Assessing the Changing Employment Profiles in the Telecom Sector: Implications for Education and Training

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1.0 Introduction

Deregulation, increasing privatization, competition, and technological transformations in the telecom sector have ushered in new ways of doing businesses in the telecom sector. As voice communication is increasingly becoming a commodity business, there is stress on telecom firms to generate revenues from innovative and value added services. Technological changes such as those in chip design, internet based protocols and services for example, VOIP), carrier grade wireless networks, software radios, etc., has meant that innovations in new product and service design can no longer be limited to those with telecom expertise. The products/services are more complex and usually require diverse teams to work together. Typically expertise from such different background as consumer electronics, media, software, telecom is required to put together services that subscribers demand. Competition from the non traditional telecom firms (Skype, Google) has put additional pressure on telecom firms to continuously come up with new products and services. Competitive pressure also implies that product development times need to be short.

These changes have been particularly hard on the incumbent firms (typically government owned) as they saw their monopoly positions being opened to competition, and their stable customer base and offerings swamped by innovative offerings from new competitors.

As the newer networks are "IP enabled", incumbents have found their "voice centric" networks a liability, both in terms of the technological capability of the network to design and the ability bundle in new services and deliver them cost effectively. By upgrading and investing in the network alone, incumbents can not hope to reach new customers or offer higher value to existing customers. They need to totally reorient the mind set of existing employees, restructure their organizations and invest in training. Incumbent telcos were not prepared for this kind of change. Their core strength was in the qualified engineering staff, expecting life time employment, working in a hierarchical organization, having little or no orientation to markets/customers, with little idea of how to price services as these were usually regulated. Since government departments/organizations were not expected to have a commercial orientation, managers had and very little idea of financial aspects of business. This means that in order for the incumbents to be able to leverage the emerging opportunities, they would need to review the existing skill set profiles.

In order to respond to these changes, organizations, both public and private have adopted a number of strategies such as restructuring, outsourcing, mergers and acquisitions etc, thus creating a change in the employment profiles.

2.0 Skill Requirements for Managing in the New Scenario

Telecom companies face the following issues in responding to the challenges.

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- Be involved in R&D for new product development, possibly using new technologies.
- Expand the network to new areas (geographic and service) to tap new customers. This has the following implications:

    - Companies should be able to design suitable products vis-à-vis customer requirements. This involves understanding the needs of different customer segments and the technical and organizational capability to design and deliver the appropriate product. This requires competencies in technical design, ability to understand customer and the skills to meld the two. Such product/service design may require teams working with extra organizational alliances and internal constituencies. Besides a higher level of technical skills, this requires a higher organizational capability than before as in the new scenario, there are more complex tasks that require multi functional skills.

    - Companies need to acquire skill sets that are increasingly important: the ability to work with and manage IT resources as these are the tools that help to design and deliver services. Not only do the employees need to understand their own computer systems, but also those of the customers (computers, interface cards, software drivers for different operating systems) as several services are bundled over the customers network.

    - An important element of the employee competency set is the ability to communicate with different types of customers, possibly across different geographic regions as companies serve global markets.

    - Companies need to implement rapid effective induction process, so that entering graduates can become productive quickly, in order to respond to competitive pressures.

    - Companies have to design mechanisms that are able to respond to challenges of quick turnover.

- Employees need to be continuously updated on their own products as companies roll out new products more frequently. Keeping track of changes in the underlying product platform as vendors supply new technologies is also necessary.

- As companies vie for market share an important aspect of required knowledge is regarding emerging standards and how these are formed. The implications of new standards on product service offering also need to be understood by those involved in design of new products and services.

- Complexity of the task to be performed especially in product development and marketing requires *experienced* specialists. The experience is closely related to the chances of "learning at work" and time of being involved in the development groups and in several development efforts. A continuous updating of individual knowledge and skills for this group of employees is urgently necessary. Time pressures on such

teams is high due to involvement in design process and thus need for a faster education cycle.

3.0 Objectives of the Paper

India is the fourth largest telecom market in Asia after China, Japan and South Korea. The Indian telecom network is the eighth largest in the world and the second largest among emerging economies. Improving economy and higher disposable incomes are expected to drive Indian telecommunication services sector during the coming years. In order to leverage the opportunities, appropriate quality and quantity of human resources are critical. While the new telecom organizations do not have a legacy problem, adequate skill set availability is an issue. India's base of technical human resources is considered to be an asset due to the high turnouts of engineering colleges, however, the changing telecom scenario requires more than traditional knowledge imparted in colleges.

This paper profiles the changing employment requirements in India in the new emerging scenario. It identifies the knowledge and skill gaps qualitatively and also makes a quantitative assessment of the gaps. Thus, the central question that this report tries to answer is that whether or not India has the required human resource, which can steer the Indian telecom growth story over the coming decade. This report reviews the Indian telecom sector starting with a brief policy overview, followed by a segment-wise study of the Indian telecom markets. We look at historical growth rates in these segments and try to anticipate future trends in each segment with implications for human resource demand and supply, also keeping in mind technological innovations. In the next section, we look at the availability of telecom specific human resource in India and the quality of technical education in terms of skill set requirement in current scenario as relevant to the Indian telecom sector.

4.0 Framework for the Study

For the purpose of this study, we have divided the Indian telecom sector in three broad segments:

- **Telecommunication Services** include Fixed Services, Cellular Services and Internet Service Provider (ISP).
- **Telecommunication Equipment**
- **Telecommunication related professional services including telecom software**

4.1 Methodology

The study is based on both primary and secondary sources of data employing both qualitative and quantitative analysis.

Qualitative Analysis

To identify the key skill requirements and the issues that current decision makers face in employing existing human resources, we interviewed senior human resources managers in key telecom companies in India. These companies typically employed more than 1000 people. The companies that were interviewed were: Sasken, Infosys (telecom vertical),

Philips (I) and Lucent (I). Interviews were semi structured covering issues of recruitment policies, training needs and skill gaps. The outcomes of the company based qualitative study are provided in Appendix 1.

Quantitative Analysis

This involved the study of the structure of the Indian telecom sector and identification of growth trends in the key market segments. Based on the growth trends and productivity of human resources, we estimated the requirements for the sector. We also estimated the turnouts from the engineering and technical institutes to estimate the gap (if any).

Estimating Human Resource Demand

Step 1: We used historical growth rates and publicly available sources of data to project the revenues for the sector by 2011.

Step 2: We estimated the productivities in the different segments based on publicly available data of number of employees and revenues.

Step 3: Based on our assumptions regarding the likely growth rates of productivity (better technology and improvements in organizational processes), we estimated the employee requirements for the segment. We did sensitivity analysis both around the productivity figures as well as the revenue estimates.

5.0 Telecom Sector in India

Telecommunications in India is a fast changing industry with major changes in government policies and market structure taking place in the past decade. As on March 2007, the total numbers of mobile subscribers had increased to over 217 million, from 54.5 million in March 2003. The wired line subscriber base stood at 40.1 million on March 2007 compared to 41.5 million in March 2003. The tele-density was at 18.2 on March 31, 2007 as against 5.1 in the March 2003.

Historically, the telecom network in India was owned and managed by the government. Considering it to be a natural monopoly and strategic service, it was perceived to be best managed under state's control. However, in 1990's, driven by rapid changes in telecom technology and deregulation in many other countries, led Indian policy makers to initiate a change process finally resulting in opening up of telecom services sector for the private sector.

Indian telecom sector has undergone a major process of transformation through significant policy reforms. The reforms began in 1980s with telecom equipment manufacturing being opened for private sector and were later followed by National Telecom Policy (NTP) in 1994 and a new telecom policy in 1999- NTP 99.

