Labor Market and Skills Gap in the ICT Sector in Bangladesh: An Exploratory Study

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Abstract

Considering the huge potential of the ICT sector as a driver of development, this study attempts to assess the labor market prospects and skills gap in the ICT sector in Bangladesh. The study also estimated the projected demand for the required human capital for the next ten years considering the expected growth of the economy. Currently the number of IT professionals working in Bangladesh is about 0.22 million, and it is estimated that the demand for the required human resources would be doubled (0.44 million) by 2025. The majority of the current workforce excels in pure technical tasks, such as programming and networking. About 40% of the required IT positions remained vacant due to skills shortage, and within the existing pool of IT workforce, 60% are skilled and the rest are semi or non-skilled. Though every year about ten thousand IT graduates enter the market, most of them are not well acquainted with the industry needs due to lack of proper training and industry-oriented education. The industry faces the shortage of a strong pool of mid-level product/project managers that hampers the expected growth of the industry. Updated curriculum, strong industry-academia linkages and IT skill development programs are some of the suggested measures that may mitigate the skill gap for the sector as well as enhance growth prospect of the sector.

Key Words: *Labor market, Skill gap, ICT sector, Bangladesh*

1. Introduction

The process of industrialization of countries like Japan, the ASEAN 4 and now South Asian economies follows the flying geese model that start off with manufacturing nondurable

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consumer goods like apparel and then progress to durable consumer goods, and then capital goods of higher value (Lopez-Acevedo and Robertson, 2016). The export-led growth in these countries was initially supported by labor-intensive apparel sector and then progressed towards capital-intense sectors like electronics and ICTs. The current situation of Bangladesh appears to be almost similar to that of East Asian countries as the country's current growth is supported heavily by the apparel sector that constitutes more than 80 percent of its export worth about USD 33 billion. Considering the sluggish growth prospect of various other sectors, the next promising export sector for Bangladesh appears to be electronics and Information and Communication Technologies (ICTs)[2] that can surpass the apparel sector in the medium to long-run because of its comparative advantages in terms of market demand, abundant supply of cheap required labor force and easy process of technology diffusions (Hossain et al., 2012).

The ICT sector in Bangladesh comprises of IT (software), ISP, Call centers, Telecommunications and hardware sectors. Excluding telecommunications and hardware, the market size of the ICT sector is now about US$ 2 billion in Bangladesh of which export earnings is about US$ 1 billion (BASIS, 2017). The industry sets a target to achieve US$5 billion to be achieved by 2021. Most of the IT firms are small in size and about 70% are domestic market oriented. The industry started growing after 2000, when the government started liberalizing the market to a greater extent. Currently, the industry employs over 0.22 million people of which roughly 50% are IT professionals. The software and ITES exports registered rapid growth after 2010 at a compound annual growth rate of 37%. The rapid emergence of ICTs paves the way for further development of electronics and computer hardware industry. With a 40% growth of both personal computer (PC) market and electronics market in a country of 160 million in 2017, this sector is intensely amalgamated with assembling and repairing services having strong potential to enter into manufacturing.

Two factors, the phenomenal growth of the mobile phone service and the "Digital Bangladesh" initiative of the government, have been instrumental to the current growth of the ICT service sector. Mobile phone penetration in Bangladesh is one of the highest in the developing economies with a tele-density of over 79 percent. The internet penetration rate is estimated to

[2]ICT is an umbrella term that includes any communication device or application, encompassing radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning. According to the OECD, ICT in manufacturing and service industry means that the industry must either perform information processing and communications by electronic means or use electronic processing to measure or control a physical process (OECD, 2000; p. 7).

be 12 percent in 2012 and 27.8 percent in 2015, with most people using mobile internet (Digital Bangladesh Report, 2015). The use of international bandwidth has increased by 200 percent in 2011 with capacity upgrades for international bandwidth of over 500 percent underway (UNCTAD, 2016). These are strengths for development of the ICT service sector. With various initiatives of the government and the private sector, usability of ICT enabled services by the people has been growing steadily over time. The number of internet, mobile and fixed telephone users and the amount of investments in ICTs has been expanding over time. However, to reap the benefits of ICTs at its full potential, it is necessary to put appropriate policies for human capital development in place.

The importance of skilled manpower for the growth of the ICT sector is well recognized. Although reaching an initial level of development of the ICT sector is possible with the availability of human capital, further growth of this sector is not possible without improving the dynamic capabilities of the firms. Dynamic capabilities of firms, reliant on skilled manpower, enables firms to use changing opportunities to carve out a niche in the export of outsourced services as well as to understand which product market or business model best utilizes the internal and external assets of the firms (Athreye, 2005). Mid-level managerial skill is essential to achieve various goals through their dynamic and innovative capabilities. Therefore, ensuring the availability of skilled workforce is the key to achieving expected growth in the ICT sector.

The purpose of the present study is to explore the current situation of skills and employment in the ICT industry and understand how to overcome the existing skills constraints. The findings of the study will help articulate a proper strategy for facilitating the development of the ICT sector in order to contribute effectively to the objective of the growth of the economy. The study has the following specific objectives: (i) assess the current level of skills and the gap in skills in terms of availability and quality; (ii) assess the supply side capacity of the academic and training institutions to mitigate the gap in skills; (iii) estimate demand for skilled workforce in the next ten years considering the growth of the industry; (iv) identify the emerging thrusts of the ICT sector, and (v) assess the training needs and ways of implementing the training programs.

The study undertook a mix of both qualitative and quantitative approaches for assessing the skills gap. The data collection method includes a sample survey of 15 ICT firms which were selected purposively and Focus Group Discussions (FGDs) were held with various industry

associations, such as BASIS, ISPAB, BACCO and BCS (Table A1 in the appendix). In addition to the surveys and FGDs, relevant literatures and documents are reviewed to assess the skills gap in the ICT industry[3]. The findings are drawn mainly for IT, ISP, Call centers and, to some extent, computer hardware sector which is mainly amalgamated with assembling and repairing services. This study uses the sector-wise elasticities of labor demand estimated by Rahman (2016) to make a projection of labor demand in different ICT sub-sectors and in different IT occupations for the next 10 years up to 2025. In a similar vein, the study also projected the number of IT professionals who need further training.

The paper is structured as follows. After Introduction, Section 2 highlights the current state of the ICT sector in Bangladesh and Section 3 discusses the employment and skill level in the sector. Section 4 analyzes the competencies of IT professionals and Section 5 analyzes the skills gap in the ICT sector. Section 6 projected the demand for IT professionals for the next 10 years and section 7 gives a brief account of IT education and training in Bangladesh. Section 8 concludes the paper.

2. Current State of the ICT Sector in Bangladesh

The ICT sector has strong potential to provide an opportunity for developing countries to 'leapfrog' into the industrialized economy status by skipping the stages of development (Perez and Soete, 1988). The rapid expansion of telecommunications over the last decade has led to the emergence of the offshore/outsourcing industry. The market size of the global offshore/outsourcing industry has been increasing rapidly, from US$252 billion in 2010 (CGGC Report, 2010) to US$484 billion in 2014 (Everest Group, 2015). Globally, the IT outsourcing (ITO) captures the major share of the outsourcing market (63%), followed by BPO (33%) and KPO (4%). While ITO witnesses a compound annual growth (CAGR) of 5.3%, BPO witnesses 6.5% and KPO witnesses 12% growth (Asia Pacific Outsourcing Summit, 2013). India, Brazil, Malaysia, and some East European countries have already captured a substantial portion of the outsourcing business. Some developing countries including Bangladesh have the potential to gain from this industry because of availability of cheap, trained and educated human capital and technologies[4]. The main concerns for these economies to build IT capabilities much faster and push trajectories in more relevant directions.

[3] The telecommunications sector has not been included in the analysis.
[4] Gartner (2010) identified Bangladesh as one of the emerging top 30 outsourcing destinations.

