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Skills demand analysis on ICT enabled services in Bangladesh

Skills Development Programme

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Skill Demand in IT Enabled Services in Bangladesh
and observations on IT-specific Labor Market

SDP – BRAC

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PREFACE

This report on "Skills Demand Analysis on ICT Enabled Services" was originally published on 10 December 2019. This study speculated before the pandemic that the future of the skills demand for Bangladeshi labour market lies in utilising the power of the technology, specifically digital platforms. With the Covid-19 outbreak, this study becomes more relevant for the labour market of Bangladesh as it shows the insights on demand-side issues on skills sector, including identification of demands for specific skills by ICT-enabled service (ITES) sectors in Bangladesh, investigating the implications of the growing importance of ITES for labour market and social protection of the workforce.

With the advent of Covid-19, the e-commerce industry is witnessing tremendous upsurge globally. Bangladesh has also seen the growth of different mobile banking services in the last few years and these platforms are strongly providing their services adapting this "new normal." Moreover, the current evidence suggests that there was an increasing demand in the online healthcare sector both pre-pandemic and post-pandemic times, the incremental need is significant. Another area of consideration is freelancing and ITES.

While prior to pandemic, the future of skills lie in sectors of telemedicine, e-commerce, freelancing, banking and educational institutions, it has become even more relevant in the era of Covid-19. Recent demand shows that there is an urgent need for having skilled people working in these sectors. Immediate actions are needed to be incorporated with the current national-level TVET curriculum, in order to standardise the occupations mentioned within the report. The TVET system is well-placed to play an important role in equipping a strong labour force for these emerging industries. They have significant potential to contribute in the post covid19 "recovery and restructuring" phase.

SKILLS IN DEMAND

Education
- IT course-instructors
- IT-enabling of administrative services
- IT-enabling of accounting services
- Data entry
- administrative skills

Telemedicine
- Full-stack developers
- Mobile, web & cloud-based application development
- Database administration
- Data analytics
- Problem-solving and adaptability

Transportation
- Full-stack developers
- Software quality assurance, testing and technical support
- CISCO/Microsoft certification
- MS office
- Communication and presentation skills

Hospitals
- Java, Android and IOS developments
- Linux, Windows and Virtualization (ESXi)
- Routing, Switching, V-Lan for Networking
- Basic computer literacy

Banking
- Hardware and network system skill
- MS office Suite
- Accessing networks/servers
- Jave and C++
- Hardware, software and network troubleshooting

FRONTEND FIRMS

FREELANCING

BACKEND FIRMS

Freelancing
- Software development
- Web design and development
- System architecture
- Graphic design
- Java & HTML related programming language

Exports
- Web Application
- Mobile Application
- ERP development
- Quality Assurance Testing
- Web Design

Domestic
- Web Application
- Web Design
- Mobile Appli cation
- Hardware, Server Installation and Maintenance
- ERP development

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Acronyms

API	Application Programming Interface
BAEC	Bangladesh Atomic Energy Commission
BASIS	Bangladesh Association of Software and Information Services
BMET	Bureau of Manpower, Employment and Training
BTEB	Bangladesh Technical Education Board
BYLC	Bangladesh Youth Leadership Center
CAD	Computer-aided design and drafting
CBE	Computer Based Exams
CCNR	Cisco Certified Network Professional Routing
CCTV	Closed-circuit television
CSS	Cascading Style Sheets
DNS	Domain Name System
ERP	Enterprise Resource Planning
ESP	Email Service Provider
4IR	Fourth Industrial Revolution
FTP	File Transfer Protocol
GDDS	General Data Dissemination System
HBTL	Hutchison Bangladesh Telecom Limited
HTML	Hyper Text Markup Language
IBM	International Business Machines
ICT	Information and Communication Technology
IIG	International Internet Gateway
ILO	International Labor Organization
IMF	International Monetary Fund
IP	Internet Protocol
ISP	Internet service provider
IT	Information Technology
ITES	Information Technology enabled Services
LAN	Local Area Network
NCSDT	National Council for Skill Development and Training
NID	National Identity

NSC	National Skill Certificate
NSDA	National Skill Development Authority
NSDC	National Skill Development Council
NSQAS	National Skill Quality Assurance System
NTVQF	National Training and Vocational Qualification Framework
OCR	Optical character recognition
OS	Operating System
PHP	Hypertext Preprocessor
POS	Point of Sale
QA	Quality assurance
RFID	Radio-Frequency Identification
SEO	Search Engine Optimization
SMS	Short message service
SMTP	Simple Mail Transfer Protocol
SPSS	Statistical Package for the Social Sciences
SQL	Structured Query Language
TTI	Technical Training Institute
TVET	Technical and Vocational Education and Training
UNCTAD	United Nations Conference on Trade and Development
UNSD	United Nations Statistics Division (UNSTATS)
UoC	Unit of Competency
VBA	Visual Basic for Applications
VSAT	Very Small Aperture Terminal
VTE	Vocational and Technical Education
VTI	Vocational and Training Institute
Wi-Fi	Wireless Fidelity

Glossary

Bandwidth	A measure of the amount of data that can travel a communications path in a given time, usually expressed as thousands of bits per second (kbps) or millions of bits per second (Mbps)
Business Process Outsourcing	The contracting of specific business processes to a third-party service provider
Cloud Computing	Cloud computing is a type of computing that relies on shared computing resources rather than having local servers or personal devices to handle applications
Cognitive Flexibility	Cognitive flexibility has been described as the mental ability to switch between thinking about two different concepts, and to think about multiple concepts simultaneously
Computer Network	A group of computer systems and other computing hardware devices that are linked together through communication channels to facilitate communication and resource-sharing among a wide range of users
Data Mining	The process of sorting through large data sets to identify patterns and establish relationships
Digital Marketing	The marketing of products or services using digital technologies, mainly on the Internet, but also including mobile phones, display advertising, and any other digital medium
Digital Subscriber Line	A technology which enables ordinary voice-grade copper telephone wires, used to service more than 600 million customers worldwide, to also carry high-speed data traffic at the same time, thus requiring the need for expensive system upgrades
E-commerce	Commercial transactions conducted electronically on the Internet
E-Governance	The application of information and communication technology (ICT) for delivering government services, exchange of information, communication transactions, integration of various stand-alone systems and services between government-to-citizen (G2C), government-to-business (G2B), government-to-government (G2G) and government-to-employees (G2E).
Enterprise Resource Planning	A process whereby a company, often a manufacturer, manages and integrates the important parts of its business. An ERP management information system integrates areas such as planning, purchasing, inventory, sales, marketing, finance and human resources
Freelance	Freelancers might be defined as those genuinely in business on their own account, working alone or with co-owning partners or co-directors, responsible for generating their own work and income, but who do not employ others.
Information Security	The state of being protected against the unauthorized use of information, especially electronic data, or the measures taken to achieve this
International	The internet data communications services for connecting with internet

Internet Gateway	service providers in both domestic and international
Internet Protocol	The set of standards responsible for ensuring that data packets transmitted over the Internet are routed to their intended destinations. Abbreviated IP
IT ecosystem	It is the network of organizations that drives the creation and delivery of information technology products and services.
IT Infrastructure	Infrastructure that is used for storing, receiving, sending and analyzing information.
IT Platform	A group of technologies that are used as a base upon which other applications, processes or technologies are developed
Mobile Financial Services	A service provided by a bank or other financial institution that allows its customers to conduct financial transactions remotely using a mobile device such as a smartphone or tablet
Offshoring	The practice of partially basing a company's processes or services overseas, to take advantage of lower costs
Outsourcing	Outsourcing is the business practice of hiring a third-party agency to perform services or create goods that were traditionally performed in-house.
Point-of-Sales System	The system using a POS terminal software with features for inventory management, barcode scanner, calculator, CRM etc. to manage transactions and operations
Programming language	A set of commands, instructions, and other syntax used to create a software
Telecommunications System	Communication over a distance by cable, telegraph, telephone, or broadcasting
Telemarketing	The marketing of goods or services by means of telephone calls, typically unsolicited, to potential customers
Telemedicine	The remote diagnosis and treatment of patients by means of telecommunications technology
Web Design	Web design encompasses many different skills and disciplines in the production and maintenance of websites. The different areas of web design include web graphic design; interface design; authoring, including standardized code and proprietary software; user experience design; and search engine optimization
Work Order	A Work Order is a task or job for a customer that can be scheduled and assigned to someone. Work order carries a different meaning in the context of IT firms, which associate work orders with those requiring new inputs (tasks to be performed). Selling already developed products (or, performing apps/software) to a different client is a resale rather than another work order.

Executive Summary

Over more than a decade, faith on graduates from general education has been on decline, and along with it, there has been efforts to structure the TVET with multi-dimensional initiatives to promote skill development. With ILO spearheading the global initiative, national level skill development programs got institutionalized in several countries. This paved the way for classifying workforce in terms of a notion of subject-specific skill level, the certificate on which is yet to get formal recognition in the job market. Amidst all these, advent of the Fourth Industrial Revolution (4IR) got a formal recognition with the publication of Charles Schwab's book (Schwab 2016) on the subject. In a world of increased adoption of information & communication technology (ICT), and wide use of internet of things (IOT), importance of skills came to be universally acknowledged. With ideas constantly changing the canvas of technology and varied applications of new technologies, it is important to monitor changes in skill demands and prepare human resources accordingly. Recognizing the importance, the Skill Development Programme (SDP) of BRAC intends to publish annual Skillwatch Reports in future, focusing on a particular 'skill sector' each year. This study, undertaken by the Economic Research Group (ERG) during March-October 2019, is a prelude to that effort, meant to provide insights on skill demands in ICT enabled service (ITES) sectors.

The study objectives were as follows: (i) derive insight on demand side issues, including identification of demands for specific skills by ICT-enabled service (ITES) sectors in Bangladesh, and (ii) investigate the implications of growing importance of ITES for labor market and social protection of workforce. Though multiple perspectives on ITES is recognized, it is presumed to include ICT-supported services that are either end-consumables, as well as those used by frontend (FE) firms to deliver an end-consumable product. In both cases, the ICT elements that go into generation of those services are termed IT-enablers, which are produced/developed by backend (BE) IT firms, some of which may be vertically linked to FE firms. Thus, the analytical framework developed and used for empirical query recognizes IT-enabled FE firms as well as the IT-enabler BE firms. The proposed scope of ITES goes beyond the definition one finds in BASIS website. In order to better comprehend the skill market, providers of training (polytechnic and trainings institutions under TVET), universities offering ICT-related courses and platform workers have also been addressed.

The study is a scoping exercise and hence makes no attempt to make numerical projections on skill or job demands. With a view to gain insights into skill demands in the ITES sectors, the following tasks were undertaken: (i) extensive literature survey and identification of data sources, which were presented in an earlier report (ERG 2019); (ii) basic information was sought from 149 BASIS members, 26 of whom were followed up with questionnaire survey; (iii) interviews were undertaken for three reputed schools & colleges, one transportation e-commerce firm, three banks, one telemedicine firm, two hospitals (and a specialized health service provider) and several IT firms; (iv) analyze publicly available data from BASIS; (v) accessible data from several freelancers' platforms (covering 2196 accounts registered with 3 platforms, from which information on 363 accounts could be used) were analyzed; (vi) relevant faculty members in several polytechnic institutes in Dhaka and Mymensingh were interviewed and a questionnaire survey was administered on 16 training institutions; and (vii) information on course offerings and enrollment obtained by visiting websites of all private and public universities, followed up by queries with several selected universities and consultation with few faculty members. Insights on the working of the labor market and current practices in social security of workforce could be gained from the first three activities mentioned above.

The present report has seven sections, the core contents of which are briefly summarized below.

Following an introduction to the objectives and scope of the study in section I, the second section highlights selective segments of Bangladesh's journey towards digitization and emergence of ITES sector. Along the same timeline, progresses in TVET and university-level offering of ICT-related courses are presented in Section II. It is suggested that education generally lagged market changes in the ICT canvas. The journey also reveals of a surge in ITES activities over last decade and takes note of current trend in favor of mobile-based connectivity. Overall, the section is meant to familiarize readers with the ICT environment -- relations between infrastructure, applications and education – within which skill demands for ITES need to be assessed.