Subsequent to NTP 99, a number of policy measures (implementation of calling party pays, removing oversight from urban tariffs, migration framework for a Unified Access License, allowing for greater flexibility in service provision to service providers) have led to growth outlined above. Appendix 2 discusses the policy reforms in detail. Table 1

gives the growth data. Since the growth is driven by wireless, spectrum availability to Indian operators is a factor in constraining growth (refer to my white paper on Spectrum). FDI caps could restrain the entry of foreign firms wishing to invest in one of the fastest growing markets. However, the recent emergence of entry by regional players (Maxis Communications, Telekom Malaysia) and global players (Vodafone, AT&T) indicate the potential that these players see in the sector. Improving economy and higher disposable incomes have driven Indian telecommunication services sector.

6.0 Estimating Growth of Telecommunication Sector:

The segment has been growing considerable having a growth rate of nearly 30% in the year 2006-07 (Table 1). The market size of the Indian telecom industry, comprising services and equipment, has increased to US$ 24.29 billion in 2006, up from US$13.71 billion in 2001. The growth driver for the sector will be mobile and wireless service.

Table 1: Overview of Indian Telecom Sector's Performance from 2001 – 2007

(Rs in billion)

Segment	2002-03	2003-04	% Growth 2003-04	2004-05	% Growth 2004-05	2005-06	% Growth 2005-06	2006-07	% Growth 2006-07	CAGR	Comments
Telecommunication Service – A											
Fixed	289.08	301.64	4.34	326.32	8.18	341.61	4.69	301.93	-11.62	0.87	
Cellular	85.99	147.48	71.51	232.84	57.88	359.94	54.59	561.83	56.09	45.56	
ISP	12.85	15.73	22.41	15.92	1.21	16.20	1.76	20.40	25.93	9.68	
A	**387.92**	**464.85**	**19.83**	**575.08**	**23.71**	**717.75**	**24.81**	**884.16**	**23.18**	**17.91**	
Telecom Equipment – B											The demand in telecom equipment manufacturing sector would be derived by demand in services sector.
Carrier	147.71	97.04	-34.30	144.27	48.67	181.79	26.01	248.92	36.93	11.00	
Enterprise	38.47	45.62	18.59	52.62	15.34	79.13	50.38	109.55	38.44	23.28	
B	**186.18**	**142.66**	**-23.38**	**196.89**	**38.01**	**260.92**	**32.52**	**358.47**	**37.39**	**14.00**	
Professional Service – C											Demand for services is expected to remain high in next 5-7 years. As apart from the domestic demand, significant part of the international demand is expected.
Telecom Software	55.70	65.97	18.44	94.42	43.13	115.19	22.00	178.71	55.14	26.26	
Network Integration	27.44	33.72	22.89	41.64	23.49	52.19	25.34	67.37	29.09	19.68	
C	**83.14**	**99.69**	**19.91**	**136.06**	**36.48**	**167.38**	**23.02**	**246.08**	**47.02**	**24.24**	
B+C	**269.32**	**242.35**	**-10.01**	**332.95**	**37.38**	**428.30**	**28.64**	**604.55**	**41.15**	**17.55**	
Indian Telecom Sector											
A+B+C	**657.24**	**707.20**	**7.60**	**908.03**	**28.40**	**1146.05**	**26.21**	**1488.71**	**29.90**	**17.77**	
Mobile**	15.20	86.13	466.64	106.88	24.09	160.57	50.23	234.52	46.05	72.85	

Source: V&D July 2002-2007 issues: **Note **:** Mobile Equipment is not taken into consideration as most of it is manufactured outside India

6.1 Telecommunication Services (A)

Overview and Overall Growth Trends

Major revenue contributors to the telecommunication services include Basic Services, Cellular Services and Internet Services. The segment had been growing at a rate of nearly 25% in the year 2006-07 (Table 1) driven by mobile services.

The internet service market also shows an increasing trend, but the growth percent is not as high as compared to that of the cellular. In terms of revenue, the market has grown by 26% from Rs. 16.19 billion to Rs. 20.40 billion from the financial year 2006 to 2007. However, the revenues and the subscribers for fixed services industry shows an overall decreasing trend and the same is expected to continue. Since Internet service revenues contribute to only nearly 2% of the total service sector revenue, we shall not be doing the human resource requirement analysis for this segment separately.

Fuelled by a growing subscriber base, the Indian telecom services revenue is estimated to reach US$ 35 billion in 2010 (http://trak.in/tags/business/2007/07/25/young-indian-population-indian-telecommunication-sectors-best-friend/, based on Gartner Survey).

Operator's Growth Trend

In the basic service sector the top players BSNL and MTNL, contributed nearly 83% of the total revenues. Both the state-run companies had started showing slow growth ever since the telecom boom began and private players entered the business, threatening monopoly. The top private players are Bharti, Tata Teleservices, Tata Teleservices- Maharashtra Ltd., Reliance and others. In this segment the revenues of public players is expected to decrease whereas that of private players' is expected to increase.

In the cellular sector, Bharti Televentures Ltd, tops the other players with a subscriber market share of 23.7%. The company registered the highest total revenue of Rs 134.31 billion, a growth of 58.4% y-o-y. The other companies to follow are: Vodafone Essar, Reliance Group (operating in both CDMA and GSM), BSNL, Idea Cellular, Spice and others (Voice and Data, July 2007).

6.1.1 Basic or Fixed Service Providers (FSPs)

Segment Outlook

The government had introduced unified license for fixed and mobile service providers in 2003. This allowed all phone companies to become mobile operators by offering cellular and landline/WLL-M services under a single authorization, ending service-specific licensing.

Since the introduction of competition in the basic sector, private operators have been very selective in targeting the customers as they recognize the inherent advantage of scale that the incumbent state operators have.

New services like IPTV and Metro Ethernet, WiMax, fixed–mobile convergence, etc. are going to drive growth in the future to reach out to more customers. However, service revenues are not likely to grow as fast as in the wireless sector.

Table 2 gives the revenues of key fixed service providers from 2002-07.

Table 2: Fixed Telecom Service Providers Revenues 2002-07

(Rs in millions)

Companies	2002-03	2003-04	2004-05	2005-06	2006-07	% Growth (over last year)	CAGR (2002- 07)
BSNL	215,700	218,560	239,890	251,950	210,200	-16.57	-0.52
MTNL	58,577	60,300	52,910	49,880	41,160	-17.48	-6.81
Bharti Telenet	3,549	7,760	11,270	13,200	16,930	28.26	36.68
Tata Teleservices	2,398	4,900	9,000	10,810	15,840	46.53	45.88
TTSL	3,696	6,080	6,270	7,130	9,240	29.59	20.11
Reliance Telecom	3,163	1,770	3,930	5,130	4,600	-10.33	7.78
HFCL Infotel	1,400	1,820	2,450	2,610	2,850	9.20	15.28
Shyam Telelink	600	450	600	900	1,080	20.00	12.47
TOTAL	**289,083**	**301,640**	**326,320**	**341,610**	**301,900**	**-11.62**	**0.87**

Source: V&D (various issues 2002-07) and TRAI (http://www.trai.gov.in)

The state operators (BSNL and MTNL), account for almost 83 percent of revenues from fixed (including fixed wireless) services. Private sector services are presently available in 18 circles, and collectively account for less than 17 per cent of revenue. However, private services focus on the business/corporate sector, and consequently average revenues-per-user (ARPU) of private operators are usually much higher.

A report by Global Insight's new Telecoms Intermodal Forecasting Service, an international intermodal/convergence forecasting service for the telecom industry, stated that more than $50 billion in revenues will be lost world-wide over the forecast period due to fixed-line subscriber declines and the migration of voice traffic to mobile and VoIP networks. A 4.5 percent decline is also predicted in traditional fixed-line accesses as the growth in the China and India markets fail to offset the erosion of traditional accesses in markets like Europe, Japan and South Korea. Europe has already seen extensive migration of accesses from fixed lines to mobile. (http://www.eetasia.com/ART_8800461902_499488_NT_552620ff.HTM)

Calculation of Productivity and HR Requirements for Fixed Service Providers

Growth Trends: We calculate the potential revenue of the segment, based on the growth trends. While the revenues due to fixed line will increase for the private sector, it is likely to decrease for the state owned entities. For the private sector, the growth will come from provision of broadband facilities, bundling and solution provision. We have taken this growth rate to be 27% based on the past data. For the state owned entities, these channels are likely to be bottlenecks, due to the poor marketing and management issues.