With various policy supports[5] of the government and private sector and strong base of ICT infrastructure[6], the ICT sector in Bangladesh has been growing steadily over time (Table 1). Internet users, mobile and fixed telephone users, tele-density and investment in ICTs have been expanding over time. As the Table 1 shows, the number of internet users and investments in the sector has increased to more than double over the last 7 years.

The ICT sector of Bangladesh currently comprises of about 2000 software firms (997 firms are registered with BASIS), 2000 Internet Service Provider firms (557 got license from BTRC and the rest are operating without license, but only 64 firms are registered with ISPAB), 282 licensed call centers (only 76 Call centers are registered with BACCO), 10 mobile phone operators, 37 IIG (International Internet gateway Service), 4 NTTNs (Nationwide Telecommunication Transmission Network) firms, 12 PSTN (Public Switched Telephone Network) operators, 65 VSAT, 26 Interconnection Exchange (ICX) Services and 2500 hardware sales and servicing centers (detailed numbers are given in Tables A2 & A3 in the appendix). According to industry insiders, the domestic market for ICT services have been expanding rapidly, and currently the size is estimated to be about US$1 billion excluding the telecom sector.

The sector currently employs roughly about 0.22 million IT professionals, of which 35000 belong to software industries, 30000 belong to freelance software service, 50000 belong to IT jobs in different NGOs and other sectors. About 50000 IT professionals are now engaged in ISPs, 30000 in call centers, 20000 in other NTTN, PSTN, IIG etc. and only 2500 in hardware sector (Table 2).

2.1 Software firms

Most of the software firms (about 70%) are domestic-market oriented and about 30 percent of the firms export software and ITES. Domestic demand for ICT services mainly comes from the financial, telecom, health and garment sectors and for exporting firms, services in ERP (Enterprise Resource Planning) are at the higher end of the value chain, followed by GIS and

[5] The National ICT Policy 2009 was formulated to facilitate the materializing of “Digital Bangladesh” which the government has pledged to build within 2021. Very recently, the government has approved the National ICT Policy, 2015.

[6] Bangladesh is now connected to second submarine cable network and several software IT parks are under construction.

digital contents, graphics, e-commerce, website development and BPO services (Hossain et al, 2012).The software and ITES exports registered rapid growth after 2010 at a CAGR of 37% (Figure 1). The software and ITES companies are currently exporting their products and services to over 60 countries and earn about US$1billion. The USA remains the top destination of software exports, followed by UK, Canada, Australia, Denmark, etc. (BASIS, 2017).

Regarding employment, about 35,000 IT professionals are engaged in the software industry and additional 30,000 or more are working as freelancers (BASIS, 2017). About 30,000 freelance programmers are now working from their homes in Bangladesh for different global companies[7] and they roughly earn a sum of around US$15 million per year with an impressive 200 percent annual growth (IER, 2012). However, according to industry stakeholders, the number of freelancers would be much higher than the reported one. Of the freelancers, 43 percent were involved in IT programming, 24 percent in designs and multimedia, 16 percent in sales and marketing, 10 percent in administration support, 5 percent in writing and translation and 2 percent in miscellaneous jobs. The freelancers were hired mainly from USA, Canada, UK, Australia and Singapore. About two-thirds of the freelancers from Bangladesh find work order through oDesk[8]—a global job marketplace for remote workers. Bangladesh has been competing with India, Pakistan and some Eastern European countries for freelance work, with its high caliber pool of Bangladeshi IT professionals.[9] Freelancers earn about US$15 to US$20 per hour on average for technical work, and US$5-10 for administrative or non-technical work. While Bangladeshi freelancers did 2 percent of the total work of oDesk in 2009, it rose to 12 percent in 2012 (BASIS, 2013).

With the impressive performances of freelancer entrepreneurs, the Ministry of Information and Communication Technology has undertaken various initiatives to train about 15,000 people each year on freelancing skills, such as SEO, animation, graphics, video editing, etc. The ICT ministry has taken some projects through which they will train people to become freelance entrepreneurs. The training module will include skills in advanced IT, business and communicative English.[10] Moreover, an initiative is now ongoing to establish an Institute for freelancers at Natore, Rajshahi.

[7]According to AKM Fahim Mashroor, former president of BASIS; Daily Star, 3 December 2012.
[8]Elance and oDesk have merged.
[9]Matt Cooper, vice-president of oDesk, The Daily Star, Dhaka, May 27, 2012
[10]Md. Nazrul Islam Khan, Secretary of Ministry of ICT.

In Bangladesh, more than 95 universities and 200 polytechnic/technical institutes are now producing around 10,000 IT/computer graduates every year (Figure 2). However, this number of graduates does not appear to be sufficient to cater to the needs of the sector given the prospects of higher growth. Capacity building of IT institutes to produce more qualified IT graduates could be an important agenda for further development of this service sector.

2.2 Internet Service Providers (ISPs)

Mobile phone penetration in Bangladesh is one of the highest in the developing world with a tele-density of over 79 percent in 2015. The internet penetration rate was estimated to be 12 percent in 2012, which had increased to 27.8 percent in 2015 with most people using mobile internet (Digital Bangladesh Report, 2015). The use of international bandwidth has increased by 200 percent in 2011 with capacity being upgraded recently for international bandwidth of over 500 percent. These are the strengths for the development of the ICT service sector.

According to ISP Association of Bangladesh (ISPAB) officials, currently more than 2,000 ISPs are operating in Bangladesh, of which 550 took licenses from BTRC. Only about 90 ISPs are registered with ISPAB. About 40,000 people are now involved with the ISPs. Of the workforce, 30-50% are IT professionals and the rest are non-IT but they do have basic computer/IT literacy. The bigger ISPs having employees of about 400 (nearly 10-20 firms) are amalgamated with ISP and Software services.

The importance of ISPs in the ICT sector can be highlighted by the extent of bandwidth usage. In Bangladesh, the bandwidth of about 225 GBPs are being used per month, of which while around 60 million mobile phone subscribers use 70-75 GBPs, only 4 million ISP subscribers use the rest 140 GBPs. The size of the market for broadband internet is about Tk. 500 million and about 0.8 million customers are added every year to the broadband customer base. Currently two NTTNs are providing cable/connectivity (transmission) services to ISPs which appears to be inadequate for the ISPs. Thus, the ISP sector appears to have huge potentials to grow.

2.3 Call Center and BPO Services:

About 80 call centers are now operating in Bangladesh, employing about 30,000 people in the sector. Of the call centers, 80-85% are voice and the rest 15-20% provide non-voice outsourcing services, mainly knowledge process outsourcing (KPO) services in the areas of

Accounting, Human Resource Management and Legal services. Most of the centers are domestic market oriented. Bangladesh Association of Call Center and Outsourcing (BACCO) claims that BPO services have earned over US$150 million revenue in recent days. The BPO/call center services does not require highly educated people, rather they need professionals having HSC exam pass or undergraduate level qualification with excellent command on soft skills including proficiencies in English. According to BACCO officials, though the country has huge potentials of BPO services, it could not tap the potentials due to the dearth of trained and qualified people with soft-skills and IT-BPO skills. This is an area where further interventions are required to tap the potentials of the BPO market.

The BPO industry has been experiencing a staggering growth in the last 6-7 years. While the size of the market was US$ 4 million in 2008-09, it reached US$ 150 million in 2015, registering a phenomenal compound annual growth of about 500% (Figure 2). Considering the growth prospects and the requirements of low level educational qualification of employees, the industry has huge growth potentials if proper policies, particularly human resource development policies are put in place.

2.4 Hardware Sector

The hardware segment of the IT industry appears to have the largest number of firms, approximately 10,000 but it also appears that this sector is intensely amalgamated with assembling and repairing services. Most of these firms sell computer and computer related accessories and roughly 60,000 PCs and laptops are sold per month in Bangladesh. The industry stakeholders suggest that the hardware sector has a current employment of about 2,500 hardware/system engineers having diploma or some other training on computer hardware systems. Most of these professionals have completed HSC exams with a few exceptions of having higher degrees. Most of them are trained in BIOS editing, BGA installation, micro-chip and basic computer knowledge. It is a big plus for the Bangladesh IT/ITES industry to have around 3 million laptops/PCs being available and over 750,000 computer savvy users.