Section III takes a narrower perspective on IT-related skill to provide the framework for empirical work. Several entry points are identified to comprehend the multi-tiered nature of skills and how those may relate to various concepts in vogue. It includes a brief review of NTVQ framework, which reflects the NSDA's level-competency approach. Skills, perceived in terms of Tools, Scripting Language and Programming, and their correspondence with micro-level Tasks, are identified. These are broadly grouped into: Software Systems/Application, Hardware and Operating System (OS), Network, Connectivity & Communication, and Specialized sectors (e.g., gaming, graphic design, data science analytics, e-commerce, accounting software, etc.). Details on the mapping are presented in the annex to section III. In a changing environment, such an exercise cannot claim to be complete, yet, the attempt will hopefully encourage others to update and further fine-tune the classification for meaningful analyses. Section III also takes note of the limitations of a narrow perspective on skills, which could not be pursued at an empirical level within the scope of the present study.

IT related skill demands in the ITES sectors originate from several distinct sources; end-consumable service sectors inside the country, end-consumable service sectors and the IT (enabler) sectors in foreign land. In case of the former, demand may arise from organized sectors (such as, banks, hospitals, ISPs) or from household sectors availing IOTs, or, availing other facilities through accessing internets. Such services may be directly procured by hiring employees, or by contracting services of individual worker/consultant. Services may also be procured (provided), through platforms of 'free workers', by (to) anonymous local or foreign firms. Study of the household demands for IOT-supported services and subsequent demand for IT-related services are not addressed. The present study assesses skill demands originating from three of the routes and the findings are summarized in sections IV and V.

Service trade in platform markets reveals relatively higher skill demands for graphic design, web design, data entry, content creation, and Java-based programming. For the IT-enabled end consumable service sectors, there is demand for specialized knowledge, primarily in software development. However, specific skills may be acquired while working under a competent mentor. In the banking sector, all mid to senior level employees are required to hold at least basic IT skills to identify the sources of problems. It is also mandatory for all new recruits to have basic computer literacy skill with the ability to operate computers and apply MS office packages in undertaking the daily business operations. Web applications development, data entry and payment gateway are demanded from all types of end-consumable service sectors, even from other IT firms. The use of MS office is considered a prerequisite for employment at the entry level (for all non-IT white collared positions), along with basic communication and presentation skills. Knowledge of Routing, Switching, V-LAN for Networking are also in demand for ITES in hospital management.

Beyond 'traditional' services (education, healthcare, transport, etc.), ITES expansion is perceived to be closely associated with successes of 'startups'. Moreover, the journey towards a digital economy is conceived (by policymakers) in terms of successes in startups, driven by ideas transformed into Apps. Startups are more likely to succeed when those help connect spatially dispersed segments of population. One would presume that a startup would require one or a small group of high-level skilled workforce to be supported by many with mid to basic-level IT-related skills. Taking cue from several case studies, the report suggests that there are economic forces at work to turn these startups into operators for larger and more robust agencies with supra-national character. The encroachment of these very supra-national ICT companies may attribute to the slowdown of the growth of the startups.

Firms that generate IT-enablers prioritize the applicants' job-specific skills, communication skills and other personality traits. To delve into the skills/programming languages/ development tools sought after in the IT industry, the study finds and ranks the most desired skills in 2019 and compares those with an earlier survey in 2016. Presently, Java ranks top in general programming language, JavaScript for scripting languages, PHP tops under web application development, CSS for user interface technologies, Node.js tops in the field of middleware server, and MySQL ranks 1st for database platforms.

Responses of BE firms' employers, with regards to relevance, importance and prevalence of WEF-identified 10 skills, were also sought in the questionnaire survey. Complex problem solving, coordination and critical thinking are reported to be important and relevant. Of the three, the first two are said to be more prevalent among employees (63 to 72 percent of responses), while critical thinking is found less prevalent (40%). The other seven skills did not surface with any significance – negotiation was the least important, least relevant and the least prevalent of all. There were other questions to capture employers' preference for skills as well. Employers prefer specific knowledge on a given subject matter along with requisite (technical) skills over educational background for recruitments at the entry level. Furthermore, the study uncovers the widespread dissatisfaction of employers in not being able to find adequately skilled employees and the workforce exhibiting an axiomatic mismatch in skills required and skills that they possess.

It is perceived that the demand for ITES will increase in the banking & financial industry, and to a lesser degree, from health and retail & trade sectors. It is also anticipated that the demand generated from the government agencies or autonomous bodies will also see a surge in the domestic market. In contrast, demand for desktop applications and web design is expected to decrease by 60.87% and 17.39% respectively. Independently, the TVET institutions are also anticipating an overall decrease in demand for hardware/network maintenance.

The study finds that 87% of the employers in the IT industry identify 'lack of skilled workforce as the major problem that the industry faces. In order to overcome this shortfall, it is suggested that on-going skill trainings give priorities to such tasks as, web design, graphic design and data entry; and on Java-based programming. While these are covered in many training programs, the courses need to be more intensive with broader focus and higher competency level. Going beyond, there is a need to impart trainings on Python for data administration.

Though the empirical work restricted the exercise to a narrow perspective on skills, it is proposed that serious rethinking of the analytics and policies on skills are needed. Basic ability to move between narrowly defined skills (adaptability) is considered more relevant than a classroom learning on a given skill. It also calls for serious and urgent rethinking on the relations between 'institutional education' and 'skill development'. Without going deep into the pedagogy, the concluding section (VII) briefly outlines a proposal for action, which skill development programs such as BRAC's SDP may find relevant.

Recognizing the need to improve the skillset of young (and future) workforce, the primary tasks of imparting skills may be supplemented by two initiatives – (i) working through schools within appropriately designed projects, business initiatives and trainings, and (ii) by collaborating with other agencies, which are closely working with local communities, to bring about changes in work habits, and by introducing and nurturing "spaces" for practices in science and technology.

Assuming that the skill development programs will be undertaken in urban areas, suggestions include involving high school teachers, facilitating business contracts between one or more teachers in a school with a commercial IT firm, along with motivating school administration to allow students to work for the teachers (as interns) in pre-agreed set of IT-related activities, and facilitating the use of IT equipment and use of the internet in enriching classroom activities with strict discipline in place.

I. INTRODUCTION

Skill appears to be the most often uttered buzzword in development sector, among both government and non-government agencies. Once mooted within the purview of conventional trades/crafts and packaged for those who failed to move up the ladder within institutional education system, skill has now acquired meanings that call for rethinking education1. Though yet to be uniquely articulated in pedagogy, literature on skills has been booming, particularly since the global recognition of the advent of the Fourth Industrial Revolution (4IR). Along with it, the term acquired wide range of meanings, and its links with different tiers of knowledge acquisitions no more remained unique. With ideas constantly changing the canvas of technology and in applications of new technologies, it is important to monitor changes in skill demands and prepare human resources accordingly. Recognizing the importance, the Skill Development Programme (SDP) of BRAC intends to publish annual *Skillwatch* Reports in future, focusing on a particular 'skill sector' each year. This is a prelude to that effort, meant to provide insights on skill demands in ICT enabled service (ICTES) sectors.[2]

The **broad objectives** of the study were:

- derive insight on demand side issues, including identification of demands for specific skills by ITES in Bangladesh's urban areas; and

- investigate the implications of growing importance of ITES for social protection of workforce.

As will be evident later, the researchers took the liberty to go beyond the parameters set by the Terms of Reference in order to make observations on a wider area of knowledge acquisition.

Study methods involved several steps. A comprehensive review of literature and secondary sources of data was undertaken to define the scope of ITES and identify the agencies in the skill sector. This was subsequently followed up by quantitative and qualitative surveys, including bilateral interviews. With new studies continuing to pour in, review of literature continued till completion of drafting the report. For the purpose of the study, following the **definition** proposed by Selwyn, Gorard and Furlong (2006), ICT is considered an umbrella term that "… refers to a range of different, albeit rapidly converging technologies [computers, software, hardware, network, telecommunication, internet, information systems] …".[3]

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[1] Ironically, education system allegedly failed to impart knowledge and ability to acquire new skills and adapt to changing labor market conditions, which, some believe, paved the way for narrowly defined skills to make entry into the university level curricula!

[2] Assessment of future skill-sector/occupation opportunity in urban space is expected to provide guidelines to SDP and other stakeholders, particularly, those agencies which operate within the National Training and Vocational Qualification Framework (NTVQ). Economic Research Group, an independent not-for-profit research organization, was entrusted to undertake the assignment. For the sake of brevity, the term IT (or, ITES) is used even though, at times, it is meant to cover ICT (or, ICTES).

[3] IT (Information Technology) refers to an entire industry that uses computers, networking, software and other equipment to manage information. Information Communication Technology (ICT) covers all those IT covers as well as all forms of communication, including telephony, mobiles, wireless networks, middleware (hardware and software), other enterprise software, audio visual systems that enable movement or manipulation of data.

Service sectors are more commonly understood within a framework of national income accounts (NIA), and are standardized across countries through such agencies as the United Nations Statistics Division (UNSD) and the International Monetary Fund (IMF). The end consumable services that are accounted for in NIA are produced by firms and the present study considers those as Frontend (FE) firms. Many of these firms are increasingly adopting IT , that is, leveraging IT to reengineer (production processes) and to deliver their services. This study identifies skill demands in several of these (FE) service sectors which are revealed to be IT-enabled. The latter, however, requires a host of IT-based services, combinedly termed as 'IT-enablers', and those are provided by Backend (BE) firms . The latter group is commonly known as IT firms, who employ ICT graduates/experts with higher level of IT-related skills. Figure 1, to be elaborated further in the discussion on skill market, shows skill development sectors that contribute towards value additions in the BE and FE firms. The findings on skill demands presented in this report are drawn from employers and employees of both FE and BE firms, as well as from several stakeholder groups (e.g., TVET, university, etc.) who enroll trainees/students keen on participating in IT-related service sectors. These segments are highlighted in Figure 1. Relative importance of the platform markets (Freelancer, Guru, Upwork, etc.) is on rise, and participants in these markets, the free workers (widely known as freelancers), provide additional information on skill demands. The latter group has also been covered by the present study.

Figure 1: Domestic Stakeholders Contributing to IT-enabled Services

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II. IT-enabled Services in Bangladesh: scope and historical overview

Connectivity through the virtual space require appropriate physical infrastructure to be put in place (at gatekeepers' end as well as for connecting various nodes and end users), receiving/ transmitting equipment at individual levels, and languages to connect humans with machines at different tiers. Interdependence of the various segments needs to be appreciated in order to comprehend the dynamics in the ITES sector. This section highlights selective segments of Bangladesh's journey towards digitization and emergence of ITES sector, along with an overview of the developments in training and education to match those developments.

II.1 Development of ICT Eco-System in Bangladesh – a brief overview[9]

Although the first satellite station in Betbunia was inaugurated in 1975, BUET had its first computer center in 1979 and although the PCs and wireless telecommunications made their marks during the 1980s, ICT engagements in Bangladesh effectively commenced during the 1990s. The early 1990s witnessed the introduction of AMPS mobile phones (also referred to as 0G – "Zero G"). Individuals could send offline emails and communicate through the Card Telephone Service of payphones. Subsequent innovations in the wireless communication technology introduced the VSAT (very small aperture terminal)-based internet connectivity in Bangladesh, which changed to xDSL based internet connectivity in 2001. Later, the submarine cable connection (SEA-ME-WE4), established in 2005, reduced the marginal cost of connectivity. Concurrently, 2G technology in the wireless telecommunication aspect resulted in a boom in wireless mobile and internet connectivity for individuals. When Facebook became available to the general public in 2006, Bangladeshi youth were quick to jump into the bandwagon. This social media and widespread accessibility of internet would eventually bring forth the boom in e-commerce-based businesses of the recent times. The public sector also utilized these infrastructural developments and initiated the biometric Voter/National Identification Cards in 2008, which facilitated the parliamentary election of 2009.