For the state owned entities, even in the case of growth of revenues in the segment, it is unlikely that additional manpower will be added, as these are already overstaffed. DOT, BSNL, MTNL together had total employees of 3.80 lakh at the end of 2005-06, as compared to 3.96 lakh during the preceding year (DoT Annual Report 2006-07).

Productivity Calculations and Employment Requirements: Productivity of Bharti in the non-mobile segment is taken as a benchmark to calculate the employment requirements of the sector. This is an optimistic scenario (i.e., estimates of human resource requirements are likely to be underestimated) as we expect Bharti to have a productivity greater than the industry average. Productivity of Bharti is calculated by dividing the non-mobile revenues by number of employees got by subtracting the total employees in the mobile segment from total employees. For comparison purposes, productivity of BSNL is also shown (Table 3)

Table 3: Productivity of Bharti and BSNL in the Fixed Line Segment

	Bharti	BSNL
Non cellular revenue) (2006-07) *(Rs in million)*	66,390	3,07,350
Non cellular Employees	13,814	3,15,588(*)
Productivity (per employee per year) *(Rs in million)*	4.81	0.97
Growth Rate of sector (minus BSNL and MTNL)	27%†	

Source: Authors Analysis Based on Data of Table 1 and Financial Statements of Bharti

	2006-07	**2007-08**	**2008-09**	**2009-10**	**2010-11**
Growth of non cellular revenues for all other operators (minus BSNL and MTNL) *(Rs in million)*	50,540	64,186	81,516	103,525	131,477
Estimated Employees in fixed sector (other than in BSNL MTNL)	10,516	13,355	16,961	21,541	27,357
Additional Required	16,841				

(*)Comment: We have taken productivity of BSNL's cellular division/employee/year at Rs 15 million (a 20% reduction from Bharti's productivity)

BSNL and MTNL are the main employers in the basic services segment. Together they employed more than 90% of the total persons employed in basic services. Since these two companies are highly overstaffed, with DEL: Employee ratios of 108:1 and 74:1 respectively compared to Bharti and Tata Teleservices have a DEL: Employee ratio of 457:1 and 267:1 respectively, it is unlikely that they will be major recruiters in the near future.

However, more than the number of persons required, the issue will be on getting employees with the right skill sets.

6.1.2 Cellular Mobile Telephone Service (CMTS)

Growth Trends

Cellular growth had been triggered by the introduction of unified licensing regime. This enhanced competition and created a level playing field between the GSM and CDMA players. The cellular segment, which experienced a consolidation wave, will be key growth driver of the telecom services market in India. The market share of CDMA players is growing gradually and steadily. Reduction in tariffs and handset prices and innovative financing schemes had driven growth. Future growth is likely to come from corporates, value added services and opening up of long distance and international services.

Table 4 gives the revenues of top mobile operators from 2002-07. The cellular services industry for financial year 2006-07 was estimated at Rs 56,183 crore ($12.76 bn) and it grew at the rate of 57%. In the previous financial year, the industry was estimated at Rs 35,994 crore ($8.2 billion).

Table 4: Revenues of Top Cellular Operators in India

(Rs in million)

	2002–03	2003–04	2004-05	2005-06	2006-07	*% Growth 2005-07*	CAGR (2003- 06)
Bharti Tele-Ventures	20,840	32,610	54,360	79,280	1,34,310	*69.41*	45.16
Reliance Group	6,830	25,710	40,890	66,730	1,07,280	*60.77*	73.47
Hutch Group	17,350	27,010	43,650	68,370	1,05,650	*54.53*	43.52
BSNL	5,900	19,840	39,560	65,740	94,000	*42.99*	73.96
Idea Cellular	10,800	13,130	22,620	29,660	43,350	*46.16*	32.04
BPL Group	9,630	10,300	5,350	6,550	5,050	*-22.90*	-12.11
Spice	5,500	5,200	7,060	8,550	7,830	*-8.42*	7.32
Aircel*	2,300	3,750	5,610	8,800	15,070	*71.25*	45.64
Escotel#	3,220	3,500	-	-	-	-	-
Tata Teleservices Group	560	2,530	5,230	18,780	40,920	*117.89*	135.91
MTNL	1,550	2,270	3,380	5,990	8,070	*34.72*	39.09
Hexacom**	1,300	1,400	-	-	-	-	-
HFCL Infotel	110	120	100	220	200	*-9.09*	12.70
Shyam Telelink	100	110	60	120	100	*-16.67*	0.00
Total	**85,990**	**1,47,480**	**2,27,870**	**3,58,790**	**5,61,830**	***56.59***	**45.56**
Revenue for the segment minus BSNL					**4,67,830**		

Source: V&D
**Includes RPG Cellular revenues*
#Escotel has been bought over by Idea and from FY 2004–05 it will have a combined turnover
***Hexacom has been bought over by Bharti and from FY 2004–05 it will have a combined turnover Group revenues include GSM as well as CDMA services revenues, wherever applicable.*

Human Resource Outlook

Step 1: Estimating Revenues for the Future

We estimated the revenues of the cellular segment by taking projections of growth rates. Though the actual CAGR in terms of revenue is 45% we feel that it would be difficult to maintain such a high growth rate given the fact that ARPU is decreasing, difficulties in increasing subscriber base after certain level and more intense competition. Therefore, we have taken various scenarios for y-o-y growth for estimating human resource requirements. Cellular services segment would emerge as the biggest recruiter in the Indian telecom sector over the next five years.

The various scenarios we took were based on the following growth rates (Table 5)

Table 5: Scenarios for Growth Rates

Year	2006-07	2007-08	2008-09	2009-10	2010-2011
Growth Rate	Actual	Estimated			
Scenario 1	56.6	40	30	20	10
Scenario 2	56.6	50	40	35	30

Source: Author's Analysis

Expectations of growth: ($24 bn by 2009 Gartner Research), ($35bn Telecom service market by 2010 (0.80*35) =$26bn) was predicted by FICCI). We take it to be $25bn by 2009-2010.

Based on the reports in the media, FICCI predicted that telecom services revenue in India are likely to reach $35 bn by 2009-10, we extrapolated it to 2010-2011, by taking the rate of growth in the last column in the table above, thus generating two scenarios for the same. We have then taken various scenarios corresponding to the above, in which we vary the estimated contribution of the cellular revenues to the total revenues between 80%, 70% and 60%. This enabled to make more realistic estimates of the growth of the sector.

Step 2: Calculating Productivity of Cellular Segment: Based on data from Bharti's financial statement, we calculated the productivity of Bharti in the cellular segment. We examined two parameters to compute this: Based on the total customers of Bharti, we estimated the employees in the cellular segment based on the customers per employee in the cellular segment. We also estimated the employees in the cellular segment based on the productivity per employee per month for cellular (Bharti's BS). Based on the data provided in the financial statements and the calculations done by us for productivity per employee, we have taken it to be Rs 20 million per employee per year.

Since the productivity has been rising in the past, we worked with 3 scenarios: 1) Rs 20 million per employee per year 2) Rs 22 million per employee per year and 3) Rs 25 million per employee per year.

