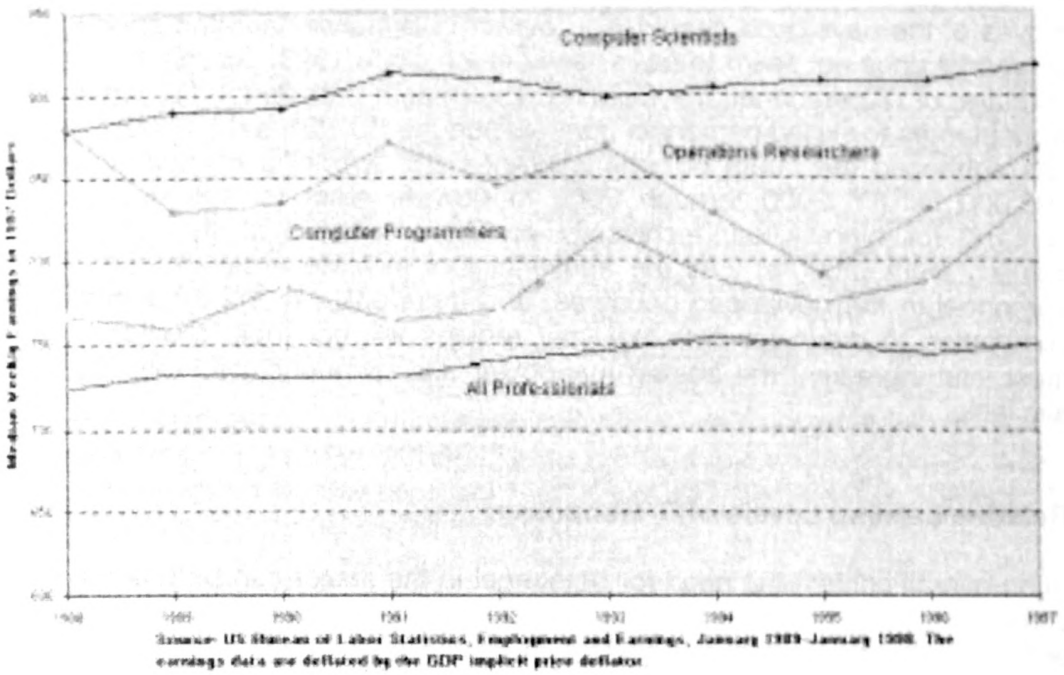
Relative Earning Levels of IT Manpower.

In an overall context the need for personnel in the sector can be broken down to computer scientists (top level) and the computer programmers (lower level). The employment trends of these sectors in the USA are shown in Figure 1. The demand for programmers in the USA has remained relatively stagnant due to companies shifting from bringing these personnel into USA to opening up operations in their home countries.



In terms of those entering the information technology sector, the prospects for earnings and career enhancement are second to none. All personnel with the requisite skill and experience earn higher wages than those in other sectors. The average earnings of all professionals are compared to those in the information technology sector in Figure 2. The graph illustrates clearly the premium obtained by these IT professionals.

Figure 2: Real Median Weekly Earnings of Workers in Information Technology Occupations: 1988-1997



Source: US Bureau of Labor Statistics, Employment and Earnings, January 1989-January 1998. The earnings data are deflated by the GDP implicit price deflator.

In the USA the average annual earnings per person engaged in the software sector in 1995 was US$ 57,319, compared against the overall economy average of US$ 27,855 (Infoline, 2000). In Singapore in 1999, 100% of IT graduates found employment and their mean gross annual salary was S $ 33,740. The respective average values for graduates of other disciplines were 88.9% and S $ 27,359 (IDA, 2000).

It is apparent that this sector holds tremendous potential for growth in the future. Those countries, which have a comparative advantage in terms of trained personnel together with the necessary infrastructure facilities, would be able to exploit this tremendous market potential.

Current Trends of IT Education and Training

IT Based Training Tools

As a result of advancements of IT itself, education and training at primary and secondary schools, higher educational institutes, domestic and corporate levels, are witnessing revolutionary changes. E-learning offers one to learn at his own place and pace. Reputed foreign universities and training institutes have already begun to offer Internet based education. The percentage of higher education institutes in USA attempting to meet their needs by offering courses over Internet and Intranets grew from 22% in 1995 to approximately 66% in 1998 (SIIA, 2000b). In the USA, Internet and Intranet-based training market is expected to reach US $ 4 billion and US $ 11.4 billion by years 2002 and 2003 respectively (SIIA, 2000-b). In 2001 utilization of web-based and computer based training is expected to overtake IT related classroom training in Singapore (Infocomm, 2000).