After 2010, Bangladesh saw rapid IT developments, both in terms of infrastructure, adoption and usage. 3G populated the market in 2013 and 4G was introduced in 2017. A secondary submarine cable, the SEA-ME-WE5, was connected during the same year, resulting in a total bandwidth capacity of 1800 GBPS (Gigabits per Second). In 2016, the Bangladesh E-Government Web Portal was launched, Smart National Identification Cards went into production and biometric registration of SIM cards took place. Bangladesh has also moved a step ahead with the launching of the Bangabandhu Satellite-1 in 2018 with the promise of ensuring real time satellite-based communication services appropriate for Bangladesh and the surrounding region. The service has been formally made available for private sector use since 2nd October 2019. The accessibility and availability of ICT based communication thus skyrocketed during the last decade, paving the way for ITES sectors to grow in Bangladesh.

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[9] Ecosystem refers to living organism, though widely used in the field of technology. An **ICT ecosystem** encompasses the policies, strategies, processes, information, technologies, applications and. stakeholders that together make up a **technology environment.**

[10] As of February 2019, there were 158.4 million mobile subscriptions (BTRC 2019). Of those, 46.4% were with GP, 29.7% with Robi, 21.5% with BTCL and rest 2.5% were with Teletalk.

[11] The satellite services have been made available to the private sector only since 1st October 2019 when this report was being drafted.

II.2 What is it we mean by IT-enabled Services (ITES)

Developments in the IT infrastructure paved the way for the IT ecosystem to develop with increased use of IT and adoption of IT-enablers in various segments of private businesses, as well as in delivery of government services to public and businesses. Adoption of IT also permitted product innovations, widening the net of clients to be served.

Table 1: IT Usages, by Sectors and Industry Verticals reportedly served by IT Firms

Industry (BSIC)	BBS 2013 (% of enterprises owning)			% of IT firms serving		
	Computer	Internet	Mobile	Tholons 2015	BASIS*	ERG 2019
Agriculture, Forestry and Fishing	1.6	1.9	88.0			4.4
Mining and Quarrying	3.5	4.7	87.1			
Manufacturing	6.7	9.5	96.3	17.0		52.2
Electricity, gas, steam and	16.0	27.8	97.9			
air conditioning supply						
Water supply, sewerage, waste	10.4	23.5	100.0			4.4
management and remediation act						
Construction	5.6	7.7	95.1			
Wholesale and retail trade, repair of motor vehicles and most	9.6	13.5	96.2	6.9	18.1	26.1
Transportation and storage	3.1	3.6	95.0	2.6	2.7	13.0
Hotels and restaurant/FMCG	5.3	7.1	94.9	3.7	4.0	17.4
Information and communication	46.8	48.8	99.7	7.5	25.5	39.1
Finance and insurance	48.7	54.0	99.1	16.9	16.1	69.6
Real Estate	25.9	26.0	92.6	4.3		
Professional, Scientific and technical activities	44.0	47.5	99.6			
Administrative and support service activities	24.0	27.2	98.8			
Public administration and defense	29.1	32.6	99.4	8.8	13.4	26.1
Education	48.0	48.7	98.9	7.3	5.4	26.1
Human health and social work	29.4	40.4	97.3		8.7	34.8
Arts, entertainment and recreation	15.1	17.4	98.9			13.0
Other service activities	11.9	13.8	96.8	5.2		30.4
Activities of households as employers, undifferentiated good	3.9	8.1	76.9			
Activities of extraterritorial organizations and bodies	47.3	45.0	100.0			
Total	7.3	9.1	92.2			

Note: The first three columns, drawn from BBS Economic Census of 2013 capture the usages of IT equipment internets. The last three columns are based on identification of verticals that BE IT firms reportedly serve. Each firm identified a single vertical in Tholon (2015), as well as in ERG-administered phone call survey. The last column is based on responses of BE firms included in the questionnaire survey administered by ERG in 2019. Several NIA sectors may have been included in a single response in last three columns.

*Phone call surveys were administered on 149 BASIS members.

Changes were most visible in the banking and other financial services, where IT use initially emerged for internal record-keeping, informed management decisions and for sharing data on clients' and banks' financial health with regulatory authorities. Major breakthroughs came in dealing with clients when IT-enablers (software and sensors with increased digitization) were introduced, paving the way for internet/online banking, ATM, credit card, and other services in the financial sector. Subsequently, services in health (telemedicine), education, retail trade, transport & ticketing, and in e-governance, increasingly got 'IT-enabled'.

Developments of IT infrastructure, described in the previous sub-section, facilitated use of computers, mobile phones and the internet at individual and enterprise levels (see Table 1). Usages of these equipment and access to virtual networks are insufficient measures to assess the size of ICT, although those are essential pre-requisites to identify the potential markets for launching ITES. Undertaking sector-specific surveys on FE firms to assess the extent to which those have been IT-enabled is a costly exercise. Reporting of local IT firms (i.e., BE firms) on the verticals those firms serve (i.e., forward-linked sectors) provide indirect measures on the relative presence of ITES in the sector-specific FE firms. The findings summarized in Table 1 reaffirm priors that telecom, banking and manufacturing industries are driving the demand for digital services in Bangladesh. IT enablers are also being increasingly used in insurance, retail trade (including e-commerce), government services & defense, health, education, transportation, and ICT sector itself. Some sectors, such as hospitals & clinics, depend significantly on imported equipment with built-in IT-enablers/software. Those may be under-represented in reports on vertical activities served by local IT firms.

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[12] Rapid developments in IT often blurs the distinction between IT enablers and infrastructure. Internet was once considered the major infrastructure to be put in place that paved the way for Facebook, YouTube, and many other popular sites. Overtime, these sites turned into pre-requisite infrastructure facilitating social commerce, communication and many more. Applications like Facebook, WhatsApp, Viber, and Skype are currently modifying and somewhat replacing the telecommunication infrastructure itself.

Box1: Rethinking BPO

Attempts to classify IT and/or ITES sectors struggle to fit the concept of BPO, which is defined from the perspectives of buyers of services through outsourcing some of their business processes. Some of the earlier works of practitioners and multilateral agencies, keen on promoting BPO in the fields of IT/ICT services, defined "global outsourcing services to include IT and IT enabled services (IT/ITES), IT-business process outsourcing (IT-BPO), and IT, business process, knowledge process outsourcing (ITO/BPO/KPO)" (WB 2015). Such association was misinterpreted and ITES was considered synonymously with BPO.

It is important to distinguish development (to promote export from developing countries) or business interests (to avail cheap sources of labor) from the analytical categories appropriate for technologically determined interlinked processes in the IT industry. One may also note that BPO works both ways and Bangladesh manufacturing and service sectors reportedly outsource many of their IT-related activities to foreign lands.

The literature often upholds fragmented perspectives on ITES. BPO, an earlier manifestation, is not considered an analytical category for this study, though it is implicit in the queries. One stream in the literature includes only the IT firms and identify their services as ITES[13]. One may note that most of those services were in the guise of IT enablers and/or other forms of technical supports that may be considered as intermediary inputs to generation and delivery of end-consumable services (or, to production of goods). Several others however recognized ITES as end consumable service that is either modified by an IT enabler or remotely delivered over an IT-enabled network/infrastructure[14]. To clarify, one may consider Uber which delivers transportation services over an IT enabled network. This is an IT enabled end user service. In order to deliver the (Uber) service, the agency may require an ERP software, application development and database management. One or more of such tasks may be outsourced to other firms with IT expertise, or, the principal firm may engage appropriate people to do the job in-house.

Both the above-mentioned segments have been included in the definition of ITES for the present study. In addition, their relations within a value chain have been formally recognized. For the purpose of the study, ITES includes the followings (see Figure 2):

- Any back-end process to either generate IT enablers or intermediary services delivered over an IT network/infrastructure is an ITES.

- End-consumable services or services used to deliver an end-consumable product, which rely on IT-enablers for their generation/delivery.

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[13] See Askari, Zabeen & Uddin (2015).

[14] See UNCTAD (2015) and Böhmann et al (2017) for a general definition of IT enabled services.

Figure 2: A sketch of different type of ITES
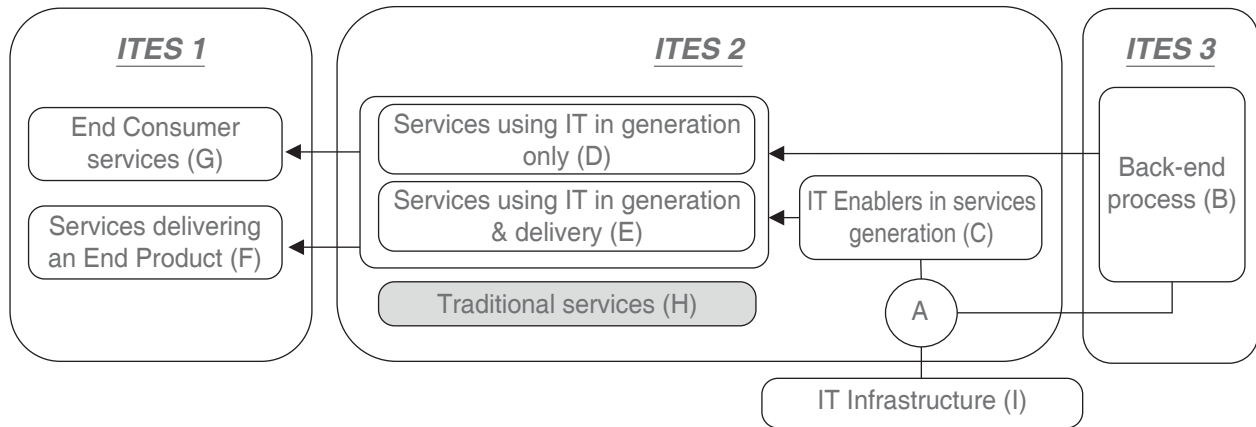
A- The innovations in delivery mechanism that occur due to technological changes in the IT infrastructure.

Back End Processes (B): These are IT based tasks (which require IT skills) that are required in order to produce the IT enablers (C). These may also be used directly by the service providing agency. For example, content generation is an IT based task. This may include graphic design contents or written (text) contents; both of which are required to produce the IT enablers (C). Certain services may directly use such contents for marketing their services i.e. the contents are considered inputs used in the generation of those services.

IT Enablers in Service Generation (C): IT enablers refer to software, websites, applications, website plugins or a broad range of such technologies that reside in a digital form and enable a new mode of service delivery. A good example of such technologies is the ERP software that moderate the various processes within a firm such as accounting or supply chain management. Generation of IT enablers often require back end processes such as content generation and plugin development for websites or coding for app development.

Services using IT in Generation Only (D): Some services avail the use of IT in generation of the services only. The delivery of the services take place through the traditional methods. For instance, the retail and trade sectors use IT in service generation using POS and other accounting software. The delivery of the service still occurs in the traditional mode without IT involvement i.e. in a physical store or shopping mall.

Services using IT in Generation and Delivery (E): There are services that apply IT to both their generation and delivery. A good example would be the modern banks which employ mobile banking services. Mobile banking provides banking services remotely through an IT enabler (the banking app in this case).

Traditional Services (H): This category of services refers to the traditional services that remain unaffected by IT. The most obvious example is the traditional postal service which remains impervious to the advents of IT. Grocery outlets and street vendors, especially in the context of Bangladesh, also remain unaffected by IT. "Traditional Service" has been kept out of ITES to show visually services or businesses that are not technological enabled and may be enabled in the future.

End User Services (G): These are services that are delivered directly to the end consumer. bKash, for example, provides transaction processing services directly to the end consumer.

Services Delivering an End Product (F): Here, reference is made to services that are involved in the delivery of a product. E- commerce platforms for instance provide services such as online shopping and delivery of a product. The delivery of meals on-demand is also a service that is being availed now.

IT Infrastructure (I): The IT infrastructure refers to the submarine cables, satellites and the cellular networks that facilitate the use and application of IT. As the infrastructure changes, new mechanisms of service delivery become available.