Table 6: Productivity of Bharti for Cellular Services from 2005-06 to 2006-07

Item	2005-06	2006-07
Bharti Employees (total)	10,970	20,314
Total Revenues *(Rs Million)*	1,16,215	1,85,196
Cellular Revenue *(Rs million)*	82,390	1,41,442
Number of Subscribers *(million)*	19.6	37.1
Number of customers/employee	3,243	5,280
Number of Employees(Cellular) calculated on basis of number of customers/employee	6,037	7,034
Gross Reve/month/employee	13,22,321	20,10,853
Number of Employees (Cellular) calculated on basis of rev/emp/month	5,192	5,862
Prod/employ/ in Rs million/year	14	20

Source: Bharti's Financial Statements and Author's Analysis

Human resource requirements were estimated by dividing the segment revenue by the productivity. We generated a number of scenarios relating to different values of productivity, revenue growth and percentage contribution of cellular to total service revenue. These are shown in Table 7 and 8 below:

Table 7: Estimating Human Resource Requirements for Cellular Segment under Various Scenarios (Scenario 1)

		2006	2007-08	2008-09	2009-10	2010-11				
Productivity (optimistic) (per employee per year) *(Rs million)*	20									
Growth percentage for cellular sector	56.6	40	30	20	10					
Revenues in *(Rs millions)*		5,61,830	7,86,562	10,22,531	12,27,037	13,49,740				
Employees *(Number)*		28,092	39,328	51,127	61,352	**67,487**				
FICCI Report Revenue Estimates (in $ bn)			16		35		Percentage Contribution of Cellular to Total			
Revenues in *(Rs millions)*			6,24,400		14,00,000	15,40,000	0.8	0.7	0.6	
Employees (Based on Bhartis Productivity) *(Number)*		51,234		31,220	70,000	77,000	**61,600**	**53900**	**46,,200**	
Productivity (optimistic) per employee per year *(Rs millions)*	22									
Growth percentage for cellular sector	56.6	40	30	20	10					
Revenues in *(Rs millions)*		5,61,830	7,86,562	10,22,531	12,27,037	13,49,740				
Employees *(Number)*		25,538	35,753	46,479	55,774	**61,352**				
FICCI Report Revenues Estimates *($ bn)*			16		35		Percentage Contribution of Cellular to Total			
Revenues in *(Rs millions)*			6,24,400		14,00,000	15,40,000	0.8	0.7	0.6	
Employees (Based on Bhartis Productivity)				28,382	63,636	70,000	**56,000**	**49,000**	**42,000**	
Productivity (optimistic) per employee per year *(Rs millions)*	25									
Growth percentage for cellular sector	56.6	40	30	20	10					
Revenues in *(Rs millions)*		5,61,830	7,86,562	10,22,531	12,27,037	13,49,740				
Employees *(Numbers)*		22,473	31,462	40,901	49,081	**53,990**				
FICCI Report Revenue Estimates *($ bn)*			16		35		Percentage Contribution of Cellular to Total			
Revenues in *(Rs millions)*			6,24,400		14,00,000	15,40,000	0.8	0.7	0.6	
Employees (Based on Bhartis Productivity)			24,976		56,000	61,600	**49,280**	**43,120**	**36,960**	

Source: Various Data Sources as Cited in the Text and Author's Analysis

Table 8: Estimating Human Resource Requirements for Cellular Segment under Various Scenarios (Scenario 2)

	2006-07	2007-08	2008-09	2009-10	2010-11				
Productivity (optimistic) (per employee per year) *(Rs million)*	25								
Growth percentage for cellular sector	56.6	50	40	35	30				
Revenues *(Rs millions)*		5,61,830	8,79,771	13,19,656	18,47,519				
Employees *(Number)*		22,473	35,191	52,786	73,901				
FICCI Report Revenue Estimates *(in $ bn)*		15.61		35		Percentage Contribution of Cellular to Total			
Revenues (*Rs millions)*						0.8	0.7	0.6	
Employees (Based on Bhartis Productivity) *(Number)*		6,24,400		14,00,000	18,20,000				
		24,976		56,000	72,800	58,240	50,960	43,680	
Productivity (optimistic) per employee per year *(Rs millions)*	22								
Growth percentage for cellular sector *(%)*	56.6	50	40	35	30				
Revenues in *(Rs millions)*		5,61,830	8,79,770.8	13,19,656	18,47,519				
Employees *(Number)*		**25,537**	**39,989**	**59,984**	**83,978**				
FICCI Report Revenues Estimates *($ bn)*		15.61		35		Percentage Contribution of Cellular to Total			
Revenues Rs millions		6,24,400		14,00,000	18,20,000	0.8	0.7	0.6	
Employees (Based on Bhartis Productivity)		28,382				**66,182**	**57,909**	**49,636**	
Productivity (optimistic) per employee per year *(Rs million)*	20								
Growth percentage for cellular sector *(%)*	56.6	50	40	35	30				
Revenues *(Rs millions)*		5,61,830	8,79,770.8	13,19,656	18,47,519	24,94,150			
Employees *(Number)*		**28,092**	**43,988**	**6,59,823**	**9,23,756**	**1,24,708**			
FICCI Report Revenues Estimates *($ bn)*		15.61		35		Percentage Contribution of Cellular to Total			
Revenues *(Rs millions)*		6,24,400		14,00,000	18,20,000	0.8	0.7	0.6	
Employees (Based on Bhartis Productivity)		**31,220**				**72,800**	**63,700**	**54,600**	

Source: Various Data Sources as Cited in the Text and Author's Analysis

From Table 7, we see that the estimated number ranges from 36960 (say 37,000) to 67,000 depending upon the parameters assumptions regarding productivity, cellular growth rates and contribution of cellular revenue to total revenue determine the outcomes. To estimate the private sector requirements of employment, we subtract the estimated employees of BSNL in cellular. If we assume that in the future BSNL would contribute 15% of the sector revenue (based on the competition in the sector), then private sector requirements range from 31,500 to 57,000.

We estimated the BSNL employees in cellular as follows: At the current level of productivity of Bharti (2006-07), there are about 6,000 -7,000 employees, who contribute to nearly 24% of the segment revenue. Using this, the total employees in the segment is nearly 27,000. Since BSNL contributes 17% of sector revenue, current employment levels in the private sector are nearly 23,000. Incremental future requirements will vary from 9,000 (31,500 - 23,000) to 34,000.

Realistically, we estimate that the higher number is more appropriate, as the productivity of Bharti is likely to be high relative to its peers, and therefore, it is better to work with the higher numbers. On the other hand, as the segment matures, newer tools etc will make the productivity go higher, thus brining down the total employee requirements.

From Table 8 we see that the numbers range from nearly 55,000 to 74,000. As estimated before, the approximate number of private sector employees is nearly 23,000, leading to a requirement ranging from 32,000 to 51,000 in the next five years.

In terms of numbers, this does not look like a bottleneck resource. However, the main issue is expected to be that of finding appropriately trained human resources, as syllabi in Indian engineering schools have not yet incorporated latest advances in the telecom arena. Consequently, the training expenses for cellular firms are expected to be much higher than the normal level of 3.5% of the total spending on employees and should be in the range of 5-6%.

6.2 Telecommunication Equipment (B)

Overview

Telecommunication equipment segment includes carrier, infrastructure and networking equipment. Growth in telecom equipment sector would be driven by an expansion in subscriber base and a growth for services such as business process outsourcing (BPO) operations, which use telecom as a delivery medium. Table gives the data on revenues of the equipment vendors. Telecom equipment sector had grown at a CAGR of 31% over the past five years. In year 2004-05, enterprise equipment market registered 29% growth to Rs 50,262 million. We expect the sector to grow around 25% in revenue terms owing to large corporate orders from banks, telecom services companies, call centres and insurance companies for the next 5 years. We have not included mobile handsets segment for making human resource projections as most of handsets are imported and not manufactured. In the future, companies are likely to set up handset manufacturing units in India.

This is party due to lowering of import duties and also because of outsourcing to cheaper manufacturing destinations in Taiwan and China. The domestic industry has not progressed at the same rate as the service industry worth Rs 303,000 million.

Growth in the telecom equipment market is expected to be driven by an increasing demand for telecom services by the larges players such as BSNL, Bharti, Vodafone, Reliance, Spice and others as well as corporates demands for networking. Since the service industry is expected to grow significantly, we expect high growth in this segment too.

The Telecom Equipment Manufacturers Association (TEMA) estimates investment of $ 30 billion or Rs 1300 billion by 2005 spread across - basic, cellular, paging, NLD, ISP and other value added services. Over the coming years, India and China will help the equipment manufacturing sector to recover. The last two years saw many renowned telecom companies setting up their manufacturing base in India. (Ericsson, Nokia, LG Electronics, Flextronics, Alcatel, Cisco, etc.).