Though repairing and assembling services of computers/laptops are adequately placed, Bangladesh could not yet step into the manufacturing of computer parts and accessories. Mobile sets, LED TVs and refrigerators are now being manufactured at a smaller scale by a Bangladeshi company named Walton with technology support from Chinese companies. Walton captures almost 70% of market demand for refrigerators by producing about 2 million

units every year. The year-on-year growth of sales of refrigerators increases by about 25%. On the other hand, there is a demand for 1 million TV sets every year. In addition to about 30 local companies that are involved in assembling and manufacturing electronic appliances, international electronic giant Samsung opened up two appliance plants in 2017 to manufacture four items, such as LED TV, Refrigerator, air conditioners and micro-wave ovens (Islam, 2017: The Daily Star). Thus, the demand for hardware engineers in this sector is on the rise though now it is somewhat stagnant.

3. Employment and Skill Level

3.1 IT Professionals and their Skills

The ICT industry basically requires about 10 categories of professionals, namely Project/Product Manager, Programmer, System Analyst, Database administrator, software engineer, hardware/system engineer, web developer, graphic designer, quality and assurance (Q&A) and technician/operator. The availability of these categories of professionals is assessed in this study. The owners/CEOs of the firms were requested to assess the availability in a 5-scale availability ranks (scarce, moderate, highly available etc.). Based on the survey results, the proportion of availability of professionals of each category has been estimated and plotted in Figure 3. The results suggest that there is a huge need for Programmers/System Analyst/software engineer and Q&A professionals as there exists only about 40% of the required demand. Similarly, existing supply of Project/Product managers (mid-level professionals) and Graphic designers can meet up only about 50% of the current demand. On the other hand, though having adequate supply of web developers, database administrators and hardware/system engineers, there is scarcity of trained operators and technicians in the industry.

Four different ICT sub-sectors (Software, ISP, Call centers and Hardware firms) require different sets of IT professionals based on the nature of their jobs. The distribution of the existing pool of IT professionals according to job category suggests that the majority of the IT professionals in a typical software firm are either programmers or software engineers (about 60%). Only about 10% of total employees are mid-level product/project manager. In ISP firms, among the professionals majority are networking or hardware engineers (50%) and about one-quarter belong to each of the manager and programmer categories. For call centers and outsourcing businesses, 80% of the staffs are BPO operators/technicians and only about 15% belong to

management categories. For hardware firms, 75% belong to the managerial job categories and 25% to the hardware engineer category (Table 3).

Among the IT professionals, managers are the most experienced professionals. While the product/project managers do have experiences of about 5 years on average, most other professionals do have experiences about 3 years. The operators and technicians are relatively less experienced as their tenure ranges between 1-2 years (Table 3).

3.2 Level of Skills

For software firms, the most commonly required IT skills include JAVA, Net, HTML5, ASP, JSP, Ruby, Python, C/C++/VC, CSS3, Mongo DB, Postgre SQL, Node JS, Big Data, other database software/applications (MS SQL, Oracle, UNIX/Linux/Solaris, XML), and mobile applications (Android, iOS, J2ME) as these are recognized by most of the surveyed firms (Table 4). The ISP and call center professionals mainly require knowledge on basic computer literacy, C/C++, JAVA, HTML5 and database applications. The industry stakeholders have identified these as the potential programming languages and applications on which a higher demand for training exists.

The level of skills of IT professionals, as recognized by their employers, is reported in Table 5. E-governance and mobile-based applications suffer from a dearth of highly skilled professionals while other sectors have been able to acquire a majority of highly skilled professionals to their credit. It is also evident that a certain proportion of semi-skilled professionals are engaged in Graphics and Mobile phone applications. For ISP and call/BPO centers, majority of the staffs are skilled (about 60%). For hardware assembling and repairing services, majority of staffs are reportedly highly skilled (67%) and one-third are just skilled.

Regarding performance, only about 20% are ranked as “Excellent”, 35% as “Very Good”, 35% as “Good” and the rest as “Moderate” (Figure 4). About 35% of Product/project managers and database administrators were ranked as “excellent” and less than 20% of the other categories were ranked as “excellent”. Most of the categories of professionals fall in the “good” and “very good” categories. The survey findings suggest that despite the scarcity of professionals, 45% of the existing categories of professionals (almost 45% excepting those that are excellent and very good) need further training to improve their performances.

3.3 Female employment in the sector

The ICT sector appears to be lagging behind in making gender balance in employment. Gender wise breakdown of existing employees in different sub-sectors of the ICT suggest that except for call centers, the proportion of female employee is less than 20% in most of the categories of occupations (Figure 5). Therefore, there is a need for labor market strategies to improve gender balance in the ICT sector.

4. Qualifications of IT Professionals

4.1 Academic qualifications

Educational qualifications of IT professionals are reported in Table 6. Except managers and graphic designers, all other IT professionals have Bachelors and/or Masters Degrees. Though most of the IT professionals have Engineering degrees (CSC/CSE/EEE/SE/ETE), about 20% have non-engineering bachelor's degrees but undertook various industry certification trainings. About 45% of managers have non-engineering degrees, particularly those are involved in ISP, call centers and hardware firms. The operators and technicians are required to have only Diploma/HSC certificates. Among the graphic designers, about 29% have non-engineering degrees (Table 6). The findings suggest that though majority of the employees in the ICT sector do have IT/engineering degrees, a certain proportion (about 20%) of employees engaged in the sector without having such degrees. Non-IT professionals are reportedly acquainted with IT issues by undertaking various professional IT trainings.

4.2 Training

Regarding training opportunities, our survey results reveal that about 67% of the firms offer apprenticeship/internship facilities for fresh graduates, the duration of which ranges between 3 to 6 months (Table 7). After successful completion of the program, outstanding participants are also offered jobs in the firm. "On the job" training is required for almost all newly recruited staffs. About 75% of the IT staff undertook training from external training institutes, mainly those that are offered by the government and industry associations. About 25% of the employees receive training from firms' own training institutes.

4.3 Emerging areas/thrusts of IT skills

Though BITM has designed a list of new courses to be undertaken in the future program through stakeholder consultations, our survey reveals that some more new courses need to be designed and offered in line with the emerging thrusts of the IT sector. The demand for IT skills is likely to emerge in the future from the following areas: Internet of Things (IoT), Cyber security, Artificial intelligence (AI), Gaming, Cloud Computing etc. (Table 9). The BACCO officials strongly argued that if an IT-BPO course (possible a one-semester course) is designed for the students of business studies, it will create a huge boost to the supply of professionals for the emerging BPO sector. At present, no such courses are offered in Bangladesh though this course is available in many countries including the Philippines. All the three sectoral Associations admitted that the IT professionals in the country suffer from the deficiencies of soft-skills, such as English proficiency and business communications. Therefore, complementary training courses on soft-skills could be made mandatory along with the regular IT training courses.

5. Skills Gap Analysis

The analysis of skills gap in the IT profession is not straightforward and therefore requires a multi-dimensional approach. The gap can be assessed from three perspectives: (i) availability; (ii) Weaknesses of the existing pool of IT professionals and (iii) Mismatch between current skills and future demand.

5.1 Weaknesses of the existing pool of IT professionals

Considering the current supply of IT professionals/graduates, there is no particular gap in the quantity demanded and supplied. However, as far as quality is concerned, there has been a huge gap/dearth of skilled IT professionals. Based on the availability and skill level information obtained from the survey findings, a summary of skills gap has been shown in Table 8. The results show that about 60% employees in the existing pool are skilled/highly skilled and there is a shortage of 40% skilled professionals in the industry. There is a huge need for programmers/system analyst/software engineer and Q&A professionals as well as for project/product managers (mid-level professionals) and graphic designers. However, the existing pool can meet up only about 60% of the required demand (Table 8).