The study recognizes that value is generated at the stage of end consumables, which are distributed across various tiers in the backward linkages. One may consider a set of goods & services that were available prior to the introduction of IT/ICT. Some of those remained unaffected, while others adopted IT at different degrees and continued to meet the demand (characteristics) in improved manner. In addition, new products and services could now be conceived with the advent of IT. The study will pick on the last two elements to assess skill aspects of the derived demand arising from expansion of relevant NIA sectors.

II.3 Selected Overview of Developments in IT-focused Education and Training

The formal education at the university level, generally stating, followed the changes occurring in the real sector with some lags. There was dismal engagement in offering ICT-related degrees -- only 10% of the universities founded before 1990 did . Subsequently, intense infrastructural developments during the 1990s was paralleled by developments in the university curricula. 64% of the universities founded between 1991 and 2010 offered ICT based degrees; and the course offers spanned from CS/CSE to telecommunication and to MIS.

Until recent past, the mainstream schooling did not include technical education. The TVET aspect saw multiple developments – (i) a Technical Education Board was established in 1967, (ii) establishment of Bureau of Manpower, Employment and Training (BMET) in 1976, primarily to facilitate emigration process and oversee migrant workers, and (iii) establishment of National Council for Skill Development and Training (NCSDT), an intra-ministerial organization, in 1979. The literature mentioning the major changes and/or development in TVET sector as well as on the whereabouts of NCSDT, apparently goes almost blank since then. The only exception was a period of activities around Vocational Teachers Training Colleges. TVET reforms were subsequently initiated in 2007, moved initially at a slow pace, and culminated in 2015 with the establishment of National Skill Development Council and the formulation of the National Training and Vocational Qualifications Framework (NTVQF). Ironically, when standardized certification on skills appear to be take firm root on papers and proclamations, a new wave of critique is emerging that call for substantive rethinking of education and cast doubts on the sustainability of narrowly specialized skills!

II.4 Brief Outline of Rest of the Report

The study considers two ends of the value chain, local FE and BE firms, as inseparable entities that constitute ITES sector. The dual objectives of the study are: (i) derive insights on skill demands in Bangladesh's urban ITES sector; and (ii) assess the implications of growth in ITES labor market for social protection of workforce. The study primarily focuses on the former and refrains from undertaking projection exercises based on non-tenable parameter values. The processes laid out identify four important (primary) sources of information on skill demands. They are, employers of FE firms, employers of BE firms, employees and 'freelancers' acquiring skills to enhance their employability and remunerations, and the agencies (universities, polytechnics and training institutes) who impart those skills and are expected to be aware of skill demands from work force. In addition, publicly available data from BASIS and several freelancers' platforms have been analyzed. Both quantitative and qualitative surveys were administered on those sources, which also provided insights on labor market issues.

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[15] ICT related degrees offered in universities are on Computer Science (CS) or Computer Science & Engineering (CSE), Telecommunications and Management information System (MIS).

[16] The Bureau was created in line with the ILO Convention 87, 88, 96 and 97

[17] A numerical exercise would require focusing on demands originating from both local and foreign sources, netting out the supply from foreign sources. No such attempt has however been made in this study.

[18] An example is the Hossain (2017).

Prior to presenting the findings on FE and BE firms respectively in Sections IV and V, skills relevant for ITES sectors are systematically classified in Section III. Information obtained from platformer workers, and from training and educational institutions provide additional insights on skill demands, which are included in Sections IV and V. Section VI presents observations on labor market conditions pertaining to social protection of workers and the findings generally fail to support the existence of an 'employer-driven' gig economy.

A large segment of the ITES sector demands skills that are specialized in nature and do not always fit into social protection measures aimed at marginalized segments of the population. While the concluding section summarizes some of the findings to recommend interventions to meet skill demands in the ITES sector, a separate set of recommendations are proposed for agencies engaged with skill development of the marginalized groups. Some such recommendations touch upon methods of knowledge acquisition at school levels upon recognizing the need to motivate and upgrade the faculty as well.

Annex to Section II

Figure II. 1: Growth of Internet users

HOW HAS INTERNET USAGE GROWN IN ASIA SINCE 2000?

Internet usage has grown all over Asia with China, India and Indonesia leading the way

INTERNET USERS (2000)	COUNTRY	INTERNET USERS (2017)
22 million	China	772 million
5 million	India	462 million
2 million	Indonesia	143 million
47 million	Japan	118 million
0.1 million	Bangladesh	80 million
2 million	Philippines	67 million
0.2 million	Vietnam	64 million
2.3 million	Thailan	57 million
19 million	Korea, South	47 million
0.13 million	Pakistan	44 million
3.7 million	Malaysia	25 million
1,000	Myanmar	18 million
50,000	Nepal	16 million
6,000	Cambodia	8 million
121,500	Sri Lanka	6 million
1.2 million	Singapore	4 million
6,000	Laos	2 million
30,000	Mongolia	2 million
30,000	Brunel Darussalam	410,836
500	Bhutan	370,423

Compiled by: ANN/DataLEADS

Source: Internet World Stats, 2018

Figure II. 2: Timeline of IT infrastructural growth and IT adoption

Infrastructure	Year	Application	TVET	Year	University
Betbunia Satellite Earth Station inaugurated	1967		Establishment of Technical Education Board	1967	
Computer Center at BUET	1975		BMET established (in 1976)	1975	ICT related degrees offered by 10% of the Universities established before 1991 (BUET was the only university which offered the CS/CSE degree, introduced in 1962)
First Digital Telex Exchange deployed	1979		Creation of National Council for Skill Development and Training	1979	
	1981		Establishment of Vocational Teachers Training College	1981	
Automatic Digital ITX started in Dhaka	1982			1982	
	1983			1983	
	1985	Personal Computers came into Bangladesh (Global market incision happened in 1981)		1985	
	1989	Multiple entities got cellular licenses		1989	
Citycell launches AMPS Mobile phones	1993	Offline Email era started		1993	
	1995	Card Telephone Service (for payphones) started		1995	ICT related degrees offered by 64.1% of the Universities established in 1991-2010 (Telecommunication introduced in 1992; MIS introduced in 1995; ICT introduced in 1996)
VSAT based internet connectivity (Dial-up Internet) started	1996			1996	
	1999	2G technology came to Bangladesh		1999	
xDSL internet connectivity started	2001			2001	
SEA-ME-WE4 Submarine Cable connected	2005			2005	
	2007		TVET reforms initiated	2007	
	2008	Biometric Identified Voter ID Cards initiated		2008	
	2011		Establishment of National Skill Development Council	2011	
Smart National ID Cards mandated	2013	3G technology came to Bangladesh	National Training and Vocational Qualifications Framework (NTVQF) initiated	2013	
	2016	Bangladesh E-Government Web portal launched / Biometric registration of SIM cards		2016	ICT related degrees offered by 62.5% of the Universities established after 2010
SEA-ME-WE5 Submarine Cable connected (1800 GBPS capacity)	2017	4G technology came to Bangladesh		2017	
Bangabandhu-1 Satellite launched	2018			2018	

III. Comprehending Skills in ITES

III.1 Difficulties of Mapping Skill from Activities/Occupations

The framework proposed earlier needs to link skill demands with ITES. In attempts to conceptualize a linkage between the outputs, production processes/tasks, skills and subsequent demand for skilled labor, literature review revealed two competing perspectives – Skill Biased Technological Change (SBTC) and Task Biased Technological Change (TBTC). Technology, playing a factor-augmenting role, has major implications in transforming the nature of tasks and subsequent skill demands. The SBTC model imposes a one-to-one relation between tasks and skills, when in fact, a worker can allocate skills in multiple tasks. In contrast, TBTC categorizes tasks into three – routine tasks, non-routine manual tasks and non-routine intellectual tasks. Bridging the two theories in formalizing links between tasks and skills run into difficulties since there exists no direct information on the structure of the production process. In addition, one-to-one relation between tasks and skills is rare -- rather a worker can allocate a skill in multiple tasks while a single task may require multiple skills for completion.

Further complications arise in conceptualizing a skill measure. Traditionally, skills were quantified through either education level, experience level or job rankings. The argument presumed that skills are not accumulated through schooling only, but also through one's career. This suggests that one's lack of skill is temporary, as it can be absorbed through additional knowledge, either through schooling or work experience.

Moreover, skill is representative of one's knowledge, technical know-how, academic aptitude, capacity built through experiences, etc. Jobs are generally associated with occupations, which embody a set of tasks to be performed, and the practice has traditionally been to use educational qualification as a proxy to assess the ability of a candidate to perform those tasks. This traditional concept of occupational skills has eroded over time due to technological advancements. Repetitive work has been automated; labor-intensive work has become less labor intensive through technology. Hence, in a world governed by technology, beholding of multiple skills allow workers to compete for jobs, and bargain for higher wages.

Another concept frequently used to measure skills involves the field of psychometrics. The measurement techniques popularized by this field and formalized in the OECD Survey of Adult Skills (PIAAC) characterizes individuals in terms of the proficiency and use of literacy, numeracy, cognition, etc. This method can assess, as well as compare, skill usage and proficiency by individuals; but suffers in terms of comparisons that can be drawn in the span of occupations or tasks.

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[19] Acemoglu, D., & Autor, D. (2011). Skills, tasks and technologies: Implications for employment and earnings. In Handbook of labor economics (Vol. 4, pp. 1043-1171). Elsevier.

[20] Routine tasks or repetitive tasks are substituted by technology easily, whereas these are not necessarily "bad jobs" as they occupy the middle ranks of wage distribution, implying the non-requirement of low-skilled labor. Non-routine intellectual tasks on the other hand are complemented by technology, which is in line with the SBTC propositions. Non-routine manual tasks, however, remains relatively less affected, despite being low-skilled in nature. See Maselli, I. (2012). The evolving supply and demand of skills in the labor market. Intereconomics, 1, 22-30.

[21] Portela, M. (2001). Measuring skill: a multi-dimensional index. Economic Letters. 72, 27-32.

[22] Topel, R. H., & Ward, M. P. (1992). Job mobility and the careers of young men. The Quarterly Journal of Economics, 107(2):439–79.

The study proposes a different method of assessing IT skills in the domain of ITES sector, elaborated further in III.3. Prior to making that attempt to tie in all perspectives on IT-related skills within one schema, Sub-section III.2 describes the curricula in the skills development program in Bangladesh, that have been developed in line with the ILO's Occupational definitions and standards. This will bring better clarity to later discussion where segmentation in skill sector is apparent, which will be relevant for the discussion in the concluding section that addresses some of the concerns of development practitioners engaged in skill development for marginalized populations as a way of graduating out of poverty.

III.2 Summary of Skills in NTVQ Framework

Skill development programs in Bangladesh are currently run under the National Training and Vocational Qualification Framework (NTVQF). The program provides nationally recognized and credible qualifications that aims to support the skill development pathways. National Skill Development Authority (NSDA) is formed to coordinate several agencies within the government as well as in private and NGO sectors, under the chairmanship of the Prime Minister. Among other activities , the Authority is also assigned the responsibility of designing curricula for skill development. The framework outlines eight levels of education and training, which includes two levels of pre-vocational training and/or education. Each level is defined against nationally recognized competency standards, generic, sector-specific, occupation-specific and elective. These are meant to cover four aspects of work performance: task skills, task management skills, contingency management skills, and environment skills; but did not have a correspondence with the current education system . Another major component of NSDA is Industry Skill Council (ISC) which brings institution and industry together to ensure that training is industry-driven, and industries have access to skilled workers. It plays advisory role in identifying industry specific occupation and skill demand. ISCs are the primary points of contact for skill issues within industries in Bangladesh.

Drawing upon information provided in the NSDC (NSDA) website, it appears that detail course curricula have so far been designed for four occupations under IT sector. These are, IT-Support Technician, Graphic Design, Web Design and Computer Operation. Occupation-Skill Mapping implicit in NTVQF is summarized in Table III.1 in the Annex to this section . As will be evident in the following sub-section, skill demands for ITES go far beyond those categories; and the segments in the skill demand space needs to be appreciated.

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[23] Psychometrics is the field of study concerned with the theory and technique of psychological measurement, which includes the measurement of knowledge, abilities, attitudes, and personality traits. See, http://www.assessmentpsychology.com/psychometrics.htm

[24] An overview of the historical evolution of technical and vocational trainings in Bangladesh is presented in Annex II.