Telecom equipment sector is a fast changing, research intensive sector. Quality of research and development by Indian companies would remain a major issue, as foreign firms are bringing in almost all the new technologies. Indian companies may not be able to leverage the growth in the communication services segment, if they do not come up with proprietary products.

The proposal for setting up Telecom Equipment and Services Export Promotion Council and Telecom Testing and Security Certification Centre (TETC) is in the pipe line. A large number of companies like Alcatel, Cisco have also shown interest in setting up their R&D centres in India. With above initiatives India is expected to be manufacturing hub for the telecom equipment.

Table 9 gives the sub segment wise (carrier and enterprise) revenues from 2002-2007.

Table 9: Telecom Equipment Industry Revenues 2002-07

(Rs million)

Segment	2002-03	2003-04	% Growth 2002-03	2004-05	% Growth 2003-04	2005-06	% Growth 2004-05	2006-07	% Growth 2005-06	CAGR
Carrier	147.71	97.04	-34.30	144.27	48.67	181.79	26.01	248.92	36.93	11.00
Enterprise	38.47	45.62	18.59	52.62	15.34	79.13	50.38	109.55	38.44	23.28
B	**186.18**	**142.66**	**-23.38**	**196.89**	**38.01**	**260.92**	**32.52**	**358.47**	**37.39**	**14.00**

Source: Voice and Data: Various Issues

Human Resource Outlook

Calculation of Productivity and HR for Telecom Equipment Segment

1. Present productivity of Cisco is calculated by dividing telecom revenues of Cisco with the number of people employed in Cisco. (The employee data is not available for many companies. We could get it in the case of Cisco).
2. We will be taking the productivity of Cisco (Table 10) as a benchmark to calculate the total number of employees in the Telecom Equipment segment. This may be an under estimate of the employment potential as Cisco's productivity may be on the higher side.

Table 10: Productivity of Cisco

Cisco (India) Revenues by 2010 *(Rs million)*	79,600
Revenues in 2006-07 *(Rs million)*	40,370
Employees *(Number)*	3,000
Productivity in 2006-07 employee/year *(Rs million)*	13.45

Source: http://www.livemint.com/2007/10/21232744/Cisco-aims-to-double-India-rev.html and author's analysis

Table 11: Estimating Employee Requirements for the Telecom Equipment Segment

If we take growth rate of Cellular Industry					
	2006-07	**2007-08**	**2008-09**	**2009-10**	**2010-11**
	40	30	20	10	
Equipment Revenues *(Rs million)*	3,58,470	5,01,858	6,52,415	7,82,898	8,61,188
Employees *(Number)*	26,639	37,294	48,483	58,179	63,997
Employees required by 2010-11 *(Number)*	37,358				

Source: Tables 7 and 8.

In order to get a more realistic assessment, we examined the productivity of another company in the segment: D Link (Table 12).

Table 12: Productivity of D Link

D-Link (India) (2006-07)	
Total revenues in *(Rs million)*	3,320
Employees *(Number)*	563
Productivity per employee/year *(Rs million)*	5.897

Source: http://investing.businessweek.com/research/stocks/financials/financials.asp?symbol=DLIN.BO

3. This shows the variations in productivity (almost double), possibly reflecting the differences in profiles of products and services. Therefore, for our assessment, we are going to increase the estimates based on Cisco's productivity by 50%.Therefore, HR requirements in this segment are nearly 50,000 by 2010-11. Other variations would arise based on the growth projections. For example, according to one estimate, the telecom equipment industry could grow to $100 billion (http://www.rediff.com/money/2006/dec/28spec1.htm). However, some components of this growth could include imported equipment.

6.3 Professional Services (C)

Professional services comprise telecom software and network integration services. The telecom software market has grown by 55% during the financial year 2006-07, reaching revenues of Rs 178,710 million. Wipro and Infosys are the key players (Table 13).

With greater focus on value added services, and IT backbone, integration with software has become a critical infrastructure for service provider. This is the driver for future network integration and telecom software growth.

Table 13: Revenues of Telecom Software Companies from 2002-07

(Rs in million)

	2003	2004	% Growth	2005	% Growth	2006	% Growth	2007	% Growth	CAGR
TCS	9,000	12,130	34.8	15,950	31.5	18,020	13.0	31,760	76.2	28.68
Tec Mahindra	6,170	7,290	18.2	10,540	44.6	12,430	17.9	29,290	135.6	36.55
Infosys	5,510	7,950	44.3	13,190	65.9	15,660	18.7	26,810	71.2	37.22
Wipro	6,500	8,060	24.0	18,790	133.1	21,320	13.5	24,430	14.6	30.32
Aricent (formerly FSS)	-	-	-	4,580	-	8,290	81.0	13,000	56.8	41.59
Sasken	-	1,670	-	1,980	18.6	2,850	43.9	4,770	67.4	30.00
Subex Azure	-	-	-	1,160	-	1,810	-	3,400	87.8	43.11
HSS	-	3,420	-	-	-		-	-	-	-
Others	23,060	25,450	10.4	28,230	10.9	34,810	23.3	45,250	30.0	14.43
Total	50,240	65,970	31.3	94,420	43.1	115,190	22.0	178,710	55.1	28.89

Source: Voice and Data (various issues)

We calculated the productivities for Wipro and Infosys by 1) finding out the ratio of telecom revenue to the total revenue. 2) based on the total number of employees, we estimated the strength of the telecom employees ratio based on the total revenues to telecom, and 3) calculating productivity based on 1) and 2) Since there was not much variation in the productivity, we took the average as the segment productivity (Table 14)

Table 14: Calculation of productivity of Infosys and Wipro Based on Revenues.

	2002-03	2003-04	2004-05	2005-06	2006-07
Total Infosys Revenue *(Rs million)*	5,510	7,950	13,190	15,660	26,810
Total Wipro Revenues *(Rs million)*	6,500	8,060	18,790	21,320	24,430
Productivity (Rs million/employee/year)	1.88				

Source: Voice and Data (various issues)

Based on the past data, we calculate the future potential revenues for this segment. Using the average productivity of the segment, we calculated the number of employees required in the segment by 2010-11 (Table 15). This does not take in to account increase in productivities due to better tools and management practices. However, correspondingly, the productivity increase would be offset by the need to write software for emerging protocols, media and devices where there would be a steeper learning curve with decrease in productivities.

Table 15: Calculating the HR demand for the Telecom Software

CAGR for telecom software sector		**28.89**			
	2006-07	2007-08	2008-09	2009-10	2010-11
Revenues in millions	178,710	2,,30,339	2,96,884	3,82,654	4,93,203
Employees	95,059	1,22,521	1,57,917	2,03,539	2,38,027
Employees Required	1,51,779				

Source: Table 13 and Author's Analysis

Overview

Professional services segment includes telecom software and network integration services. This segment has been growing at nearly 29% CAGR for the last five years. Domestic as well as international telecom service providers are the major customers for professional service organizations. We expect domestic sector to contribute substantially more to the growth of professional service providers owing to a telecom sector slowdown in developed economies.

Network Integration Segment

The network integration business was worth Rs 67,340 million, with Wipro Infotech as the leader registering nearly 53% percent growth. The segment saw an increased growth of nearly 29% i.e., to Rs 67,330 million from Rs 52,190 million for the 2006 to 2007 (Table 16)

Segment Outlook

Wipro Infotech, HCL Comnet, Datacraft, Tulip, HCL Infosystems are key companies in terms of revenues in third segment. The increase in revenues for these companies from 2002-07 is shown in Table 16.