Though the academic institutes and other vocational and IT training institutes produce roughly 10,000 IT professionals every year, many of them are absorbed in non-IT professions and some

remain unemployed. The situation can be explained from both demand and supply-side perspectives. The IT industry has been facing problems in getting adequate projects from both domestic and foreign markets due to stiff competition, which is attributable to various other causes like problems in public procurement policies, IT infrastructure bottlenecks, Tax/VAT policies etc. On the other hand, the graduates supplied by the formal educational institutions lack proper skills required for the industry. The main reasons behind under-supply of required skilled graduates are, *inter alia*, lack of linkages between industry and academia, lack of up-to-date IT curriculum, and the shortage of R&D labs.

Most of the newly recruited IT staffs need on-the-job training and other trainings which incurs huge costs to the employers. Moreover, as there has been a substantial gap of skilled employees, the mobility of the trained staff is also high which costs them significantly as well.

5.2 Mismatch between current skills and future demand

The shortage of skilled manpower and shortage of required professionals for the emerging thrusts of the IT sector are two key challenges for the ICT sector. Since the country currently faces a shortage of about 40% of the required skilled manpower in the sector, industry growth and investments are likely to be severely affected in the future. Proper policies and training programs thus need to be adopted to mitigate this gap of skilled manpower in the ICT sector.

On the other hand, as the existing pool of IT professionals are not adequately trained in new emerging IT issues, the academia needs to adjust their curriculum to accommodate the emerging thrust sectors/issues (as highlighted in Table 14). The current extent of the shortage of skilled IT professionals restricts FDI inflow in this sector to a great extent.

6. Projected Demand for IT personnel and Training

6.1 Projected demand for IT personnel

The current employment in the ICT sector has been estimated and projected for the next ten years in Table 9 based on the information received from the industry stakeholders through focus group discussions and key informant interviews. The projections are made considering the current level of growth of the industry as well as the existing gap in the required IT professionals. For example, the software industry has set a target to achieve US$1 billion exports by 2018 under “One Bangladesh Vision”. The BPO industry also sets a target to achieve

US$1 billion by 2021. Therefore, these sectors roughly have to increase their output by 150% annually and the consequent increase of employment would be roughly 20-25% per annum. However, according to a BIDS study, the annual growth of labor demand is at around 10% or below considering the current growth of the industry (Rahman, 2016). Considering the same growth rates, the projections of labor demand have been made here. As the ICT industry currently employs about 0.22 million people, considering this figure as the base, we have forecasted manpower demand for the next 10 years in Table 9. The forecast shows that labor demand for the ICT sector (excluding telecommunications) would be about 0.44 million by 2025.

6.2 Projected labor demand for sub-sectors

Based on the estimated proportion of labor in each of the occupations of the subsectors given in Table 3, projections of manpower demand for different occupations are made in Table 10 assuming that the same will continue over the next ten years. Though this is a conservative assumption and estimates are based on linear projections, the projections can be improved with increased number of samples. However, the projected estimates of labor demand for various occupations will likely to make sense, if there is no big structural change in the ICT sector.

According to the forecast, the demand for programmers/system analyst/engineer and product/project manager will be three-fold in the next 10 years. For the software industry, the projected labor demand is 0.035 million and 0.21 million for managers and system analyst/engineers respectively in 2025. Similar projections are made for other ICT sub-sectors.

6.3 Projected Training Demand for 10 years

In a further attempt, the demand for training by IT professionals across different occupations has been estimated in Table 11. For the estimation, first, the need for training of the existing pool of labor has been assessed through our survey results on the performance of the employees in a 5-scale performance ranking (see Table A5 in Annex). It is assumed that the proportion of employees whose performance is evaluated as good or below will need further training. The proportion was then plugged into the estimated labor demand given in Table 10 to get the desired demand for training of the IT professionals. The estimates suggest that higher demand for training comes from system analyst, web developer, Q&A, and operator/technicians. Therefore, based on emerging demand for training, strategic plan for training programs needs to be spelled out.

7. IT Education and Training in Bangladesh

Currently, both public and private universities have been producing about 10 thousand IT graduates every year in Bangladesh (Figure 6). The students pursuing IT education in the country have shown tremendous potential in recent years by winning international programming contests and developing various software. In addition to the universities, there are a quite good number of Diploma/Vocational Institutions in the country that provide IT training and education (Table 12). At present, around 71 universities, 40 colleges and institutions and 300 IT centers have been offering various IT related training courses in the country (Digital Bangladesh Report, 2011/2015). These institutions mainly offer engineering and computer science degrees at the university level as well as short-term IT courses and industry certification courses namely CISCO, Apple, SUN, JAVA and other certified courses. However, the interviews with the stakeholders revealed that the training facilities in these institutes are inadequate and the types of training provided do not commensurate with the industry requirements. Most of the training institutions provide training on basic computer skills. Only a few institutions (NIIT, Aptech, Base etc.) provide advanced level of training courses. However, they lack the relevance to the actual needs of the software companies. Professionals have the option to acquire certifications provided by Microsoft Certified Partners. To overcome the deficiency of the institutional training facilities, almost all companies have developed in-house training programs. Moreover, they strongly recommend for allowing foreign investors to do the same.

To mitigate the skills gap in the industry, BASIS started its own training institute in 2012, namely the BASIS Institute of Technology & Management (BITM) with support from the World Bank. BITM was established with a view to addressing skills gaps of the fresh IT graduates and make them ready to be absorbed into the industry. The BITM is now receiving various supports from the Skills for Employment Investment Program (SEIP) of the government to train up to 23,000 IT professionals over the period of 3 years. A total of 5000, 9000 and 9000 trainees will be trained in the 1st, 2nd and 3rd year respectively. BITM has been offering twelve IT and one soft-skill training courses for the new entrants and the duration of the courses ranges between 1 and 3 months (Table 13).

Considering the future demand for new skills in the Industry, BITM has been planning to offer some other 13 new IT courses and 5 soft-skill training courses.The management of BITM and

trainees feel that the duration of trainings which is now up to 3 months, is inadequate and thus needs to be extended up to 6 months.

7.1 Capacity building of IT training institutes

Many training institutes have been offering various IT training courses in the country. However, they mainly offer basic computer literacy trainings except for a few who offer quality IT training. Academic institutions provide degrees on IT and related fields; however, such curriculum does not fit into the requirements of the industry. Currently BITM has been offering some training courses taking into consideration the industry needs and it receives support from the government and donors. However, it could accommodate only 1,500 trainees in each quarter with the duration ranging between 1-3 months. This training institute receives huge attention from the potential trainees and therefore its capacity needs to be enhanced. Similar types of institutes need to be established under the aegis of other Associations, such as BACCO and ISPAB. Hardware related training programs is another neglected area in Bangladesh. Some of the hardware professionals undertook training from India by their own efforts. So the BCS or the BCC could be given the responsibility to organize training programs on hardware aspects.

7.2 SEIP Program

The Bangladesh Government has established a Skills for Employment Investment Program (SEIP) with assistance from Asian Development Bank (ADB) and Swiss Agency for Development & Cooperation (SDC) to enhance skills of 1.5 million people during 2014-2020. For the ICT sector, under the program a total of 23000 professionals will be trained in three years with promise of gainful jobs. The Program also intends to provide technical support to some Universities to design and upgrade their IT curriculum aligning with industry needs and job oriented.

8. Conclusions and Recommendations

The core strength of the Bangladesh's ICT sector is the abundance of human capital with intellectual aptitudes. The main challenge is to train them and prepare them as per the need of the industry. It is also noteworthy that though initial human capital is required to move the industry forward, the further growth of the industry depends on the dynamic capability of the

firms which critically hinges upon mid-level managers/professionals. The industry is now in need of a strong pool of mid-level experienced professionals.