[25] The National Skill Development Authority Bill, 2018 was passed in the parliament in September 2019, which aims to expedite the country's overall economic development through developing skills of the capable manpower. According to a local daily, NSDA will oversee skill development activities of 13,163 organizations under 13 ministries and at private and NGO levels.

[26] Activities of NSDA, as mentioned in the NSDA Act 2018, include, (i) Formulate policy, strategy and action plan; (ii) develop key performance indicators for training institutes, develop uniform training curricula, and oversee implementation, monitoring and evaluation; (iii) forecast sector-wise skill demand in national and international labor markets; (iv) strengthen industry-linkages; etc.

[27] Recently, it is reported, education up to grade VIII or beyond is considered mandatory for skill certification.

III.3 Identification of ITES related Skills – mapping across multiple dimensions

It is presumed that each occupation is expected to perform a single or several tasks, and performing each task requires certain competency level involving one or more skills. Moreover, 'Abilities' in individual workers are considered a set of attributes, which include skills as well as cognitive and other abilities. While the overall abilities of a worker, ceteris paribus, determine how much a worker may contribute towards value addition in the economy and (therefore) be employable, there are limits to skill acquisition set by the initial endowment of 'non-skill' abilities in an individual (see Box 2). The non-skill attributes may include cognitive ability, critical thinking, discipline, drive/motivation, etc. The study team is aware of recent trends in accommodating both I the guise of tech-skill and soft-skill, as well as several formulations on critical thinking. It is also aware of trends in educational institutions turning into providers of skills, and emphasis on certificate-based skill development programs with little or no appreciation for the social processes that breed 'soft-skills', including critical thinking. Since attending to those call for wider scope, assessment of skill demands in the ITES sectors is confined to set of IT-related skills that may be linked to various dimensions one finds in the literature and in development practices pertaining to skill development.

Accordingly, several entry points were identified to comprehend the multi-tiered nature of skills and how those may relate to various concepts in vogue. BASIS has its own classifications and the NSDA approach is reflected in the level-competency design implicit in NTVQF. Extensive probing was also done into Freelancers' websites to categorize tasks, skills and occupations. After several iterations, the team proposes the classifications put together in Table III.2 in the Annex to this section. Few highlights are noted below:

- There are four broad categories: Software Systems or Software Application, Hardware and OS, Network, Connectivity and Communication, and several Specialized sectors.

- Sub-categories are essentially broad tasks, along with the types under each. Narrowly defined IT skills may be associated for each of the latter. Under such groups as, Development Tools, Scripting Language, Programming Language, Mark-up Language, Client-side scripting language, Framework, Architecture/Algorithm, etc.

- Occupations are identified in the second-last column and the last column shows correspondence with the NTVQF curricula for the four ICT related courses in offer.

- The correspondence among activities, skills and competency standard reveals that NSDA caters to a small portion of the sub-category of IT tasks and through courses that are not of pre-vocational levels.

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[28] Currently 12 ISCs are in Bangladesh working with NSDA from different industries including ICT Industry.

[29] It appears that Web Design has been dropped from the ICT-related competency standard listed in the NSDA website (viewed on16 November 2019).

[30] BASIS classification of its member firms distinguishes between software developer, e-commerce, ITES, BPO and multifunction.

The empirical findings presented in the following two sections will adhere to the broad and sub-categories of skills presented in Table III.2. One may note that a specific skill may occur in more than two categories, as in the case of Java or HTML. Needless to mention that a task may be performed in more than one way, each requiring a different skill (or, skill set). A number of quotes to suggest wider meanings of skills is compiled in Box 2. While delving into those is beyond the scope of this study, some aspects (such as communications skills) have been covered in the survey.

Box 2: Selected quotes on Skills

"Many jobs … will require specific skills—a combination of technological know-how, problem-solving, and critical thinking as well as soft skills such as perseverance, collaboration, and empathy. The days of staying in one job, or with one company, for decades are waning. In the gig economy, workers will likely have many gigs over the course of their careers, which means they will have to be lifelong learners." (p. vii, foreword. The Changing Nature of Work, The World Development Report, WBG, 2019)

The skill pool is defined as the size of the labor pool with the required ICT skills (Kotlarsky et al., 2013). These skills include technical and business knowledge, management skills, languages, and the abilities to learn new concepts and innovate.

"living organisms that survive are neither the strongest nor the smartest, but the one that responds more effectively to change" (Karanikola and Georgios, 4th Industrial Revolution: The Challenge of Changing Human Resources Skills, European Journal of Training and Development Studies Vol.5 No.3, pp.1-7, August 2018).

Dumitru et al (2018) distinguishes between skills and dispositions. Skills include, Interpretation, Analysis, Inference, Evaluation, Explanation, and Self-regulation; while Disposition includes, Truth-seeking, Open mindedness, Analycity, Sistematicity, Self-confidence, Inquisitiveness, Cognitive maturity. (In "A European Collection of the Critical Thinking Skills and Dispositions Needed in Different Professional Fields for the 21st Century, ERASMUS").

The skills involve 5 main ICT occupational domains: Software Development, ICT Project Management, Enterprise Architecture Design, Network and System Administration and Information System and Network Security" (WB 2018, Preparing ICT Skills for Digital Economy: Indonesia within the ASEAN context).

"Evidences abound that technologies are affecting jobs and skills; however, it is notoriously difficult to predict the course of technological changes and business scenarios. The only thing that is predictable is that technical skills needed for jobs are increasingly becoming unpredictable." (Bangladesh Skills for Tomorrow's Jobs: Preparing Youths for a fast-changing economy, WBG 2018).

Table III. 1: Correspondence between Competency, Task-based Occupation and General Skills implicit in NTVQF

Level	Web Design	Graphics Design	IT Support Technician	Computer Operation	Skill class
The contents as per level dictates the minimum competency required or achieved for an employee to be regarded as a worker of a particular skill level					
1	Create and edit web content using HTML	Separate and compose images, create basic designs using illustration software	Assemble hardware components, install components of a computer and configure	Operate word processing application, spreadsheet and PowerPoint applications	Basic Worker
2	Edit images (basic level), convert design to HTML, web animation (basic Level), develop client-side dynamic webpage using JavaScript & host the website	Manipulate image using image processing software, create professional designs using Illustration software.	Apply electronic fundamentals, use basic instrumentation, install and optimize OS and utilities, connect PC to an existing network, maintain equipment and software, maintain standalone security (virus, worm, trojan horse)	Create database and customize settings, retrieve database information, create forms of the database, generate database reports, test and use database, design database table and customize settings, retrieve database information	Basic skilled worker
3	Develop cascading style sheets, develop client-side dynamic webpage using jQuery, use web design and content guidelines, web animation (Intermediate Level), edit images (Intermediate Level)	Perform creative design work using multiple graphics design software, perform estimating and costing in graphic design	Install software to network computer, evaluate system status and run standard diagnostics, use product documentation for IT support, troubleshoot computer and networks, basic system administration		Semi-Skilled worker
4	Develop dynamic website using server-side language, create and manage Rich Web Content, develop theme from design for CMS, use Ajax and JSON, monitor and compile website traffic data	Create template using graphic design software, develop materials for output	Provide defense systems for network threats, cyber center management, apply basic mathematics to digital electronics, develop a Local Area Network (LAN)		Skilled worker
5	Configure plug-ins for CMS (Content Management System), apply SEO Techniques, develop online shopping system, maintain website security, design and administer a database (RDBMS)	Find and use recent developments of tools and procedure in graphic design, Apply supervision and management skills in graphic design workplace	Setup and expand networks, manage IP address and routing, apply basic data storage concepts		Highly skilled worker/ Supervisor

Note: Compiled from information provided in NSDA/NSDC website. See Annex II for further discussion of NTVQF. Level 6 applies to Diploma. Other two levels not mentioned above are the two pre-vocational levels.

Table III. 2: Mapping of IT skills with tasks, occupation and NTVQF competency

Broad Category of Activity Space/Tasks	Sub-Category of Activity Space/Task	Skills (Tools, Scripting Language, Programming) and Micro Tasks	Occupation	Competency Standard (NSDA)
Software Systems or Software Application Skills that could not be allocated in any specific sub-category: CRM, CRM Integration, Cross Platform Development, ERP, Heroku, Ion, Jet, Mocha, Mochapro, Module Design, Nuxt.Js, OpenGL, Opensips, Payment Gateway Integration, Requirements Analysis, Revit Architecture, Sharpdx, Solidworks, Solutions Architecture, Twilio, Vivado, VUE, WPF	Web Applications, Website, Web Portal	Development Tools: Dreamweaver, Visual studio, NETBEANS, ECLIPSE Scripting Language: PHP, Python Programming Language: C#, JAVA, BASIC, Mark-up Language: HTML,XHTML, HTML5, XML Client-side scripting language: JavaScript, jQuery Framework: .NET framework, DJANGO, CODEIGNITER Architecture/Algorithm: MVC, 3-Layer Architecture, OOP Style sheet: CSS, CSS 3, Bootstrap, CMS: WordPress, Joomla, Drupal, SHOPIFY, SQUARESPACE, WEEBLY, DOTNETNUKE Misc.: Ruby on Rails., NodeJS, Angular, JSON, AJAX, GOOGLE API SEO: LINK, LINK BUILDING Hosting: AMAZON AWS Web Server: IIS, APACHE, APACHE TOMCAT Advertisement: AMAZON PPC, Software Development Methodology: DEVOPS, AGILE	Programmer, Web Developer	Web Designer NTVQ Framework: **Level 2:** HTML, Adobe Suite, CSS3, Java Script **Level 3:** HTML, Twitter Bootstrap, Zurb Foundation, uiKit, Dreamweaver, NetBeans, sublime texts, notepad++, HTML5, CSS, Slick Slider, Cycle Slider, wow.js **Level 4:** HTML, Dreamweaver, NetBeans, sublime texts, notepad++, HTML5, Ajax, Json, jQuery **Level 5:** CSS breadcrumbs, RDBMS, CMS, and HTML.
	iOS Apps	Programming Language: Swift/Objective-C, Development Tools: XCode Database: SQLite/Realm	Programmer	
	Android Apps	Programming Language: Java/Kotlin; Development Tools: Android Studio; Database: SQLite/Realm	Programmer	
	Desktop	Programming Language: Java, VB, C#, FOXPRO, C++ .Net Framework: .NET framework Architecture/Algorithm: MVC, 3-Layer Architecture, OOP, BOOST	Programmer	
	Relational Database (RDBMS)	Language: Structured Query Language (SQL)/ PLSQL, Oracle, MySQL, SQL Server, PostgreSQL Tools: MS ACCESS	Database administrator, Database Specialist, Programmer	Web Design + Computer Operation Level 2: SQL, MySQL Level 4: Ajax, Json, jQuery Level 5: CSS breadcrumbs, CMS