Table 16: Revenues for Key Network Integration Companies

	2002-03	**2003-04**	**% Growth**	**2004-05**	**% Growth**	**2005-06**	**% Growth**	**2006-07**	**% Growth**	**CAGR**
Wipro Infotech	2,470	3,230	30.77	4,860	50.46	6,700	37.86	10,280	53.43	28.33
HCL Comnet	1,950	2,540	30.26	3,760	48.03	4,910	30.59	8,120	65.38	33.02
Datacraft	2,880	3,500	21.53	4,660	33.14	5,190	11.37	6,750	30.06	18.57
Tulip	2,100	2,760	31.43	3,040	10.14	4,260	40.13	5,250	23.24	20.11
HCL Infosystems	1,800	1,680	-6.67	2,780	65.48	3,450	24.10	5,240	51.88	23.83
GTL	-	2,340	-	2,240	-4.27	2,290	2.23	2,740	19.65	4.02
Others*	16,240	17,670	8.81	20,300	14.88	25,390	25.07	28,960	14.06	12.26
Total	27,440	33,720	22.89	41,640	23.49	52,190	25.34	67,340	29.03	19.67

Source: Voice and Data Various Issues

Human Resource Outlook

Table 17 estimates the productivity of Wipro Infotech and HCL Comnet. Since there was not much variation, the average is treated as benchmark value for the segment. The segment is expected to grow at a CAGR of 19.67%.

Table 17: Productivity of Wipro and HCL Technologies (Network Integration Segment)

Item	Amount	References
Wipro's Global IT Business Revenue *(Rs million)*	1,10,950	http://www.moneycontrol.com/india/news/OTHER%20NEWS/wipro%E2%80%99s-net-income-grows-42fy06-07/03/28/277291 http://www.thinkingstreet.com/jobs/2008/01/23/january-23-2007-engagement-manager-wipro-infotech/
Wipro's Telecom Business Revenue *(Rs million)*	10,280	
Employees *(number)*	67,818	http://www.wipro.in/Company/financials.htm
% of (wipro Telecom to total Revenue	9.27	
Employees in Telecom	6,284	
Average Productivity (per employee/year) *(Rs million)*	**1.52**	
Productivity	1.64	
HCL Technologies		
HCL Comnet Revenues	56,750	http://jobs.monsterindia.com/details/4974027.html
Employees	40,149	http://myiris.com/shares/company/reportShow.php?url=AMServer%2F2003%2F09%2FHCLTECHN_20030923.htm
Telecom Revenues	8,120	
Percentage Contribution of Telecom Revenues	14.31	

Source: Cited in the Table above and Author's Analysis

Human Resource Outlook

We estimate the number of employees required in the segment for 2010-11 as 76,360. With the current estimated base of nearly 37,000, we expect the requirements in this sector to be nearly 39,000 (Table 18)

Table 18: HR Requirement for the Network Integration

CAGR for telecom network integration sector	**19.68**				
	2006-07	**2007-08**	**2008-09**	**2009-10**	**2010-11**
Revenues *(Rs millions)*	67,340	80,586	96,437	1,15,406	1,38,097
Employees *(number)*	44,303	53,017	63,445	75,925	76,362
Employees Required	39,126				

Source: Voice & Data various issues

7.0 Calculations of Total Additional HR Required in All the Segments:

Table 19 gives the consolidated HR requirements across different segments.

Table 19: Consolidated HR requirements across different segments.

(Numbers have been rounded to the nearest 000)

Segment	**Lower Bound**	**Upper Bound**
Fixed Service Segment	17,000	17,000
Cellular Service	32,000	74,000
Telecom Equipment Segment	37,000	74,000
Telecom Software Industry	1,51,000	1,51,000
Network Integration Industry	39,000	39,000
Total	2,76,000	3,55,000
Per Year requirements	55,200	71,000

Source: Author's Analysis

8.0 Supply Side Analysis

Estimating the supply side scenario is problematic due to the poor availability of Engineering education statistics (Gerrefi, Wadhwa and Rissing (2006), Banerjee and Muley (2007)). The data on Engineering graduates includes those who are awarded the four year degree, but also those who get diplomas and three year degrees. Besides, data is available for different years for enrollment, and sanctioned strength. Little or poor quality data is available for number of students graduating every year. In the year 2004-05, there were approximately 115,533 IT professionals from degree and diploma colleges in India (Banerjee and Muley (2007)). Table 20 shows the ratio of sanctioned to enrolled percentages for 2002-04 from some states. Table 21 shows the enrolled to outcome ratios for 2002-04. Table 22 uses the average percentages in Table 20 and 21 to derive the number of graduates passing out in different disciplines (Excerpted data from Banerjee and Muley (2007)).

Table 20: Calculated Enrolled to Strength Ratio for Graduates 2002-2004

State	2003	2004
Karnataka	-	-
Tamilnadu	-	-
Maharashtra	0.96	-
Delhi	0.84	0.87
West Bengal	-	-
Himachal Pradesh	0.93	0.89
Haryana	0.82	0.79
Assam	-	-
Rajasthan	-	-
Arunachal Pradesh	1.00	-
Manipur	-	-
Tripura	0.87	-
Average for two years	0.90	0.85
Overall Av erage	0.88	

Source: Bannerjee and Muley (2007)

Table 21: Calculated Outcome to Strength Ratio for Graduates 2002-2004

State	2003	2004
Karnataka	0.56	-
Tamilnadu	0.77	-
Maharashtra	1.11	-
Andhra Pradesh	-	-
Kerala	-	-
Delhi	0.64	0.57
West Bengal	-	-
Himachal Pradesh	0.78	0.61
Chandigarh	0.8	-
Orissa	0.89	0.98
Haryana	0.37	0.32
Assam	-	-
Gujarat	1.03	-
Average over two years	0.77	0.62
Overall Average	0.70	

Source: Bannerjee and Muley (2007)

Table 22: Derived Percentage of Total Students Passing from Various Branch

Item/Branch of Engineering	Chemical	Civil	Comp/IT	Electrical	Electronics	Mechanical	Others	Total
No of sanctioned Strength	7552	13806	73497	24498	49448	40044	17639	226484
Percentage of total	3	6	32	11	22	18	08	100
Total Sanctioned Seats in 2007-08								554,000
Percentage of total	**	4	34		39	12	11	100
Sanctioned strength across disciplines for 2008 based on percentages for 2006 (*Bannerjee and Muley (2007, pg 30)*)	**	22160	188360		188360	66480	60940	554,000
Potential graduates available to Telecom Sector*	78587 (79000)							

Source: Bannerjee and Muley (2007) and Authors Analysis
*** This has been merged with "Others", as data was not separately available, similarly combined data for Electrical and Electronics is available for 2006.*

*Assumption is that 20% graduates from Computer/IT, 30% from Electrical, Electronics and 10% from other branches join the telecom sector and the output is 70% of the sanctioned strength. (Table 21)

9.0 Supply and Demand Gap

The supply of human resource requirement in next five years is likely to be problem, both in quantity and quality. Besides the gap in numbers of professionals required, there are gaps in the required skill sets.

Quantitative Gap

Our demand estimates indicate a requirement of graduates to be between 55,000 and 71,000. However, there are going to be additional demands based on increasing outsourcing of telecom sector jobs to low cost countries, including India. For example, a Deloitte Touche survey of 42 global telecommunications operators shows that over 275,000 telecom jobs may move to India, China, and other low-wage nations by the year 2008 (www.telecomweb.com). Even if 33% out of 275,000 comes to India, and 40% of this requires engineering graduates, then this would create additional requirement of around 36,000 thus leading to total requirement of around (71,000 + 36,000) = 107,000. This indicates a quantitative gap of around 20,000 – 25,000 annually provided that assumptions regarding sanctioned strength and outputs and ratios regarding the availability across different disciplines for the telecom sector are valid (Table 22).

While engineering institutes are going to be the major supplier of human resources, a small part of the demand is likely to be met by outside the university offerings in Information Technology and Electronics and telecommunication engineering courses. Such offerings are provided by various institutes in India offering in-house as well as paid training specific to the telecom industry in areas viz. technical, management, CISCO certified, advance computing etc. *(Appendix 3)*. However, some of these do not offer a level of certification that could contribute to substantially increasing the skill pool for the sector.