The number of IT professionals working in Bangladesh is now about 0.20 million, the demand for IT professionals is expected to reach 0.44 million by 2025. The current pace of producing 10 thousand IT graduates every year is not sufficient to meet the emerging labor demand and therefore capacities of both educational and training institutes need to be enhanced to meet the growing labor demand in the IT sector. Another potential problem is that most of the university graduates lack sufficient skills to be absorbed in the industry due to lack of proper training and industry-oriented education. Currently there exists a demand-supply gap of around 40% in the portfolio of IT professionals, and among the existing pool of IT workforce, 60% are skilled and the rest are semi or non-skilled. As industry grows, the gap will be widened if proper measures are not taken. The key findings on skills gaps in the ICT sector can be summarized as follows.

- Fresh graduates are not adequately trained to enter into the industry due to the outdated curriculums followed by the educational institutions and the lack of linkages between the industry and academia;
- Our projections suggest that the labor demand in the ICT sector would be doubled in the next 10 years and the demand for training will also be enhanced which has to be met with appropriate policies to facilitate the growth of the sector as well as the economy;
- The industry faces shortage of a strong pool of mid-level product/project managers that hampers the expected growth of the industry;
- Most of the existing IT training institutions impart sub-standard training programs, which could not fulfill the skills requirements and therefore it is important to streamline their curriculum and ensure certain standard of training in these institutions;
- The need for developing standardized and uniform IT training curriculums has been felt enormously by the industry stakeholders so that a minimum level of quality of training can be ensured;
- It is also strongly recommended by the concerned stakeholders to establish some centers of excellence in IT training to mitigate the skills gap in the ICT sector; and
- It is also observed that existing training programs offered by respective institutes do not give due diligence to the emerging thrusts of the IT sector.

The development of the ICT sector is important to enhance overall development of the country through technology acquisition in various sectors and facilitating the employment and growth. Moreover, the ICT industry itself has the huge potential to grow. However, the development of the ICT sector critically hinges upon availability of proper human capital base. Based on the above skills related issues, we recommend that building some training institutions, updating ICT curriculum, devising proper strategies for linkages between academia and industries could be the possible measures that can address the growing demand for appropriate human capital by mitigating the existing skills gap in the ICT sector.

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Tables and Figures

Tables

Table 1: ICT development indicators in Bangladesh, 2008-2015

Indicator / Year	2009	2010	2011	2012	2013	2014	2015
Internet Users (per 100 people)	3.10	3.70	4.5	5	6.63	9.60	n.a.
Secure Internet Servers (per 1 million people)	0.19	0.31	0.64	0.73	0.77	0.86	1.32
Telephone Mainlines/ Fixed Telephone Subscription (per 100 people)	0.82	0.85	0.65	0.62	0.691	0.615	n.a.
Mobile phone subscribers (million)	46.41	70.34	59.98	87.7	98.6	115.63	123.7
Tele-density (%)	34.05	44.6	47.8	61	64.64	77.81	79.3
Investment in Telecoms with private participations (in million US$)	372.00	520.50	494.00	412.00	662.00	657.10	n.a.

Sources: World Development Indicators, The World bank. BTRC Bangladesh; n.a.- Not Available; Digital Bangladesh Report 2015, Ministry of Finance, Bangladesh

Table 2: Employment Status of IT Professionals in the ICT Sector in Bangladesh

	Sector and Subsectors	**Total employment (current)**
1.	Software	
	a. Software firms	35,000
	b. Freelance	30,000
	c. Other private, public and NGOs	50,000
2.	ISPs	50,000
3.	Call centers and BPO centers	30,000
4.	Hardware (IT professionals)	2500
5.	Others (NTTN, PSTN, IIG etc.)	20,000
	Total	**2,17,500**

Source: Focus Group Discussions with Industry Leaders, 2016

Table 3: Percentage distribution of IT staff in different sectors by job category

Categories	Software (%)	ISP (%)	Call Centre (%)	Hardware (%)	Average Experience
Project/Product Manager	10	23	15	75	5 years
Programmers/ System Analysts/ Software Engineer	60	25	5		3 years
Database Administrator	6	2			3 years
Hardware/system/ networking	-	50	-	25	3 years
Web Developers	7				3 years
Graphic Designer	4				3 years
Quality & Assurance	5				3 years
Operator/Technician	8		80		2 years

Source: BIDS Survey, 2016

Table 4: Specific types of skills required according to major activities (in percentages)

Types of Skills	Software (%)	ISP (%)	Call Center (%)
Software			
Basic computer Knowledge	12.5	33.3	75
C/C++/VC	37.5	33.3	-
JAVA	75	33.3	25
Net	75	33.3	25
HTML 5	100	33.3	25
ASP	50	-	
PHP	75	-	25
JSP	50	-	-
Java Beans	12.5	-	-
CGI Perl	12.5	-	-
Node JS	37.5	-	-
Python	50	-	-
Ruby	62.5	-	-
Scala	12.5	-	-
CSS 3	37.5	-	-
JS	25	-	-
Mongo DB	37.5	-	-
Pouch DB	12.5	-	-
Big Data	37.5	-	-
Postgre SQL	37.5	-	-

No SQL	25	-	-
C Sharp	12.5	-	-
Realm	12.5	-	-
Database			
MS SQL	75	66.7	-
MS Access/ Fox pro	12.5	66.7	-
Oracle	50	33.3	-
My SQL	75	66.7	25
MS NT 2000, 2006	37.5	33.3	-
UNIX/ Linux/ Solaris	62.5	66.7	-
Lotus Notes	-	33.3	-
XML	50	-	-
UML	37.5	-	-
Mobile Applications			
Android	100	33.3	-
iOS	75	33.3	-
J2ME	25	-	-
Action script 3	12.5	-	-

Source: BIDS Survey, 2016

Table 5: Level of skills according to the types of activities (in percentages)

Software	E-commerce	E-Governance	GIS/ GPS	BPO	Data entry	Website	Graphics	Multimedia	EPR	Mobile application
Highly skilled (%)	60	33.3	66.7	-	66.7	100	66.78	100	50	40
Skilled (%)	40	66.7	33.3	100	-	-	-	-	50	40
Semi-skilled (%)	-	-	-	-	33.3	-	33.3	-	-	20

Level of skills	IT-BPO and call centers	ISP	Hardware	
			Assembling	Repairing
Highly skilled (%)	5	25	66.7	66.7
Skilled (%)	67	60	33.3	33.3
Semi-skilled (%)	28	15	-	-

Source: BIDS Survey, 2016

Table 6: **Educational qualifications of IT Professionals**

	Bachelors-Engineering	Bachelors-Non Engineering	Masters-Engineering	Masters-Non Engineering	Diploma/ HSC	Other trainings
Project/Product Managers	32.14	23.86	25	20.29		
Programmers	60	20	20			
System Analysts	40	10	50			
Database Administrators	75		25			
Software Engineers	50	16.67	33.33			
Hardware/System Engineers	58.33	16.67			25	
Web Developers	75	25				
Graphic Designers	71.43			28.60		
Quality & Assurance	70	30				
Operators/Technicians					70	30

Source: BIDS Survey, 2016

Table 7: Percentage of IT employees who undertake any training

	% IT employee undertook training	**Average duration**
Apprenticeship / Internship	67	3-6 months
On the job training	100	Week to month
Training from training institute	75 (Mainly from govt and industry assoc. initiatives)	3-7 days
Internal Training Institutes	25	3-15 days

**Findings are based on only IT, ISP and Call centers*

Table 8: Skills Gap analysis

A. Skill level				
		Skilled/Highly skilled	Non-skilled	Comment
	Overall	60%	40%	In terms of quality
B. Availability (occupation-wise)				
		Available	Gap	
	Programmers/System Analyst/software engineer and Q&A	60%	40%	In terms of supply
	Project/Product Manager and Graphic Designer	60%	40%	In terms of supply
New entrants (fresh graduates)	Entry level Programmers/System Analyst/software engineer and Q&A		100%	On the job training is required

Source: BIDS Survey, 2016

Table 9: Projected labor demand in the ICT sector, 2016-2025 (million)