Alliances

Many national universities in India have alliances with one or more of large multinational organizations and foreign universities such as Microsoft, IBM, AT&T, Parametric Technology, SAP and Sybase Technology Education (Infoline, 2000). Many educational and training institutes have found this to be an effective way of keeping pace with rapid developments and offering programs to cater to the ever-changing needs. Therefore, most of the relevant departments of universities and institutes in many developing countries have entered or are in the process of entering in to strategic alliances and affiliations with appropriate international companies and educational institutions. Such alliances enable local institutions to keep abreast with the latest state of the art technology, offer their certified courses, obtain assistance in training the trainers, curriculum development, procure software on complimentary basis or at discounted rates and so on.

Franchising

The reasons given above make the franchisee model extremely appropriate for IT training. Here the principle training institution develops curriculum, training methodology, course materials, teaching aids, instructor guide lines and also does advertising and creating a brand image. Principle training institution in addition to using above in its own training centres provides the entire package to franchisees. Franchisees have to bear the costs of training centre premises, hardware, software, communication facilities and instructors. The franchisees typically retain 60% to 80% of the revenue and give the balance to the principle training institution. The franchisees would normally already have the premises, which constitute the major cost factor, thus making his incremental expenses minimal. The principle-training institute too could spread its costs over a number of franchisees. Such an arrangement will enable the delivery of consistent programmes across the country. This practice is becoming increasingly popular among the IT education and training providers.

Training by International and Local Software Companies

Microsoft, Novell, IBM Global Services, Cisco, Unisys, Intel, Oracle, Compaq and SAP have already established their own or authorized training centres or are planning to do so in India (Infoline, 2000; Mehta, 1998). Many countries have found this to be an effective way of keeping abreast with new developments in the field of IT education and training.

Career Oriented Training

Most of the successful education and training providers maintain strong links with the industry to make their programmes career oriented. Such links enable them to benefit by way of obtaining a feedback of the current industry needs, as well as opportunities for training placements and employment for participants on completion of the courses.

To participate successfully in the implementation of company wise IT projects, both technical and business management backgrounds are necessary (Stam,

1999: 375-387). Therefore, many analysts argue the desirability of incorporating subjects related to management along with an industry placement to enrich the overall curriculum of IT courses (Klass, 1999: 117-123, Stam et al., 1999: 375-387, Munasinghe & Jayawardene, 2000: Goonatilake et al., 1998: 219-225).

Public-Private Sector Partnership

The public and private sector shared computer centre model, is being used in some parts of India to maximize the benefit of the limited resources available. With this model, initial costs for the centre, normally set up at a government school, are borne by the government and maintenance and upgrading is the responsibility of the private sector partner. In return for the part played by the private sector partner, the centre is made available for private sector training programmes after normal school hours. IT advances so rapidly and as a result both hardware and software need frequent upgrading. This model relieves the government of allocation of funds to upgrade the hardware and software, of which burden is taken by the private sector partner. It is also desirable to make the maximum use of the facilities before it become outdated. This arrangement therefore maximizes the net capacity to train manpower and is mutually beneficial.

Rating Education and Training Providers

Many countries practice a system of rating education and training providers of all disciplines to create a competitive environment, and thereby raise the standards. Rating is normally based on factors such as: waiting time for employment, level of entry for employment, starting salary levels, number enrolled, number successfully completed, research and development activities, links with industry, consultancy services provided to the industry, revenue generated through consultancy services, training provided to the industry etc. Often government funding for the institutes are based on the performance measured on such criteria.