Qualitative Gaps

Quality and knowledge base of fresh graduates is expected to be a major issue. The fast changing technology and standards in telecom sector mean that unless the universities make a constant effort to upgrade the curriculum, the percentage of employable graduates would continue to hover around 30-40% (our estimate). Similar data was reported by the 2005, McKinsey Global Institute survey of Human Resources. This quality issues refers not only to the gaps in technical knowledge but also soft skills

As an example, an analysis of ads for jobs in the telecom sector at the entry level shows the requirements of technical knowledge of the following protocols and operating systems (Box 1):

Box 1

Protocols

- TCP-IP, ATM and OSI-7 protocols
- SS7, ISDN, R2, R1, SGCP, MGCP, Sigtran
- Telecom standards: H.248, H.323, G.703, G.751, G.823, G.824, G.992.1, G.992.2, ANSI T1.413
- Wireless Standards: GSM air interface (ETSI 04 series), I.363 .(1-5), UTOPIA Level 1;2, Q.922, Q.933. Network management protocol - SNMP and TMN for CMS/NMS, Layer-3 protocols OSPF, RIP, BGP
- Routing and bridging protocols, frame relay, GSMP, ISDN, LAN and Serial protocols

Real-time operating systems

VxWorks, WinCE, QNX, VRTXsa, pSOS+, OSE, RT Linux, embedded Linux.

Operating systems

Win2K/WinNT, UNIX, Sun Solaris OS, open VMS, Linux.

Technology

USB, Bluetooth, Wireless LAN, GSM, GPRS, UMTS, 3G, ATM, VoIP, GSM, GPRS

A review of the curriculum of most engineering colleges reveals that these topics barely covered. This implies that companies have to spend their resources in getting up to the mark.

Thus, if an organization is looking at recruiting fresh graduates for positions in operations, it is likely that they would have to invest significant amounts of time and money to bring the candidates up to the latest industry standards.

The requirements of entry level management training covering marketing, finance, human resource management is barely covered in the present curriculum. Many suggestions have been made regarding this, including the need for a “finishing” year after the technical skills/knowledge has been acquired.

This requires a major revamp of the engineering education. The archaic system of government run accreditation/review body (All India Council of Technical Education) and the dire shortage of faculty are the two major bottlenecks in this exercise. There is also a need to train the existing faculty in newer technological and management developments.

The ability to work in a research oriented context is important. However, a bit of the teaching and examination is based on note learning, making it difficult for graduates to adopt an analytical and research oriented approach. A lot of the new development in telecom is based on white papers posted on standards bodies, website, etc. An employee must be able to visualize how a standard specification may be turned into product. At a more detailed land, the product has to be detailed out in terms of its features and subsequent a design and implementation. For example for Product development, developers will:

- *need to work with manufacturer, and how they interface to their customers, service providers*
  undertake product testing and certification
  manage the release program
  need to manage vendors that requires high levels of coordination skills and management of quick deployment cycles

The knowledge and skill required in this process is not provided as a part of the engineering curriculum in most cases.

Several accreditation agencies have analyzed the competencies required by fresh engineering graduates to be "work ready". These are: ability to apply knowledge, design skills, problem solving skills, technical competence, communication skills, sensitivity towards global, societal, environmental issues and readiness for life long learning (Goel, 2006). However, in the Indian context, very little initiative has been taken on this account at the national level in the telecom sector. One isolated example, in a related area was the NASSCOM-KPMG (2003) task force on meeting the Human Resource Requirement Challenges for IT and IT Enabled Services.

10.0 Mechanisms to Address the Gaps

National Policy Interventions: The HRD ministry does recognize the gaps in skills for engineers. The ministry of HRD, industry associations, educational institutes need to design strategic policy interventions to address the skill gap. Policy intervention should examine the role of autonomy in enabling engineering institutes to deliver quality education. This is applicable to the larger issue of engineering education in India. The role of national level organizations such as AICTE and UGC also needs a drastic review. Since the industry is a major beneficiary of the education system, it should take a proactive role in such policy interventions. Recognizing the need for enabling skills, the HRD ministry plans to set up "finishing schools" across the country (www.nasscom.in).

Academic Institutes: Academic institutes need to undertake a comprehensive review of the curriculum. They need to review the accreditation process, and develop inter linkages with industry. Such linkages can provide opportunities to students to understand their learning in a work context and provide them a perspective on managerial issues as well. These linkages could also lead to up gradation of faculty as they work with more relevant and recent developments from the perspective of the industry. Such initiatives need a proactive approach from both sides and visible benefits. For example, Infosys has designed such an initiative for the IT industry as a whole, where it helps to upgrade the quality of teachers in engineering schools through partnerships (www.infosys.com/newsroom/infosys-in-the-news/leadership.asp). Wipro has also started a similar initiative (www.nasscom.in).

Industry Associations: Telecom based industry associations could take a variety of initiatives. For example, in Singapore, the Critical Enabling Skills Training focuses on the development of core skills and is being implemented by the Productivity and Standards Board. Singapore government provides a 70 per cent subsidy against the cost of continuing education for software developers. Ireland and Japan provide grants for tax reductions and in-house training. As another example, with the support of the European Commission, seven major ICT companies in Europe IBM Europe, Nokia Telecommunications, Philips Semiconductors, Thomson CSF, Siemens AG, Microsoft Europe and British

Telecommunications -- have formed an ICT skills Consortium and embarked on a pilot project to explore new ways of addressing the skills shortage (National Association of Software Services Companies, www.nasscom.in). Nasscom has worked with the Ministry of HRD to set up new IIITs (Indian Institute of Information Technology) and finishing schools and extending Nasscom Assessment of Competence (NAC) to IT services sector.

In addition, it plans to set up five new IIITs, based on the Public-private partnership model, by the year 2008. In all, the Ministry of Human Research & Development aims to set up around 20 IIITs over the next few years. The finishing schools will be implemented in phases. Initially they will be located at the seven National Institutes of Technology (Nasscom Press Information Note, www.nasscom.in).

Employers: Employers will need to increasingly focus on employee training and skill upgradation. The global standard for training spend is approximately 3.5% of the payroll spend (Feb 2003, The Bulletin, Hong Kong General Chamber of Commerce). Although the current training spends in India are estimated to be much lower than these figures (Arthur Anderson report, Voice and Data Annual 2001), we expect the training spends to reach the global averages in another 3-4 years, owing to the competitive nature of the industry and a much faster pace of technology changes as compared to other industries.

For existing employees companies not only need to provide life long learning opportunities not only because of technological changes but also because of new business models (outsourcing) that require new and different kinds of managerial skills.

Appendix 1: Outcomes of the Company based Qualitative Study

Objective
Provides a company perspective on employee requirement based on interviews

The Study

Coverage: Companies employing 800-1000 people (Sasken, Infosys, Philips (I) and Lucent (I))

Key organizations in the Indian Telecom Sector

Sasken Communications: Background

Sasken is a leading provider of telecom software services and solutions to network equipment manufacturers, mobile terminal vendors and semiconductor companies around the world. Sasken delivers end-to-end solutions

Richer content delivery on next generation networks in wireless and broadband technologies, signal processing and IC design.

How To Address The Skill Gaps

"Finishing schools" to give industry perspective

Sponsored project: To reduce learning time, and give project management and quality orientation.

Infosys: Background

Infosys Technologies Ltd. provides consulting and IT services to clients globally — as partners to conceptualize and realize technology driven business transformation initiatives. With over 10000 employees worldwide, company use a low-risk Global Delivery Model (GDM) to accelerate schedules with a high degree of time and cost predictability.