31 http://www.nsdc.gov.bd/bn/competencystandard-list/

Broad Category of Activity Space/Tasks	Sub-Category of Activity Space/Task	Skills (Tools, Scripting Language, Programming) and Micro Tasks	Occupation	Competency Standard (NSDA)[31]
	Manual QA	Test Cases, Manual Testing, Test Plan	SQA Engineer/Tester	
	Automated QA	Automation Tools: Selenium, Appium, JMeter, Katalon Studio	SQA Engineer/Tester	
	Project Management	Managing software development, SDLC, SCRUM, AGILE	Project Manager	
	System Analysis and Design	System Requirement Analysis (SRS), System Design Document (SDD), Use Case	System Analyst, Analyst	
	Documentation	User Manual		
Hardware and OS	Desktop, Laptop and Servers	Desktop and Server configuration and setup, OS Setup: Windows, Linus, Apple Mac, Troubleshooting and resolving hardware and OS issues, Printed Circuit Boards (PCB)	IT Support Technician, Operator, Hardware Technician, System Engineer	IT Support Technician + Computer Operation Level 1: OS setup, Device Drivers setup, BIOS Configuration, utilities Configuration, antivirus setup etc. Level 2: antivirus setup, malware protection, Level 3: troubleshooting OS, antivirus setup, malware protection
Network, Connectivity and Communication	Network, Internet & Security	TCP/IP, HTTP, HTTPS FTP, LAN, WAN, Router, Active Directory, Cloud Storage, VOIP, Virtual Private Networks (VPNs), Network Security, Firewalls, Malwares, Designing LAN, WAN systems. SMTP, WHMCS, CPANEL, DNS, DOMAIN REGISTRATION	IT Support Technician, Operator, Technician, System Engineer	IT Support Technician + Computer Operation Level 2: TCP/IP setup, FTP setup, Router/WAN/LAN setup, Level 3: troubleshooting networks, TCP/IP setup, FTP setup, Router/WAN/LAN setup, Level 4: network security system setup, TCP/IP setup, FTP setup, Router/WAN/LAN setup, Level 5: network security system setup, troubleshooting networks, TCP/IP setup, FTP setup, Router/WAN/LAN setup
Specialized sectors	Gaming	Unity, Frostbite, HTML5, OpenGL, Java, Adobe Flash	Programmer	
	Graphic Design	Adobe Suite, Autodesk, Cinema4D, Microsoft Publisher, SOLIDWORKS, **Tasks and Work** Advertisement Design, Album Art, Animation, Architecture, Art, AutoCAD, Backdrop, Background Change, Banner, Billboard, Blender3d, Book Cover Design, Booklets, Brand Identity, Brand Logo, Brochure Design, Business Card Design, Cad, Camtasia, Catalog Design, Character Design, Clipping Path, Clipstudio, Color, Comic, Concept Art, Concept Development, Cover Art, Dashboard Design, Deep Etching, Digital Drawing, Digital Image Editing, Drafting, Draw, Editing, Feather Flag, Flyer Design,	Graphic designer	Graphic Design NTVQ, Level 1- 5: Adobe Suite (Adobe Photoshop, Adobe Illustrator, Adobe InDesign.)

Broad Category of Activity Space/Tasks	Sub-Category of Activity Space/Task	Skills (Tools, Scripting Language, Programming) and Micro Tasks	Occupation	Competency Standard (NSDA)[31]
		HD Video, Icon Design, Ideation, Illustration, Image, InDesign, Jewelry Design, Line Art, Logo Design, Logos & Identity Packages, Lumion, Minimalist Design, Modelling, Music Production, Pixel Art, Poster Design, Process Design, Product Brochure, Product Design, Remove Background, Rendering, Roll Up Banner, Rotoscope, Sales Brochures, Siemens Nx, Silhouettefx, Sketchup, Skin Retouching, Stationary Design, Texture Art, Theme, Theme Design, Vector, Vector Design, VHDL, Video, Visual, Visualization, V-Ray		
	Data Science & Analytics	R, SQL, IBM Watson Analytics, Python, Excel	Data Scientist	
	Big Data/Data mining/ AI	No SQL, Mongo DB, Hadoop, Blockchain	Database administrator, Programmer	
	Data Entry, Extraction & Analysis	Bill, Bulk Lists, Curation, Data, Data Analysis, Data Collection, Data Control, Data Entry, Data Feed, Data Management, Data Mining, Data Processing, Data Research, Data Scraping, Directory Submission, eBay Listing, Email & RSS, Email List Building, Email List Creation, Estimation, ETL (stands for Extract, Transform, Load), Excel, Excel Programming, Google Analytics, Google Spreadsheet, IMacros Scripting, Machine Learning, Macro, MS Excel, Product Listing, Spreadsheets, VBA, Xml		
	Writing, Translation & Transcription	Academic Writing, Acrobat, Article Editing, Article Rewriting, Article Writing, Assignment, Bengali Translation, Blog, Book Writing, Citation, Content Writing, Copy Typing, Editorial Writing, Email Design, English, Ghostwriting, Microsoft Office, Presentations, Product Descriptions, Reports, Rewriting, Screenplay, Script, Short Stories, Storyboarding, Tagalog, Transcription, Translation, Typing, Typography, Web Content Writing, Resume		

Broad Category of Activity Space/Tasks	Sub-Category of Activity Space/Task	Skills (Tools, Scripting Language, Programming) and Micro Tasks	Occupation	Competency Standard (NSDA)[31]
	Sales & Marketing	Ad Posting, Advertising, Affiliate Marketing, Amazon SEO, Aweber, B2b, B2c, Backlinking, Branding, Business To Business Marketing Strategy (B2b), Cold Calling, Content Marketing, Direct Digital Marketing, eBay Sales, Email Marketing, Facebook Advertising, Facebook Followers, Facebook Likes, Facebook Marketing, Facebook Page, Getresponse, Google AdWords, Google SEO, Google Shopping, Guest Posting, Instagram Followers, Instagram Likes, Instagram Marketing, Internet Leads, Internet Marketing, Lead Generation, Likes, LinkedIn Marketing, LinkedIn Profile, Mailchimp, MLM, Odoo, Off Page SEO, On Page SEO, Product Marketing, Reviews, Sales, SEM, SEO, Social Media Marketing, Telemarketing, Twitter Marketing, Website Promotion, YouTube Marketing, YouTube Subscribers, YouTube Videos, YouTube Views, Bing, Facebook, Google, Instagram, LinkedIn, Pinterest, Twitter, YouTube, Call Handling, Call Monitoring, Clickable Email Signature, Collections, Email, Email Handling, Email Signature, Help Desk, Sales Automation		
	E-commerce	Big-Commerce, ETSY, Magento, Woo-Commerce, Alibaba, AliExpress, Amazon, Amazon Wishlist, Craigslist, eBay, Google Merchant, Personal Shopping, Product Wishlist, Add to Cart		
	Accounting & Finance	Accounting, Bank Reconciliation, Bookkeeping, Financial Analysis, Financial Reporting, Intuit QuickBooks, Xero, Chart of Accounts		
	Research & Consultancy	Customer Research, Market Research, Survey, Regression Testing, Research, Statistical Analysis, Internet Research, Keyword Research, Web Research		
	HR & Inventory	HR & Payroll, HRM, Inventory Management, Invoice		
	Other specialized skills	Campaign Planning, Civil Engineering, Construction, E-Learning, Electrical Design, Engineering, HVAC System Design, Interior Design, IP & Trademark, Management, Mechanical Engineering, Media & Public Relations (PR), Medical, Moodle, Photography, Plumbing, Real Estate, Telecommunications, Vehicle Engineering, Virtual Assistant, Call Center		

Note: ITQSB certification corresponds to Quality Assurance; PMP certification corresponds to Project Management activities; CCNC, CCNP and Mikrotik certifications correspond to Hardware and Network related activities.

IV. Demands in IT-enabled end-consumable Service Sectors

A list of end consumable services was reported in Section II, which was purposively confined to the sectors included by the Bangladesh Bureau of Statistics in its National Income Accounting (NIA) exercise . Since the service sectors availing IT/ICT were of interest for the study, several sub-sector from financial sector, healthcare, retail trade, education and transportation were meant to be covered to assess skill demands for ITES in those sectors. A long list of firms was compiled for each of those sub-sectors and initial consultations with several revealed that a standard questionnaire survey for numerical analyses would not be feasible. Thus, in-depth interviews and FGDs with several knowledgeable persons in the same organization were administered. Each of the services covered is discussed in separate sub-sections below, with the concluding part reflecting on few insights from the case studies.

IV.1 Telemedicine: Skill demands in Jeeon

The firm selected for telemedicine, Jeeon, was established in 2014. Under the program, Rural Medical Practitioners (RMPs) who provide doctor visitation services through rural pharmacies, are connected to accredited doctors practicing medicine in Dhaka city. The connectivity is established using an apps installed in tabs. All necessary hardware is provided by the firm and a virtual wallet is programmed to ensure transfer of fees to all relevant parties using bKash.

The e-learning application was created as a knowledge refreshing platform for the RMPs, and is available in Google Play Store for free, for those keen on verifying their knowledge on medications and ailments to reduce the opportunity of mistreating patients.

The experience suggests that there is demand for specialized knowledge, primarily in software development. However, specific skills may be acquired while working under a competent mentor. It is also important to recognize that e-learning imparted to the RMPs are specific to the business and require basic literacy to handle Android mobiles and the urge to learn trade that enhances employability and income. While scaling up the same activity would not require additional software developers, IT-personnel and professionals with subject-specific knowledge ought to remain up to date with the content of e-learning and for reaching out to newly selected RMPs. The interest to upscale appears to be fizzling out!

Snippet into Telemedicine (Jeeon)

Services provided by Jeeon:
- Telemedicine
- Drug ordering
- E-learning

Coverage of services:
- 34 centers (3 districts)
- 16 centers active daily
- 18 centers active weekly

Total consumers served:
- 7500+ patients

Service development environment:
- In-house
- Full-stack development
- For android

IT employees distribution and skills:
- 1 product manager
- 5 software developers
- All technical employees proficient at mobile, web & cloud-based application development
- Also proficient at database administration & data analytics

IT skills sought when hiring:
- Specialization in programming language not required

How employees' skills are upgraded:
- On-the-job

Non-IT abilities sought when hiring:
- Problem solving mindset
- Critical thinking
- Adaptability
- Determination

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[32] It is important to note that BBS formally took the ICT sector into its NIA exercise only since 2018-19, while this study commenced. Once this matures, one may expect to get the ICT output (from BE firms) used as inputs in the FE activities; and meaningful estimates of various derived demands may be attempted.

IV.2 Educational Institutions: Schools & Colleges in Dhaka City[33]

There are three broad areas where an educational institution at school & college levels would demand IT-related skills and supports; and these are related to the extent to which an institution engages in providing ITES and impart IT-related learning. The most obvious of the last is the classroom teaching of ICT courses, which require infrastructure and engaging qualified teachers. The second is the IT-enabling of education services, which is most prominently found in the digitization of administrative and accounting services. Education Resource Management (ERM) software are more readily available to provide the latter services. One school even reported of preparing and maintaining the voter list of students for school elections as an example of where ITES has made inroads. Beyond specialized teaching staff, an institution may consider having a separate IT department to oversee all the activities related to ICT use and for providing in-house services to the users among staffs and students. Interestingly, the three case studies reveal of variations that make working with average parameter value difficult, and yet, are worth pursuing in future research.

With regards to handling the digitization of administrative and accounts related activities, each of the three is found to have taken a different path. All the three rely on vendors, reportedly due to the need for having exclusive focus on teaching. There are however significant differences in the modality. One of the schools almost exclusively engages an US-based company headed by a BUET graduate, a second depends on a local IT firm, while the third assigned the task to one of its sister concerns (an IT firm owned by the group of enterprises it belongs to). There are in-house works to be done to support the vendors. The school with large number of students and double shifts moved to establish an IT department with 5 staffs for data entry to maintain profiles on admission applicants and current students, as well as on teachers' payroll. The two other schools chose to use existing staff to provide such services.

Snippet into education

Who they are:
- 2 schools under NCTB
- 1 school under British Curricula

Segments which has seen ICT adoption:
- Digital classrooms
- E-library
- Online admission and form submission
- Online fees collection
- HR payroll
- Digital ID cards

IT products/services and support bought from:
- Third party firms

Skill demands – current practices:
- 1 teacher for 240 students to teach ICT course.
- All the teachers in private school from Computer Science (CS) background, while one-third of ICT teachers in public schools have CS background

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[33] On an average, a school unit (a branch, where applicable) enrolls (approx.) 3620, ranging from 1000 to 6250; 9 to 14 percentages of whom graduate every year. The high figure reflects multiple shifts, implying greater capacity utilization of space and equipment, as well as higher stress on management. The student/teacher ratio ranges from 32 to 45; and is inversely related to the total student enrollment. If number of shifts are accounted for, average number of students per computer lab in non-private schools would be more than five times than that of the privately run high-fee schools. Percentage of digital classroom varies from 3% of all classrooms to 16%, and to having all classrooms for middle and senior sections digital.

[34] The college admission system enforced by the government through SMS only provides the college with the list of students to be enrolled. The information on the number of applicants is privy to the government only.