Opportunities for Sri Lanka

When compared with achievements of neighbouring India, it is evident that Sri Lanka has failed to make the best use of the opportunities that were available during the last two decades in the software exports sector. However, as indicated elsewhere, manpower requirements grew so rapidly and other low wage countries have also not been able to cope with the demand. Therefore, the opportunities for Sri Lanka are still very much alive. With unemployment among graduates and highly educated youth at a relatively high rate, the software development industry offers Sri Lanka tremendous potential and perhaps the only opportunity to offer them high wage employment. With the vast potential for software exports, it could also make a major contribution to ease the unfavourable balance of payment situation. This is because software development and services is the only industry where:

a. Educated youth could be absorbed in large numbers. Every year over 50,000 youth that qualify to enter Universities fail to get a placement (CDN, 2000-b). This would be a good base to select, those who possess good

mathematical and logical skills and a reasonably good knowledge in English. They would be ideal candidates to undergo training in software development.

b. Industry could be located anywhere in the country. Present advancements in information and telecommunication technology have resulted in a drastic reduction of time and distance and made transportation of software & communication extremely cheap, efficient & reliable. (Jaber, 1999).

c. Capital investment is relatively low. Software industry being essentially manpower and skill intensive, the up front cost is minimal and capital requirements for a small timer would be least, if communication facilities are available (Mehta, 1998).

d. Huge potential to earn foreign exchange. The major costs being that of labour, value addition is very high. Therefore, net foreign exchange earned through exports would be very high (MSPL, 1998).

e. Very attractive gross margin rates, in many cases as high as 80 to 90% (ITDS, 2000; Jaber, 1999).

f. There is almost no damage to the environment. Like in many other industries vast sums of money need not be spent to prevent damage to the environment.

Thus the potential for software development industry in Sri Lanka cannot be overemphasised. However, many countries in the region have realised the potential available and have launched programmes to achieve very ambitious growth rates.

Manpower needs assessment

The Department of Industrial Management of the University of Kelaniya conducted a survey on manpower needs of IT industry, in August 2000, on behalf of the Science and Technology Personnel Development Project, funded by the Asian Development Bank. This was also followed up in May 2001 by the same department with a view to enlarge the sample coverage. The findings given below are based on both these surveys.

In order to assess the manpower and other needs of the industry, a questionnaire was formulated and sent to organizations identified as software development houses. The total sample size was seventy. A vast majority of these enterprises were registered with Board of Investment (BOI). The breakdown of the sample is given in Table 1.

Surveys were carried out on enterprises located in the Western Province only, since those located elsewhere were insignificant.

The questionnaire was designed mainly to identify the following.

(a) Manpower requirements for specific areas of skills, for the period 2001 to 2005.

(b) Requirements of qualifications and experience for different job titles

(c) Main obstacles for the growth of the software industry.

As could be expected for a mail survey the direct response was around 25%. In addition, discussions were held with a number of CEOs of non-respondent organizations and verified their requirements for the future. These responses were in line with those who replied the questionnaire and hence served to reinforce the results. The breakdown of the responded enterprises is given in Table 1.

Table 1- Breakdown of the Sample

Size – based on number of employees at full capacity	No of Enterprises	No. Responded
Small (less than 20)	3	2
Medium (20 to 100)	46	10
Large (above 100)	21	6

Results & Analysis

a. Human resource requirements

The forecasted demand by skill area of average number of personnel per enterprise is given in Table 2. Since, the technology and development tools are evolving very fast, enterprises were reluctant to forecast numbers for specific computer languages far into the future. But, they emphasized on the demand for personnel with the appropriate tools applicable in their environment.

Table 2: Forecasted Demand for Personnel per Enterprise by Skill Area

Skill area	Average no. of personnel per responded enterprise											
	2001			2002			2003			2004		
	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
Operating Systems / Network Admin / Data Communication	0	3	5	1	4	11	-	5	11	-	5	11
Analysis / Design	2	5	12	3	15	14	3	20	45	3	15	54
Development	10	30	77	15	50	176	20	59	223	20	50	304
Quality Assurance	-	-	12	-	10	21	-	12	42	-	20	51

The most widely used development tools are given below.

- Visual Basic
- C++ / Visual C++
- Oracle™ / Developer 2000™ / Designer 2000™
- Informix™
- Delphi
- Java
- Corba
- Paradox
- Power Builder
- Access

b. Required qualifications

The preferred minimum qualification and experience for job categories in the industry is given in Table 3.

While a Masters degree is a prerequisite for a career in the field of IT consulting, the basic requirement in all other fields would a bachelors degree. In the case of programming even a diploma would suffice with some industry exposure.

Table 3: Requirements of Qualifications and Experience by Job Category.