	2016 (Base)	2017	2018	2019	2020	2021	2022	2023	2024	2025
Annual growth rates of labor demand*	0.11	0.10	0.09	0.08	0.10	0.09	0.08	0.08	0.07	0.05
Software & others	0.14	0.15	0.16	0.17	0.19	0.21	0.23	0.24	0.26	0.27
ISPs	0.05	0.05	0.06	0.06	0.07	0.08	0.08	0.09	0.10	0.10
Call centers	0.03	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.06	0.06
Hardware	0.003	0.003	0.003	0.003	0.004	0.004	0.005	0.006	0.006	0.007
Total labor	**0.22**	**0.24**	**0.26**	**0.28**	**0.31**	**0.34**	**0.36**	**0.39**	**0.42**	**0.44**
Total Labor projected in the Macro study, BIDS 2016	0.14	0.155	0.17	0.185	0.2	0.22	0.24	0.26	0.28	0.3

*Notes: * Annual growth rates of labor demand in the ICT sector are taken from the Macro study on ICT skill gap analysis conducted by BIDS in 2016; However, in this study as the base-year (2016) estimate of labor demand has been made on the basis of FGD with stakeholders, it differs with the figures estimated in the Macro study using the Labor Force 2013 data.*

Table 10: Ten (10) years projection of manpower demand by major occupations for the ICT sector (million)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Software										
Product/ project manager	0.014	0.015	0.017	0.019	0.021	0.024	0.027	0.031	0.035	0.035
Programmers/ system analyst/software engineer	0.081	0.090	0.099	0.113	0.126	0.144	0.162	0.185	0.207	0.211
Database Administrator	0.008	0.009	0.010	0.011	0.013	0.014	0.016	0.018	0.021	0.021
Web developer	0.009	0.011	0.012	0.013	0.015	0.017	0.019	0.022	0.024	0.025
Graphic designer	0.005	0.006	0.007	0.008	0.008	0.010	0.011	0.012	0.014	0.014
Quality & assurance	0.007	0.008	0.008	0.009	0.011	0.012	0.014	0.015	0.017	0.018
Operator/ Technician	0.011	0.012	0.013	0.015	0.017	0.019	0.022	0.025	0.028	0.028
ISP										
Product/ project manager	0.012	0.013	0.014	0.016	0.018	0.020	0.023	0.026	0.029	0.030
Programmers/ system analyst/software engineer	0.013	0.014	0.015	0.017	0.019	0.022	0.025	0.028	0.032	0.033
Database Administrator	0.010	0.011	0.012	0.014	0.016	0.018	0.020	0.023	0.026	0.026
Hardware/ networking	0.025	0.028	0.031	0.035	0.039	0.044	0.050	0.057	0.064	0.065
Call Center										
Product/ project manager	0.005	0.005	0.006	0.006	0.007	0.008	0.009	0.010	0.012	0.012
Programmers/ system analyst/software engineer	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.004
Operator/ Technician	0.024	0.027	0.029	0.033	0.037	0.043	0.048	0.055	0.061	0.063
Hardware										
Product/ project manager	0.0019	0.0021	0.0023	0.0026	0.0029	0.0033	0.0038	0.0043	0.0048	0.0049
Hardware/ networking	0.0006	0.0007	0.0008	0.0009	0.0010	0.0011	0.0013	0.0014	0.0016	0.0016

Source: Author's own estimates.

Table 11: Occupation-wise Training Demand Projection for 10 years (in Million)

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Product/ project manager	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004	0.004
Programmers/ system analyst/software engineer	0.030	0.033	0.036	0.041	0.046	0.052	0.059	0.067	0.075	0.077
Database Administrator	0.003	0.004	0.004	0.005	0.006	0.006	0.007	0.008	0.009	0.009
Web developer	0.006	0.008	0.008	0.009	0.010	0.012	0.013	0.015	0.016	0.017
Graphic designer	0.002	0.003	0.003	0.004	0.004	0.005	0.005	0.006	0.007	0.007
Quality & assurance	0.004	0.005	0.005	0.005	0.007	0.007	0.008	0.009	0.010	0.011
Operator/ Technician	0.008	0.008	0.009	0.011	0.012	0.013	0.015	0.018	0.020	0.020

Source: Author's own estimates.

Table 12: IT Education and Training Institutes

	2010	2011	2012	2013	2014	2015
Public Universities (including Science & Technology)	19	19	19	22	22	22
Private Universities	51	54	58	67	76	83
Polytechnic Institutes	171	171	218	218	300	337
Technical Training Centres	43	43	81	81	81	134
Technical Institute	29	29	29	33	33	33
Technical Vocational Institute	50	50	50	50	50	50

Source: MoE (BANBEIS) Education Statistics 2015; Bangladesh Economic Review 2015, MoF

Table 13: Existing Training Courses offered by BITM

SL.	Name of the Course	Duration(Month)
1.	Web design course	3
2.	Graphic design	3
3.	Online Marketing	1
4.	Web Application Development – PHP	3
5.	Web Application Development- Dot Net	3
6.	Practical SEO	1
7.	Mobile Application Development (Android)	3
8.	Server Administration & Cloud Management	2
9.	IT Support Technical	3
10.	Affiliate and e-Commerce marketing	3
11.	Customer Support & Service	1
12.	IT Sales Management	1
Soft Skill Training- Up skilling		
13.	English & Business Communication	1

Source: BITM

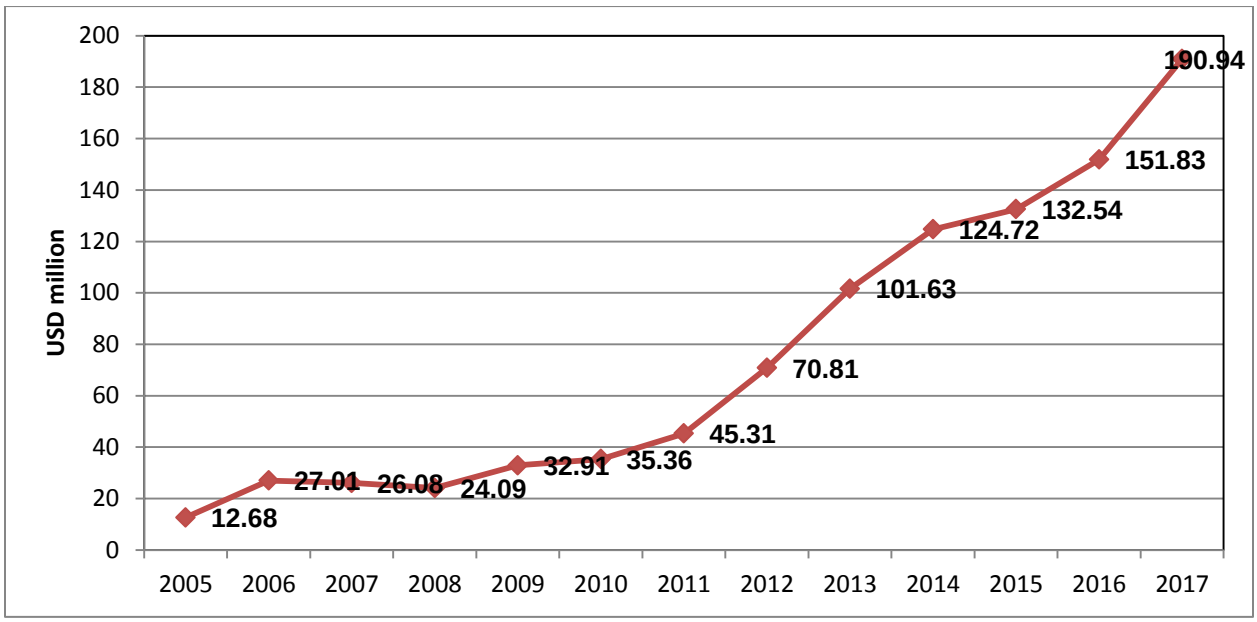
Table 14: Supply side problems of IT skills