IV.3 e-Commerce in Transportation: e-ticketing and rides

An agency that provides a range of IT-enabled services including ticketing and on-demand rides was interviewed in April 2019. A single software is used to provide all services. The organization has Accounting & Finance department, a Human Resource department and an Administrative department. In addition, there are about 6 to 7 departments, each overseeing a different business function. In order to generate the actual services of the firm, certain IT inputs in the form of apps or websites are required. The in-house IT department meets all these requirements. The apps and website used by the firm are all developed in-house by the firm's IT team. The software development and quality assurance team are engaged in producing the final software while the product evaluation team provides a critical assessment of the output generated.

During recruitment, priority is given to applicants' job-specific skills, communication skills and other personality traits. The use of MS office is considered a prerequisite for employment at the entry level (for all non-IT white collared positions), along with basic communication and presentation skills. Experience was identified as an important indicator of skill at lateral level entries in senior positions while education and extra-curricular activities are considered important during skill assessment of entry-level workers.

The firm does not see a proportional relationship between output growth in business and growth in required number of employees. The firm had experienced a steady increment of 10% annual growth in workforce, which was not proportional to output growth. Instead, the growth in workforce is reportedly driven by diversification of business activities. The firm only considers employment growth when the business expands into new service markets, or, when new IT infrastructure is put in place. As new software tools need to be developed, the firm may need to hire new employees who specialize in the use of such tools. For instance, the respondent mentioned that they were trying to recruit an employee having specialization in the use of the data analysis software, tableau, which would allow the firm to gain greater insights.

Snippet into transportation

Services they provide:
- Ride sharing
- Food delivery
- E-ticketing (Bus, Launch, Movie)

Service development environment:
- In-house application and website development
- Full-stack development
- For android

IT teams in the firm:
- Product evaluation team
- Quality assurance team
- Software development team
- Technical support team

IT employee count:
- 73 IT employees (252 total employees, which excludes "independent workers" and delivery services outsourced to other local agencies).

Certification required for network support staff:
- Only from renowned institution
- Ex: CISCO, Microsoft

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[35] It was difficult to identify a proxy measure for the output of (services generated by) the firm. Only information gathered were on lifetime transaction count of 6.5+ crore, and App downloads of 50+ lakh.

IV.4 Banking Institutions

Officials of three banks were interviewed during April-May 2019, often involving several key personnel in a single meeting. All three were private banks, one from the first generation (before 1990), one from the third generation (1998-2005) and the third was at the planning stage after obtaining a license . The last one provided information on incremental needs, the second was still dependent on outsourcing, while the first had a matured in-house IT segment. This section provides brief overview of the ICT adoption in the banking industry, identifies the types of ITES provided and the nature of skill demands in the banking industry.

ICT adoption started in the core banking system in the financial sector. By the end of 1990s, about 60% of the workers of Bangladesh's financial sector learnt proper use of keyboard and mouse operation. By the end of 2010s, the younger generation of workers became proficient at using ICT, but the tech-apathy among seniors and distorted incentives around procurement of external software and services deterred a faster pace of in-house adoption. Several of the respondents expect the tide to turn by the year 2025, when the "structurally impaired generation" moves out of the workforce, and ICT adoption in the sector to increase. Currently, hardware and network system skills are more demanded in the sector with less demand for software skills. Due to security reasons, management in most banking institutions are opposed to the idea of allowing employees to tinker with software. Such risk averse policies often discourage innovations and favor increased dependence on outside consultants.

Apart from the sales section and the foreign exchange section, all activities of the core banking system have seen almost 100% ICT adoption in the first-generation banks. Such adoption has been partial and segmented among the third-generation banks, which remain largely dependent on external consultants.

In a matured bank where in-house IT-capacity has been developed, almost 85% of the specialized expertise are in software, and the rest are divided equally between hardware and network system. It is found that less than 100 IT professionals (2% of total employees) may manage a banking network of less than 200 branches. To support branch level operations, it is gathered that number of head-office IT experts would increase by 50% if total number of branches increased by 250%, but the changes are discrete over time.

All mid to senior level employees of each branch are required to hold at least basic IT skills to identify the sources of problems. For the entry level, logical thinking and cognition of the candidate are given the most precedence. The successful candidates are groomed and integrated upon assessing their niches. Table 2 summarizes the information on types of IT skills demanded by various banking activities.

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[36] The last one was included since it would help in knowing the demands considered at planning stages.

[37] Impaired in terms of ability to operate computers.

[38] Relative share of software would be less for banks which depend mostly on vendors, as was observed in the case of the third-generation bank studied.

[39] Change in the number of IT employees in response to changes in ITES consumers is expected to be low because since innovations in product and delivery system are generally labor (in this case, white collared) displacing.

Table 2: IT Adoption in the Banking Sector

Activity	Department/ sub-activity	IT skills needed	Remarks
Core banking system	Cash	MS Office Suite	All new recruits must have basic computer literacy skill and apply MS office packages in daily operations.
	General banking		
	Customer service		
	Operation management		Approver of the activities of 3 previous departments.
	Credit		
	Foreign exchange	Accessing networks/servers	Works on the foreign exchange portal/server set up by the central bank.
	Sales		Yet to see ICT adoption. Back-end teams compile & integrate sales data collected by sales force.
IT activities	Database administration (7.5% IT employees)	Java and C++ are the programming languages all candidates must be adept in.	Oracle Database Management System is popular.
	Application development & support (10% IT employees)		Follows SDLC framework; for some banks, will still be outsourced to foreign firms for software and maintenance. In entry level, graduates from BUET, DU, SUST, NSU, BRAC & CU are given preference.
	Alternate delivery channel		
	Data center/disaster recovery & quality control		
	Network support		Outsourced to external agencies. CCNA & CCNP certifications required.
	General support	Hardware, software and network troubleshooting	Consists of CSE graduates with some experience in the banking sector or MIS. CCNA & CCNP certifications required for intranet support.
	Cyber-security & money-laundering		Dependent on external expertise.

IV.5 Healthcare Systems

The study team studied two hospitals that have both in-patient and out-patient services. One of those is located in Dhaka city, while the other is in a divisional town outside Dhaka. There were computers and CCTVs in the non-Dhaka hospital, but no system in place – not even a segmented one. Both hardware and limited MS Office supports were provided by a vendor, and the management would not share the details of the vendor. Information on employee attendance, payroll, and basic information pertaining to patients and consultant physicians were recorded on excel templates, and the management expressed no intention of putting a system in place because information may go in "wrong" hands. Talking to other similar operators with less reputation, it is understood that there is a huge market for IT-related vendor services that normally go hand-in-hand with hardware sale/services.

Several private hospitals in the country now have hospital management software in place. Two of the early adopters, Apollo and Square Hospital Ltd., took different routes to institutionalize the system. Their lessons generally suggest why developments in one specialized area may or may not be tied to software development sector in Bangladesh. Those who are new in the adoption path, or, are yet to go into operation, face the dilemma in choosing between in-house capacity development and outsourcing to a third party. These are relevant to assess if expansion of hospitals or their adoption of IT will automatically generate demand for software skills in domestic market. Some further details on IT adoption and skill demands are highlighted below.

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[40] ESX/ESXi is the primary component in the VMware Infrastructure software suite that provides a platform to allow operation of multiple software.

[41] Larger in terms of both client base and geographic coverage. In a globalizing economy, this would also include the possibility of local firms taken over by multinationals, or, local firms sharing foreign equity to remain competitive.

It is understood that IT adoption is indispensable for some departments/hospital activities. These are laboratory, radiology, financial services and healthcare (patient profile & prescription). The last in the list also calls for data extraction for various purposes, including establishing links with pharmacy. There are other activities, such as, consultation, logistics, HR, building maintenance and security, where IT adoption helps, but are not absolute necessity. Finally, it is reported that cleaning services, central sterilizing services department (CSSD) and operations monitoring may require little or no IT adoption.

Though averages to estimate input/output ratios do not apply, it is learnt that a hospital with less than 400 beds and 1500 to 2000 daily visitors in OPD can be managed by an IT department with 20 or less employees with specialized IT knowledge. Several IT experts currently associated with developing hospital management system suggest that Java, Android and IOS are important for software development. The System management involving Data Center and storage will require knowledge of Linux, Windows and Virtualization (in particular, ESXi) . Knowledge of Routing, Switching, V-LAN for Networking are also in demand for ITES in hospital management.

Knowledge of IT among non-IT hospital staffs are extremely important. Nurses and other administrative staffs regularly operate PC, monitor, printer, scanner, barcode reader and other computerized medical equipment. These staffs need regular training by IT experts with adequate domain knowledge.

To summarize, IT product/service demand in healthcare industry are fulfilled by third party vendors. For those departments where IT adoption is indispensable, training of operators is covered under medical training regime. The administrative departments benefit from IT adoption and non-IT hospital staffs require IT knowledge for day to day operation.

IV.6 Selected Observations

The five cases generally reveal that each sector as well as each sub-sector within a sector vary widely in terms of IT adoption and the search for a standardized set of parameter values to link skill demands with output growth (sub-sector specific GDP) may be elusive. Yet, selected observations are made to guide future research as well as actions for skill development among existing as well as emerging workforce.

- Domain knowledge is important and IT adoption can progress if IT skill is rightly blended with such knowledge. In other words, ICT is a cross-cutting theme that can flourish as problem-solver; and the latter arises when the mind engages with real world issues.

- Insufficient data availability makes it difficult to obtain reasonable measures of output that can be related to demands for workers with a given (set of) skill. Thus, quantitative exercise on demand projections may not appeal to critical observers.

- The schools and colleges under national curricula system have recently started adopting IT in the administrative side and in basic education services. In contrast, British curricula followed by some private schools appear to emphasize on practical IT usages. Ways to find optimal blend between schooling and imparting IT knowledge may be found by contrasting various schooling systems currently followed in Bangladesh.

- Financial industry stands as the most IT integrated industry. Banks nowadays require basic IT skills in non-IT jobs as well. However, in much of the banking operations, the white-collared graduates get little opportunity to think and innovate.

- Although greater importance is now being put on cyber security, the current performance is dismal. Cyber security is a potential area where IT skills will be demanded the most in future. Yet, the learning process to prepare the future workforce may be jeopardized due to the sensitive nature of such initiatives.

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[42] Reportedly, many youths with Bangladeshi origin and having permanent residency and/or citizenship in foreign countries, are working organizations such as bKash.

- Many of the ITES that connect with spatially dispersed numerous segments of population are startups and are driven by ideas transformed into Apps. Once developed, there is often little room for creative engagement (e.g., in software development) unless the business expands into new areas. It appears that there are forces at work that will turn these startups into operators for larger and more robust agencies with supra-national character. The innovators may like to move into new fields, and the innovated Apps, further fine-tuned can find efficiency gain in larger markets.

- ITES expansion in Bangladesh has significant dependence on imported ERPs and on external IT consultants. Thus, outsourcing work in both directions. It is important to assess the comparative advantage and the likely outcome if those are left to markets alone.

- The above has implications for skill demand. With expansion of ITES, demand for basic computer operators will increase, and relative demand for high-powered skills may diminish. As noted in the previous section, the path is unpredictable, especially, the set of skills that define 'high powered' as opposed to 'regular skills' may not be stable.

At the cost of being repetitive, few additional observations are made.

There appears to be similarity between IT-enabled business start-ups and innovations in platforms on open-source software since both are likely to be taken over by the larger corporate entities. Roles of the early entrepreneur as well as of a core group of IT-specialists may therefore be viewed transitional, which may rather get reduced over time (or expand) depending on the route a particular business takes to grow. bKash appears to be developing along the latter line creating greater demand for skill, drawn from within the country as well as from abroad. In other instances, it is apprehended that the start-ups that locally developed Apps (or relevant software), would succeed in areas where building a network is important. In the case of telemedicine, establishing the rudimentary network with a number of clients (patients) was the essential first step. With increased investment needs for scaling up, the segment dealing with initial software development may find it more attractive to sell the start-up at an infant stage. Thus, the possibility of reduced demand for technical persons may not be ruled out.