Job Title	Minimum		Maximum	
	Qualification	Experience (years)	Qualification	Experience (years)
Project Managers	BSc	3	MSc	5
Systems Analysts	Higher Diploma	3	MSc	3
Network Managers	BSc	3	MSc	3
Programmers	Diploma	2	MSc	2
Quality Assurance	BSc	1	MSc	2
Consulting	MSc	5	-	-
Implementing Executives	BSc	2	-	-

c. Obstacles faced

It was the opinion of those surveyed that the biggest hindrance to the expansion of the IT sector is the lack of sufficiently trained personnel (See Table 4 for the ranking).

As seen by the demand forecast and the present number of trained personnel coming out of the universities and other institutes, there exists an urgent need for the government to address this issue as a priority.

The other main concern was the absence of a reliable telecommunication infrastructure. As a result there is a tendency to locate IT industries within major urban areas, where the telecommunication infrastructure is considered better. Development of these facilities would enable these organisations to be more productive, reduce costs in terms of rentals by locating industries in outstations and also enable them to provide employment to a large number of youth in these areas.

Table 4: Ranking of obstacles

Obstacle	Rank
Lack of Trained IT Personnel	1
Inadequate Infrastructure Facilities (i.e. telecommunications)	2
Bureaucratic Delays by Government Agencies	3
Inadequate Incentives	4
Lack of Finances	5

d. Government incentives

The Government has identified IT as one of the main thrust areas for investment purposes, and given all encouragement to the private sector to invest in this sector by providing attractive incentives. But one of the main drawbacks facing the expansion of this sector in Sri Lanka has been the lack of trained personnel in this area. Local companies are finding it difficult to convince foreign companies to locate their offices in the country, since foreign companies are of the opinion that the country lacks the requisite number of trained personnel.

The Government has also recognised the problem of acute shortage of manpower and is addressing this issue by providing incentives to local and foreign companies to train personnel in the required areas. Some of these are:

1. Tax holiday of 5 to 8 years (depending on the percentage of exports)
2. Duty free import of equipment

There is no minimum investment limit to qualify for incentives. The only criterion is that the company employs a minimum of 25 technical personnel within two years of commencement of the project.

The incentives are just bearing fruit with companies in India, such as the TATA group, NIIT and APTECH opening up joint ventures locally. However, these companies at least initially would be training personnel at the lower end of the market. The demand for trained personnel with specialised training at the graduate and undergraduate level will remain high, and not matched by the supply considering the current output of such personnel coming out of the universities.

In a recent proclamation, the Government announced that the year 2001 be declared as the year of information technology and it would invest Rs. 1 billion to provide computing facilities to schools and universities (CDN, 2000-a).

BOI approved software development enterprises

Out of the 74 enterprises approved to commence operations under the Board of Investment (BOI), 54 have collaborators from 16 different countries. The range of countries amply proves the interest shown by investors worldwide. Table 5 shows the current status of the IT related projects approved by the BOI.

Table 5: Current Status of Projects Approved by the BOI

Status	Number
Under Construction	12
Commercial Operation	32
Awaiting Construction	5
Closed	2
Awaiting Agreement	23

Source: Board of Investment, Sri Lanka 2000

Issues Related to Manpower Development

Types of Education & Training Courses

IT education and training courses available can be divided in to two main categories.

a. Courses targeted at users of software packages: - Such courses at "literacy level" cover fundamentals of computers and most widely used application packages such as word processing and spreadsheets. There are also user-oriented courses at a higher level to give training on using a specific software package. These are targeted at professionals who intend using a specific software package to carryout their functional activities such as accounting, designing, management and stock control.

b. Courses leading to a career or upgrading a career in IT: - These are at a number of different levels and categories. Diploma or degree courses giving a comprehensive training in all aspects in IT, training programmes on proprietary software packages such as SAP™ and Oracle™ to professionals, courses targeted at technology or skills upgrading such as computer aided software engineering (CASE), adoption of graphical user interfaces (GUIs), training on programming languages such as Java, Visual Basic, C++, Power Builder, courses leading to a career in a niche area such as web page designing and multi-media designing.