Infosys: Telecom

18 % revenue, 1600 people, 4 locations

Telecom segment growing faster than the rest of the company

Sees greater opportunities in NMS and OSS

Recruits 80% recruits for telecom with telecom+electronic background, 20% with Comp Sc background

Curriculum redesign cycle mismatches tech changes

Infosys: Key Skill Requirements

Ability to learn in a "research oriented context" A technology knowledge is not in text books but in research papers

To identify new standards and understand how to implement them

Project management skills

SI skills

For Product development

- *need to work with manufacturer, and how they interface to their customers, service providers*
- *product testing and certification*
- *manage the release program*
- *For carriers need to manage vendors, high levels of coordination skills and manage the quick deployment cycles*

Infosys: Recommendations

Training has to be continuous, entry, 3 yrs, 5 yrs

Mentoring is absolutely essential

Managing learning curves is becoming difficult

Course execution to be very dynamic
Need for a generic + product specific training
Training at Infosys: Generic Infosys training+ telecom industry + specific product group + specific product
Big player in Europe in EPABX (feature addition)

Philips: Background

Philips Software Centre, operating from Philips Innovation Campus PIC(A 650 member strong, ISO 9001/TickIT - SEI CMM Level 5 conpany, PSC has grown to become one of the premier software labs within Philips) Bangalore, India, was established in September 1996 as a wholly owned subsidiary of Royal Philips Electronics N.V., The Netherlands, (one of the worlds biggest electronics companies with a turnover of US$ 34 billion)with the objective of meeting the growing need for high-quality, cost-effective software development capacity within the Philips organization.

PIC has built up extensive know-how and expertise in the software engineering and technology domains relevant to its business. Pica's software expertise is primarily in the areas of embedded and information system engineering, architecture design, programming and testing. PIC's IC design expertise is in the areas of logic and circuit design.

Philips: Addressing the Skill Gap

Hiring experienced person is better. General talent pool is good. Informal sharing of info leads to greater learning
Basic computing skills thru NIIT, Aptech etc.
6 week entry level training program
Mentoring

Lucent India

Lucent India is an engineering and product co. Bell labs is the R&D company. Bell Labs looks at technologies over a 10 years horizon.
Skills Development: Software project management, documentation, technical writing
Unlike a demand based co that trains and delivers, Lucent attempts to build competencies in anticipation of future demand.

Lucent: Skill Requirements

Not only should have the domain expertise but also be able to provide end to end solutions in a domain such as Wireless data networks (understand user requirements etc)
Skill Curve
Feature development
Subsystem development
End to end
Value Addition
Large scale deployment (GSM deployment in Slovenia)
Multi level interoperability important

Lucent: Practice and Recommendations

Use their own project management practice, their own sw tools, and then give 6 month training
New employee assimilation process through mock projects

Recruitment
Experienced (difficult to hire in large numbers)
Fresh (up to 2 years experience)
Partnership model (Satyam, Wipro)

Qualitative Attributes

Complexity of the task to be performed especially in product development and marketing requires experienced specialists. The experience is closely related to the chances of "learning at work" and time of being involved in the development groups and in several development efforts. A continuous updating of individual knowledge and skills for this group of employees is urgently necessary. Time pressures on such teams is high due to involvement in design process and thus need for a faster education cycle

Highly Qualified Specialist

Organisational and vocational training implications
close cooperation with different professions
support and opportunity to update competencies
Estimation on changing demands
- low numbers (development groups are small groups but they are essential)
- ongoing need for highly skilled staff/high performance staff
- faster "induction" processes for graduates to become productive
- danger of "burn out"

For Management

Organisational and vocational training implications
- management of these units while there is an "in" and "out" of staff
- danger of "burn out"
- recruitment by internal management development procedures, partly from external companies

For Marketing Research Staff

Organisational and vocational training implications
close cooperation with different professions
support and opportunity to update competencies
Estimation on changing demands
there seems to be a scarceness in finding experienced marketing people, but less dramatic than in the technical professions danger of "burn out"

Leading -edge companies make significant investments in training. At IBM and Nokia, for example, approximately 15 out of a total of 200 working days per year are typically spent learning new skills. The search for ready-made "talent" is also on the rise, as this allows economies of time to be made.

View from the Industry

Graduates are not work ready. Often lack management, problem solving and interpersonal skills needed to be effective on the job oral communication, problem solving, team working, improving your own learning, business awareness, and creativity and innovation. [E biz national training organization in UK focuses on them]

National Strategies: Australia

In Australia, these are identified as key competencies and are a part of the National Training Strategy. All students undergo this training

National Strategies - Singapore

In Singapore, the Critical Enabling Skills Training focuses on the development of core skills and is being implemented by the Productivity and Standards Board

Singapore provides a 70 per cent subsidy against the cost of continuing education for software developers. Ireland and Japan provide grants for tax reductions and in-house training. In Latin America universities have played a major role in developing in developing software industry capabilities

National Strategies - Europe and The US

With the support of the European Commission seven major ICT companies in Europe IBM Europe, Nokia Telecommunications, Philips Semiconductors, Thomson CSF, Siemens AG, Microsoft Europe and British Telecommunications -- have formed an ICT skills Consortium and embarked on a pilot project to explore new ways of addressing the skills shortage.

Much the same emphasis on these "core" skills is found in the United States where, in a recent survey, one third of IT managers identified communication, problem solving, analytical , capacity and the ability to lean quickly, as a valuable skill set. Unsurprisingly, the balance and mix of these skills varied according to the job. Imparting these skills is emphasized in corporate universities with the aim of developing the corporate culture.

Recommendations

Engineering college curriculum redesign. Last year could be treated as a finishing school (specializing in a specific domain). More practical with Indian companies going up the value chain and having special "verticals".

Industry Associations need to work closely with

curriculum bodies.

Educational institutes

Network the experts

Helping experienced people with training (tacit knowledge, becoming as important as formal knowledge in the workplace

Recommendations

Training as a policy to retain staff.

Skill provision through the private sector: Vendors as trainers.

The move towards industry-based online learning.

Public / private partnerships for skills development.

Recommendations

Creation of a database to monitor and forecast future trends in human resource training and education

Creating awareness about studies such as this

Public Private partnership

Appendix 2: Overview of Policy Reforms in the Indian Telecom Sector

The overall policy framework for the Indian telecom sector was provided by the Department of Telecom (DOT), under the Ministry of Communications and Information Technology. Bharat Sanchar Nigam Limited (BSNL) and the Mahanagar Telecom Nigam Limited (MTNL) were the two state owned incumbents. MTNL provided services in Delhi and Mumbai: the two metros. BSNL provided them in the rest of the country. BSNL was formed on October 1, 2000. By the corporatization of DOT, It was wholly owned by the government. Government held the majority shares in MTNL. There were several private service operators in the various service segments: fixed, cellular, national long distance, international and infrastructure providers. These provide services under category specific licenses. Fixed and cellular service providers could choose the specific category license or opt for a license under the Unified Access Service License (UASL), under which they could provide both fixed and/or cellular services.

The Telecom Regulatory Authority of India (TRAI) was the regulatory authority mandated with tariff regulation, fixing interconnection terms, quality of services etc. The Telecom Dispute Settlement and Appellate Tribunal was a quasi-judicial body that adjudicated and settled disputes between service providers or licensor and licensee and reviewed appeals against TRAI directions.

Appendix 3: Key Institutes in India offering courses specific to the telecom industry

The following are the key training centres for BSNL. Some of these also provide third part training on a commercial basis.

Advanced Level Telecommunications Centre, Ghaziabad, Uttar Pradesh
Regional DoT Training Centres (44 in total)
Bharat Ratna Bhim Rao Ambedkar Institute of Telecom Training (BRBRAITT)
Circle Telecom Training Centres (CTTC)/ District Telecom Training Centres (DTTC) (27 Centre)

Other Institutes: There are some training/education in institutes that provide courses related to telecom. Some of these are:

Amity Institute of Telecom Technology and Management
Institution of Electronics & Telecommunications Engineers (41 centres)
Cisco Systems (Training & Certifications)
Symbiosis Institute of Telecom Management
Dhirubhai Ambani Institute of Communication & Information Technology, Ahmedabad
Bharti School of Telecommunications Technology (in collaboration with IIT, Delhi)
Usha Martin Academy of Communication Technology (with IIT, Chennai)
The Centre for Development of Advanced Computing, Mumbai
Institution of Electronics & Telecommunications Engineers

The following training options are available:
On-site - Internal
On-line / CD Based
Outsourced
Offsite (At universities /Institutes)

Source: Voice and Data

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