Problems	Importance of the labor supply side problems			
	Less important (%)	Neutral (%)	More important (%)	Total (%)
Lack of up-to-date IT related curriculum	-	42.86	57.15	100
Lack of industry-academia linkage	11.11	-	88.89	100
Shortage of quality teachers/ trainers	44.44	11.11	44.44	100
Lack of quality and facilities in IT training institutes	20	30	50	100
Shortage of R& D labs	12.50	12.50	75	100
Limited range of courses offered by IT training institutes	33.33	33.33	33.33	100

Source: BIDS Survey, 2016

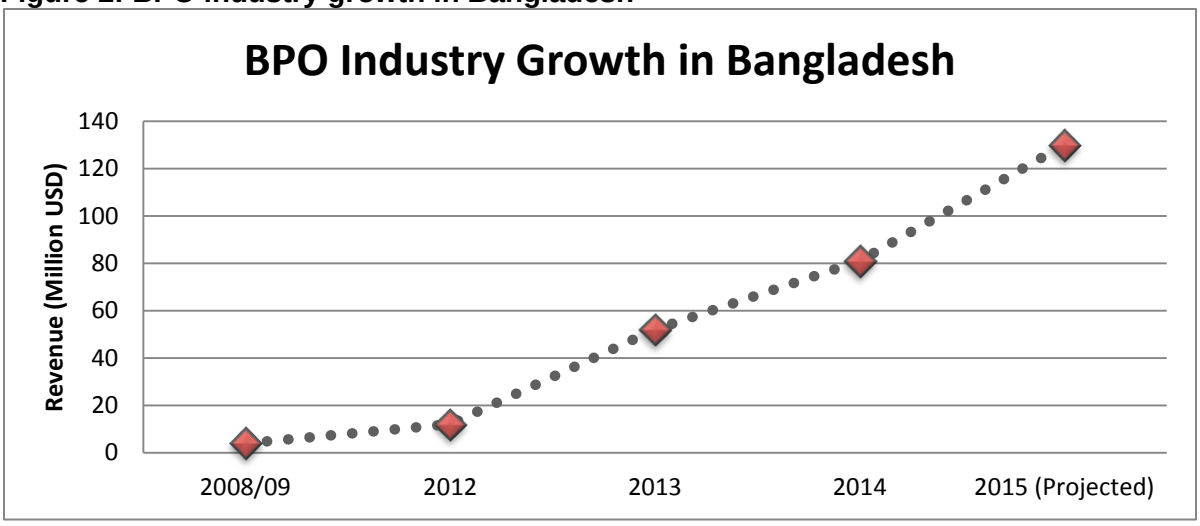
Figures

Figure 1: Export of Software and ITES



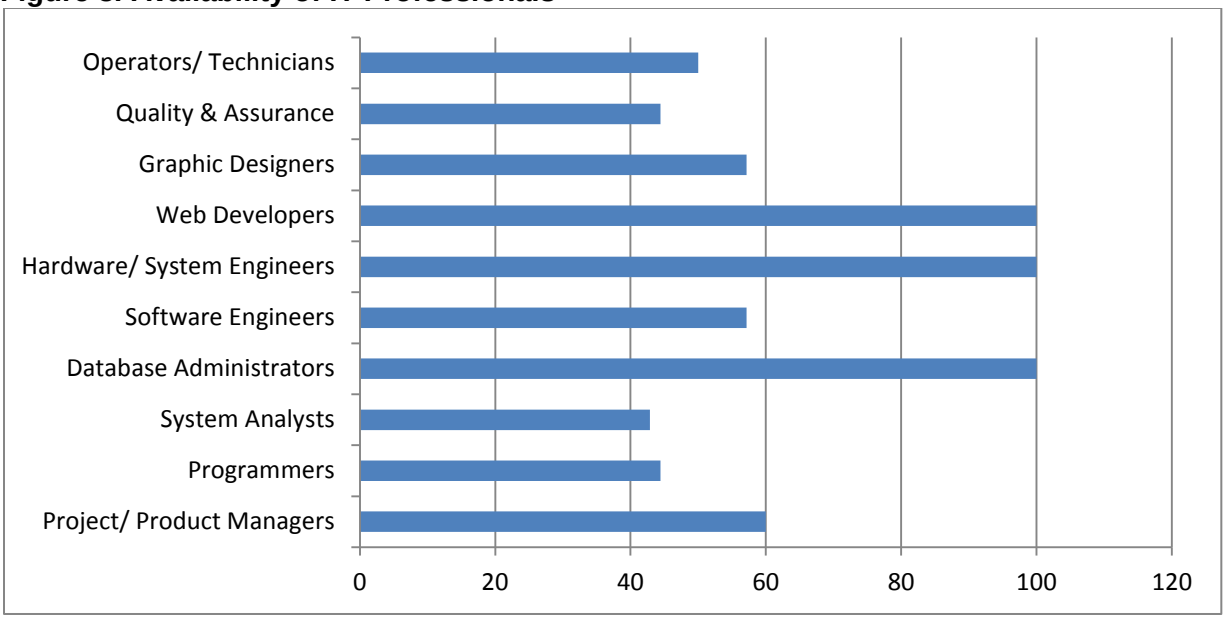
Source: EPB, 2017

Figure 2: BPO industry growth in Bangladesh



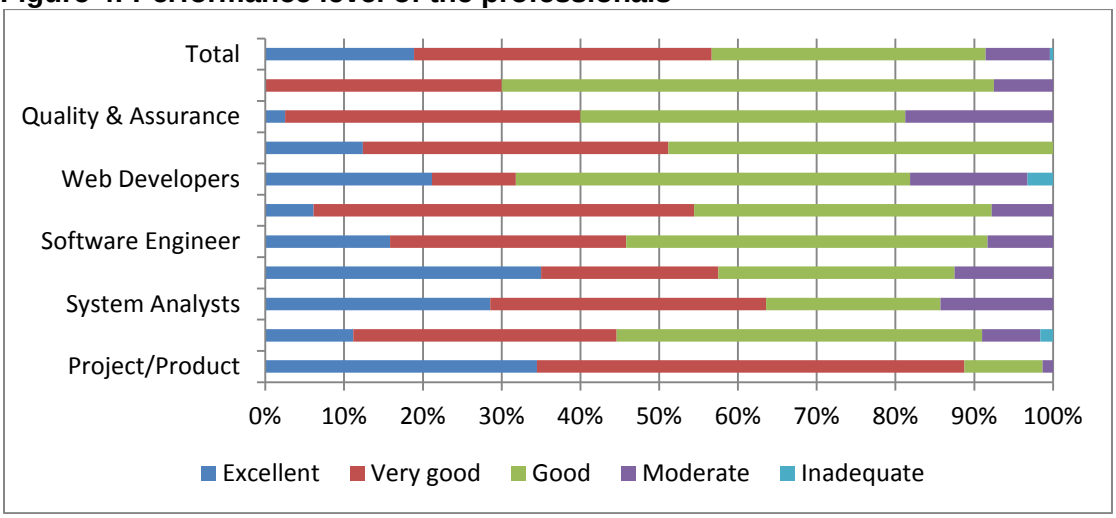
Source: BPO Summit Keynote 2015, BACCO, Bangladesh.