Education and Training Providers

At present, education and training to enhance the manpower base of IT in Sri Lanka are provided by a number of different types of institutions. Contributions from these different institutes are vital to develop a vibrant IT sector, where software development industry is the major sub-sector. The types of institutions providing training are:

a. Universities and public institutes.

b. Private institutes offering degree and other types of courses.

c. Schools.

Different bodies govern the activities of the above three types of institutions.

Universities and Public Institutes

At present the government funds all universities and public institutes in Sri Lanka. These institutions are expected to play the most important role in giving leadership and setting national standards for the growth of education and training on IT.

Table 6: Annual Intake for IT/CS Courses by Institutes

University/ Institute	Annual intake								
	Diploma / Higher Diploma or IT/CS as a subject for a Degree			B.Sc (IT/CS)			PGD/MSc (IT/CS)		
	2001	2002	2003	2001	2002	2003	2001	2002	2003
Colombo Uni.	150	150	150	50	50	50	200	200	200
Eastern Uni.	Nil	Nil	Nil	30	30	30	Nil	Nil	Nil
Kelaniya Uni.	170	120	240*	Nil	50	100*	40	120	120
Moratuwa Uni.	Nil	Nil	Nil	100	200	200	Nil	Nil	Nil
Peradeniya Uni.	100	100	100	30	50	50	Nil	Nil	Nil
OUSL	20	20	20	8**	8**	8**	Nil	Nil	Nil
Rajarata Uni.	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Ruhuna Uni.	60	120*	100	Nil	Nil	Nil	Nil	Nil	Nil
Sabaragamuwa	10	10	10	Nil	Nil	Nil	Nil	Nil	Nil
SJP Uni.	40*	20	20	Nil	Nil	Nil	Nil	Nil	Nil
Wayamba Uni.	25	60*	100	Nil	Nil	Nil	Nil	Nil	Nil
South Eastern Uni.	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
SLIIT	500♣	1000♣	1000♣				Nil	Nil	Nil
NIBM	550	550	550	90	90	90	Nil	Nil	Nil

IIT	Nil	Nil	Nil	Nil	Nil	Nil	55	55	55
IICS	Nil	Nil	Nil	120	120	120	Nil	Nil	Nil
IDM	40	40	40	40	40	40	Nil	Nil	Nil
ITS				40	40	40			
Other	50	50	50	15	15	15	Nil	Nil	Nil
Total	1715	2240	2380	523	693	743	345	425	425

♣ Proportion of them will continue to obtain BSc (CS) Degree

* Double Batches

** Average number completing the degree

Universities, which have the most number of well-qualified faculty, equipment, and infrastructure facilities no other institute can match, combined with patronage of the government and hence access to funding from international agencies and more importantly client acceptance. For example, the Institute of Computer Technology (ICT) of the University of Colombo has received funds in excess of 3 billion Sri Lankan Rupees since its inception, from the government and foreign funding agencies. However the contribution made by the universities in comparison to the available resources is insufficient. This may be due to factors such as insufficient flexibility of the system, ineffective leadership that has failed to motivate the academics, the uncertainty prevailing in the system, the negative attitudes of staff and students and other negative issues such as student unrest.

Private Institutes Offering Degree & other Courses

Private sector institutes play an important role in IT education and training. Though few in number, institutes, which offer career oriented degrees and other courses (especially those in collaboration with foreign universities), are making a significant contribution towards the development of IT manpower. IT is acknowledged worldwide as the most rapidly changing sector and education or training programs demand quick response to be most effective. Compared to government sector universities and institutes the private sector institutes with their inherent advantages such as flexibility and independence, have the capacity to quickly respond to changes.

There are also a large number of private institutes scattered all over the country which offer user oriented literacy level courses. These are of varying standards and lack up to date curriculum, teaching material, hardware, software and suitable trainers. Unfortunately instead of considering the presence of such large numbers of entrepreneurs, as a strength and supporting them to overcome their weaknesses, they are often vehemently condemned at many forums for exploiting the demand for IT training by offering sub-standard courses. Promoting a franchisee model could be an ideal way of developing them. One or more private institutes or universities having links with foreign institute could act as the principle-training provider. National examinations in computing at different levels can be used as a mechanism to have a uniform standard in the private sector computer training. These examinations may be conducted in liaison with foreign partners, as the syllabi have to be updated regularly. It is desirable if updated course material and guidelines for instructors too could be provided to assist these institutes upgrade their overall capacity. Availability of a national

examination for the students to evaluate themselves and obtain a national certificate would also help to raise the standards of the private institutes.

Schools & Regional Learning Centres

Secondary and primary education in Sri Lanka is largely dominated by the state. Computers are not available at a great majority of these schools, while in a majority of rural schools, even electricity supply is not available. At schools the computer education and training is normally aimed at giving knowledge on fundamentals of computers and usage of commonly used software. Basic programming languages too can be offered at higher levels. However, by and large these programmes will not be career oriented. The National Institute of Education (NIE) has set up computer resource centres for those awaiting results of general certificate examinations to obtain computer related training. The number of these centres would be increased to 300. Sri Lanka plans to impart computer education for school children through learning centres. Computer learning centres are proposed for 1000 secondary schools across the country. All schools with GCE (advance level) classes, amounting to about 2500 are to be provided with computer centres by the year 2003 (CDN, 2000-a). This is a noteworthy initiative as the availability of computers and other hardware are necessary to support infusion of IT into school curriculum. It is hoped that these programmes are implemented effectively and relevant teachers are adequately trained to realise the maximum benefits of the investments. Nevertheless, progressively computers have to be made available to all schools. In the developed countries there are no separate programmes to teach IT, but computers are widely used in teaching most of the subjects. This is a desirable arrangement as it helps students to acquire computer literacy as well as a good knowledge of application of computers in various disciplines.

Recommendations

Software development sector has the potential to be the major growth sector for earning foreign exchange while also offering a golden opportunity for the educated youth in Sri Lanka to obtain high quality employment. Lack of trained personnel is one of the main reasons that keep foreign investors away. A coordinated effort using both public and private sectors is essential to intensify the manpower development. Sri Lankan training institutes have to be encouraged and assisted to; make use of foreign trainers, create alliances and affiliations with foreign institutes, use the franchisee model, offer web based training programmes, develop links with industry, keep abreast with new developments and upgrade facilities and courses. World over, education and training in IT is emerging as a lucrative industry; therefore sourcing investors would not be a difficult task. Government also has to take aggressive measures to encourage international companies to establish their own or authorised, training centres in Sri Lanka. Existing software companies should also be encouraged to initiate training units on a commercial basis.

In education and training related to IT, both public and private sector institutes have to liase together to develop a synergy that is mutually beneficial. The public and private sector shared computer centres could be a desirable model for Sri Lanka and should be tried out on a pilot basis. Government should also seriously consider assisting private sector institutes by way of making available funding

and channeling some of the assistance of foreign agencies. In the IT sector, the government may even let public and private universities and institutes compete with each other based on their performance, for a certain quota of funds. Such competition is likely to produce desirable results.

All universities and public sector institutes should play a much bigger role in IT education and training. Intensive programmes have to be arranged at higher educational institutions during weekends and vacations to train relevant schoolteachers and academics. Relevant departments in universities have to take steps to adequately train existing faculty, attract and retain qualified faculty, acquire and maintain up to date infrastructure including computers, have high speed access to Internet, acquire audio visual and library facilities, update the curriculum to suit advancements of technology and future industry requirements and tie up with appropriate local/foreign institutions. The current allocation of 0.1 billion Sri Lanka rupees to each university is heartening. It may be desirable to get universities to develop sound plans for utilization of these funds, with time-based outputs. Their performances too may be monitored against plans.

It will be worthwhile for Sri Lanka to develop an appropriate methodology for classroom teaching of IT related courses using options such as web based training, interactive training programs available on CD-ROMs and advancements of video conferencing technology that would minimise intervention of scarce trainers.

A system of rating may be introduced for public and private sector universities and institutes engaged in human resource development based on factors related to their products such as: waiting time for employment, level of entry for employment, starting salary levels, number enrolled, number successfully completed, research and development activities, links with industry, consultancy services provided to the industry, revenue generated through consultancy services, training provided to the industry etc. UGC may consider funding the institutes based on performance measured on such a system.

India is taking steps to employ over one million in the software development industry by year 2004. All other countries in the region too have realised the potential, software development industry offers to enhance the employment opportunities and have taken wide ranging steps to make the best use. Sri Lanka therefore has no time to relax and should launch an aggressive programme to develop a well-trained, efficient and cost effective workforce, which is a key factor for a successful software development industry.

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