Figure 3. Availability of IT Professionals



Source: BIDS Survey, 2016

Figure 4: Performance level of the professionals



Source: BIDS Survey, 2016

Figure 5. Gender balance in IT Employment

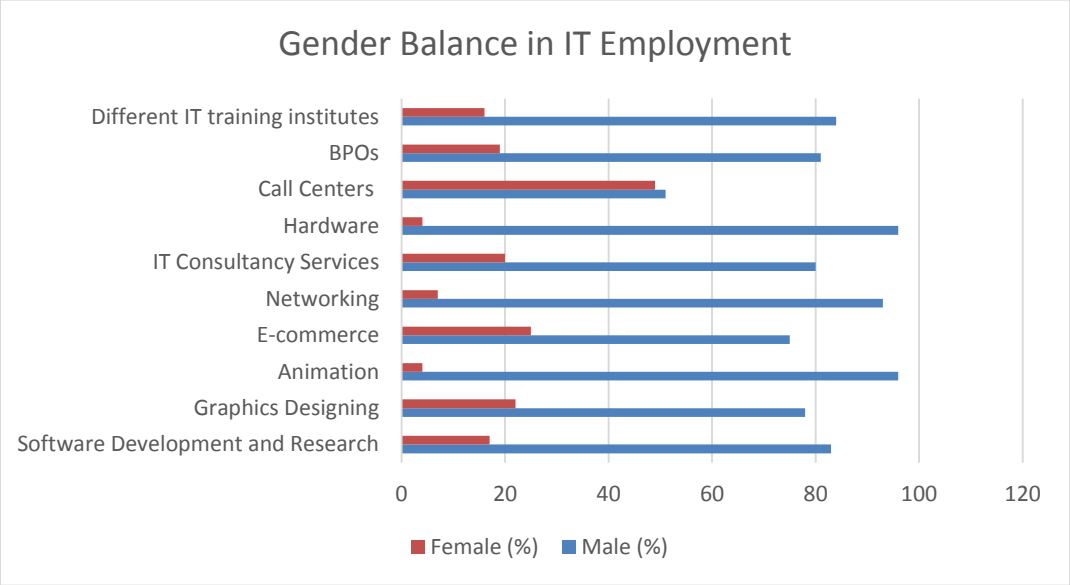
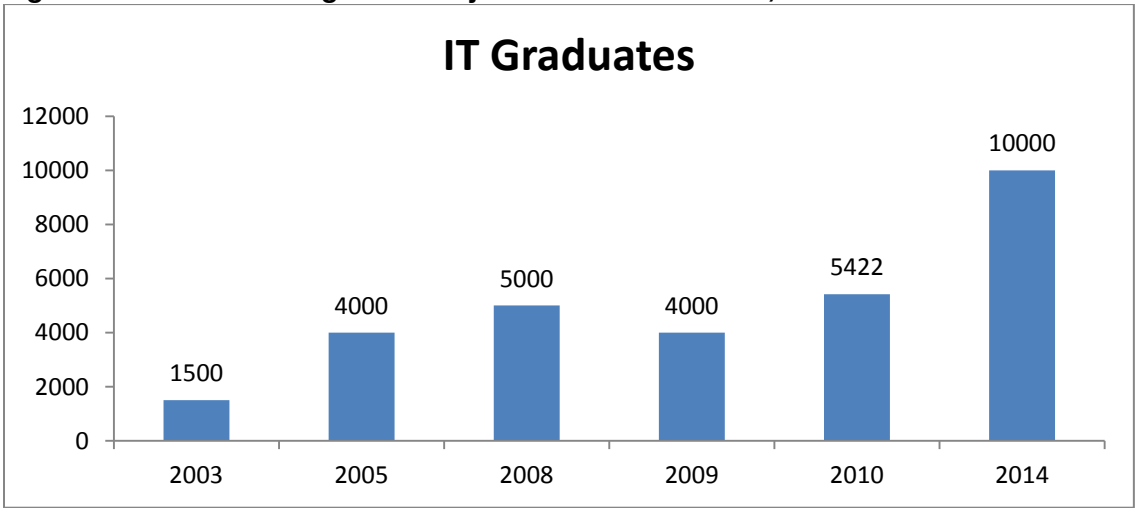


Figure 6: Number of IT graduates joined the labor force, 2003-2014



Source: Digital Bangladesh Report 2015, Ministry of Finance

APPENDIX

Table A1: Number of Surveyed firms and FGDs

Sector	No. of firms surveyed	No. of FGDs conducted
IT/Software	8	1 (BASIS & BITM)
ISP	3	1 (ISPAB)
Call center and BPO center	2	1 (BACCO)
Hardware	2	1 (BCS)
Total	**15**	**4**

Table A2: Number of Licensed Firms

Type of BTRC operators	Categories	No. of licensed firms	Associations
Internet Protocol Telephony Service Provider(IPTSP)	IPTSP Nationwide	33	
	IPTSP Central	7	
	IPTSP Zonal	3	
	Total	43	
Internet Service Provider(ISP)	ISP Nationwide	119	Internet Service Providers Association Bangladesh (ISPAB)
	ISP Central	65	
	ISP Zonal	47	
	ISP A	228	
	ISP B	31	
	ISP C	67	
	Total	557	
Call Centers	Call Centers	203	Bangladesh Association of Call Center and Outsourcing (BACCO)
	Hosted Call Centre	41	
	Hosted Call Centre Service Provider	36	
	International Call center	2	
	Total	282	
Mobile Telecom Operators	2G	6	Association of Mobile Telecom Operators of Bangladesh (AMTOB)
	3G	4	
	Total	10	
International Internet Gateway Services (IIG)	Total	37	International Internet Gateway Association of Bangladesh (iiGAB)
International Gateway (IGW) Services	Total	25	IGW Operators Forum (IOF)
National Internet Exchange (NIX)	Total	2	
Broadband Wireless Access	Total	2	

Type of BTRC operators	Categories	No. of licensed firms	Associations
(BWA)			
Interconnection Exchange (ICX) Services	Total	26	Association of Mobile Telecom Operators of Bangladesh (AMTOB)
VSAT	User	48	
	Provider	12	
	Provider with HUB	5	
	Total	65	
International Terrestrial Cable (ITC) Services	Total	6	
Nationwide Telecommunication Transmission Network (NTTN) Service Provider	Total	4	
Vehicle Tracking Services	Vehicle Tracking Service Licensee	17	
	Vehicle Tracking Service Approval	3	
	Total	20	
Public Switched Telephone Network (PSTN) Operator	National	4	
	Zonal	7	
	Rural	1	
	Total	12	

Table A3: Associations and their current members:

Name	Current members
Bangladesh Association of Software and Information Services (**BASIS**)	997
Bangladesh Association of Call Center and Outsourcing (**BACCO**)	76
Internet Service Providers Association Bangladesh (ISPAB)	64
Bangladesh Computer Samity (**BCS**)	1452 (till March 2016)
Association of Mobile Telecom Operators of Bangladesh (**AMTOB**)	General Member: 6
	Associate Member: 2
International Internet Gateway Association of Bangladesh (**IIGAB**)	36
IGW Operators Forum (**IOF**)	28

Table A4: Performance evaluation of the employees (%)

	Excellent	Very good	Good	Moderate	Inadequate	Training required
	1	2	3	4	5	[3+4+5]
Project/Product	34.47	54.31	9.89	1.33	0	11.22
Programmer/System Analysts	28.57	35	22.14	14.29	0	36.43
Database Administrator	35	22.5	30	12.5	0	42.5
Web Developers	21.17	10.65	50.04	14.92	3.23	68.19
Graphic Designer	12.38	38.81	48.81	0	0	48.81
Quality & Assurance	2.5	37.5	41.25	18.75	0	60
Operator/Technician	0	30	62.5	7.5	0	70
Others	100	0	0	0	0	0
Hardware/system	6.11	48.33	37.78	7.78	0	45.56

Table A5. Availability of employees according to job categories.

Job Categories	Availability of employees					
	Highly scarce (%)	Scarce (%)	Moderate (%)	Available (%)	Highly available (%)	Total (%)
Project/ Product Managers	26.67	13.33	40	13.33	6.67	100
Programmers	22.22	33.33	33.33	11.11	-	100
System Analysts	14.29	42.86	14.29	28.57	-	100
Database Administrators	-	-	80	20	-	100
Software Engineers	28.57	14.29	28.57	28.57	-	100
Hardware/ System Engineers	-	-	44.44	55.56	-	100
Web Developers	-	-	60	40	-	100
Graphic Designers	28.57	14.29	28.57	28.57	-	100
Quality & Assurance	33.33	22.22	44.44	-	-	100
Operators/ Technicians	-	50	-	50	-	100