No matter what the course these start-ups take, successes in a given ITES sector means an expansion of the network that was initiated. Thus, demand for operators, such as Jeeone's RMPs with competency in basic computer skills and in operating mobile-based apps, will increase.

Banking sector as well as the educational institutions and hospital system will demand workforce with basic computer literacy, preferably tied to the respective subject domain. While demand in the health system and education is expected to increase, it is unclear whether employment of IT-literate workforce in the formal banking sector will increase or not. There are apprehensions that ICT-adoption will lead to consolidation in banking activities, while expansion of agent banking and MFS will demand computer and mobile apps-literate self-employed service providers and clients. On a separate context, while healthcare institutions can expand by outsourcing their IT activities, quality of educational services appear to be severely impaired due to inadequate in-house IT capacity in educational institutions that continue to upgrade.

There is a large number of ITES providers who source their IT needs from individuals or agencies with the requisite expertise. The study team recognizes the need to study the backend service providers in order to make a difference in the adoption of IT as well as the quality of ITES in various sectors. The present study covers only the backend IT firms that are registered and are members of BASIS. The details are presented in the following section.

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[43] Further studies on the dynamics of startups are needed to assess the likely path of future skill demands to arise out of these startups. It is also important to be cautious of having over-optimism with start-ups since their expansions are inherently constrained within a global distribution of technology and market power.

V. Skill Demands in ITES: backend IT Firms and Freelancers

The questionnaire survey administered on backend IT firms covered large number of issues. Only those pertinent for assessing skill demands are presented in this section. Additional information drawn from analyses of data on freelancers registered with three different platforms have also been presented, since those reflect the demand for IT-related skills from across the globe revealed through those platforms. A brief on skill demands revealed in the courses offered by training/TVET institutions is placed in the Annex to this section.

V.1 Skill Demands in BE Firms

Majority of the BE firms surveyed (63%) are engaged in export; and 8 out of 9 of them serve domestic market as well. The products/services delivered by these firms were primarily software (or, software-based), about a quarter reported of delivering hardware and/or network services, while one-third mentioned of specialized ICT services. In-depth interviews with some of the firm-owners revealed that there are instances where some of the IT firms act as commission agents in marketing imported products & services, including specialized software. As shown in Figure 3, developed countries remain the major destinations of the exporting IT industry. There are however several firms reporting of IT exports to developing countries in the Asian region.

Figure 3: Percentage of Survey Firms, by Products/Services and Export Destination
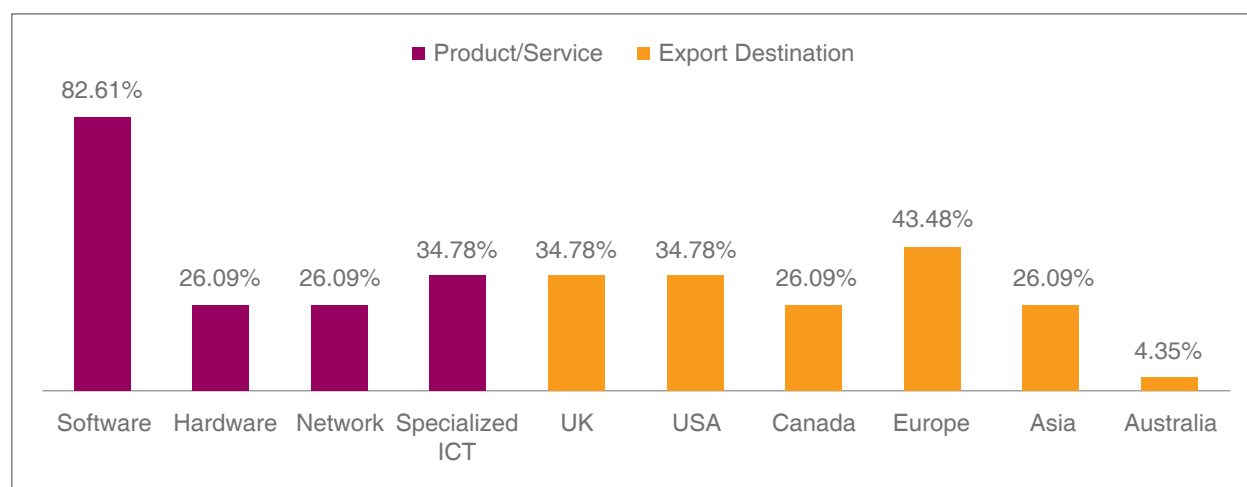
Note: Asia includes Japan, Cambodia, Myanmar, Nepal, Maldives and India. Europe includes Germany, Italy, France, Switzerland, Denmark and Netherlands. Firms specialize in multiple product/services and export to multiple destinations.

V.1.1 Product/Services delivered differ across markets served

The product/services generated by the IT firms are shown in Figure 4. Relative importance of these products/services varies across market destinations. ERP, mobile applications (consisting of iOS, android and windows systems) and web applications developments have the highest levels of incidence overall, whereas web design has moderate demand. In the domestic market, web design and development have high demands. Moderate demand is observed in the domestic market for ERP and mobile applications development, and hardware/server installation & maintenance.

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[44] A rigorous approach would need to account for scale of operation of the firms under study. In the absence of adequate information, relative importance is measured by percentages of firms reporting delivery of one or the other product/service.

For the IT product/service provider firms that cater to both the domestic and foreign markets, highest incidence of product/service corresponds to the overall demand, but moderate demand is observed in Quality Assurance (QA) and testing, web design and e-commerce site development. Major concentration is observed in these mentioned product/services, but small number of IT firms provide niche IT product/services, such as game development, cloud computing services, IT consultancy, content creation and management, data entry and analysis, and GIS mapping. Digital marketing services are only provided in the domestic market. ISPs work only in the domestic market as well.

Figure 4: Product/service provided, by different market orientation (% of BE firms)
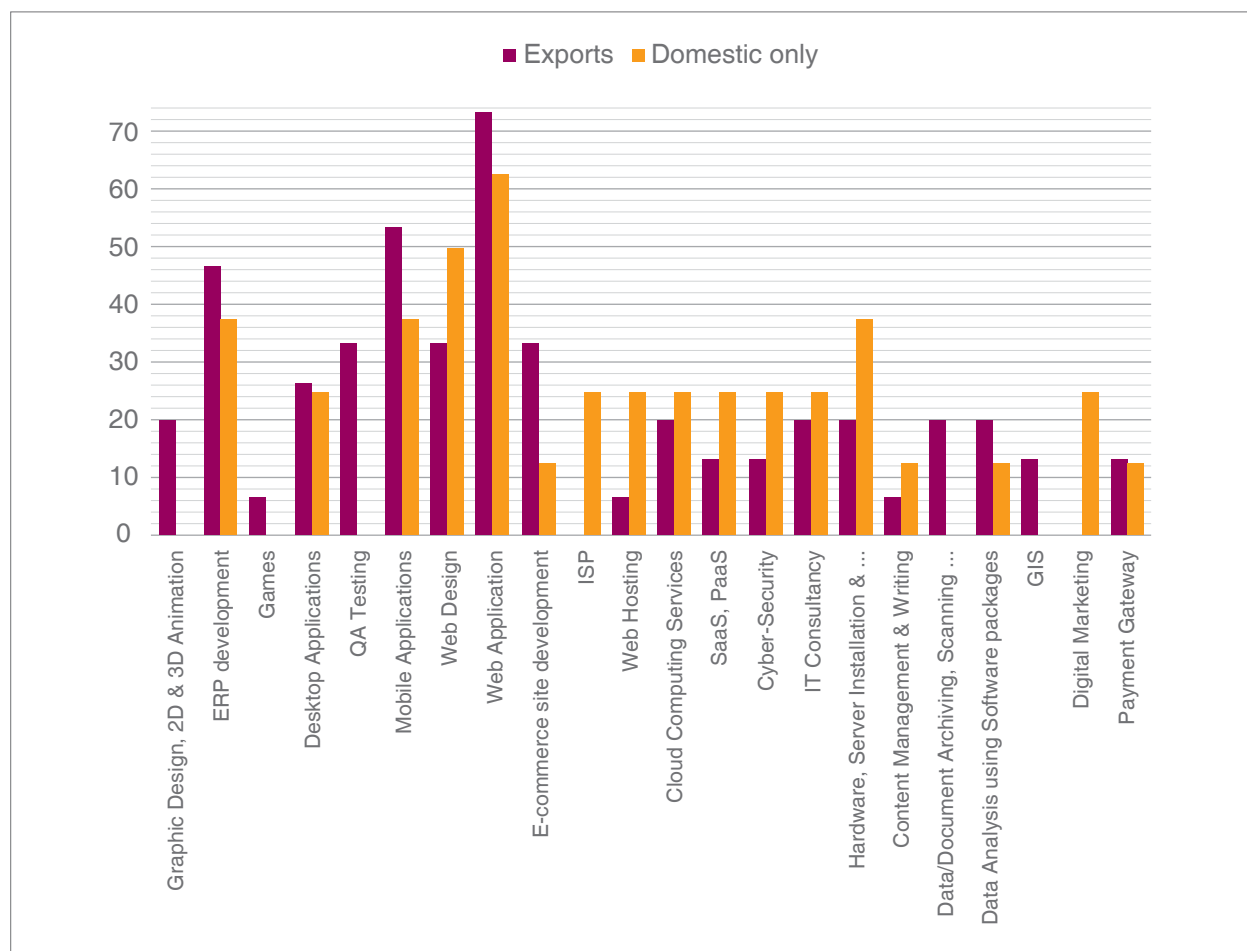
V.1.2 Employment and IT Skills Demands by Verticals served

While industry-specific skill inputs from BE firms were not available, the survey had information on verticals a firm served as well as on the various skill-mix it has among its employees. Thus, distribution of products/services in terms of percentages of BE IT firms serving a vertical could be compiled. Table 3 draws a correspondence among industry verticals served by these firms and the product/services provided to these industries. Graphic design is not demanded by the Banking & Financial industry, nor by the Health, Transportation, Education and Communication industries. However, web applications development is demanded from all types of end-consumable service sectors, even from other IT firms. Similarly, data entry and payment gateway have a niche demand. The hardware/network products/services also exhibit a niche demand in terms of industry verticals they are provided to.

## Table 3: Industry verticals and corresponding product/services provided (row % of firms reporting a vertical)

Industry vertical	GD	ERP	DA	MA	WA	ISP	WH	CCS	SaaS	CS	ITC	HN	CCM	ECS	DE	SA	PG*
Banking & Financial		18.18	9.09	9.09				9.09				18.18			9.09	9.09	
Health				50											50		
Retail & Trade	25	25			25					25							
Transportation		100															
Education														100			
Communication					40								40				
Government agencies	33.33				33.33											33.33	
Armed forces					25	25				25		25					
Manufacturing				12.5	12.5		12.5			12.5	12.5		12.5			12.5	12.5
IT firms	33.33				33.33											33.33	

Note: Blanks imply zero or insignificant proportions. GD = Graphic Design; ERP = ERP development; DA = Desktop Application; MA = Mobiles Application; WA = Web Application; WH = Web Hosting; CCS = Cloud Computing Services; CS = Cyber-Security; ITC = IT Consultancy; HN = Hardware/server installation and maintenance; CCM=Content Creation & Management; ECS = E-Commerce Site development; DE = Data Entry; SA = Data Analytics; PG = Payment Gateway.

* As most PG services are extensions of banking services (debit/credit cards, internet payment), the incidence of local IT firms providing PG services are very low.

Figure 5 (Table V.2 in Annex) shows the average employment per firm according to the industry verticals served. The average employee count per firm is sufficiently disaggregated in terms of contractual engagement and gender to draw multiple conclusions. In general, female employment is considerably low in the IT industry. Discounting one firm (an outlier) among those who serve the domestic market only, the average number of employees per firm serving both the foreign and the domestic market is higher compared to those serving only the domestic market. Firms serving both the markets also tend to hire more part-time workers. Firms serving the Retail & Trade industry and operating in both the markets allocates the highest average number of employees, which is explained by drawing a correspondence among IT product/services that are provided to this sector.

Figure 5: Average number of full-time employees in IT product/service provider firms
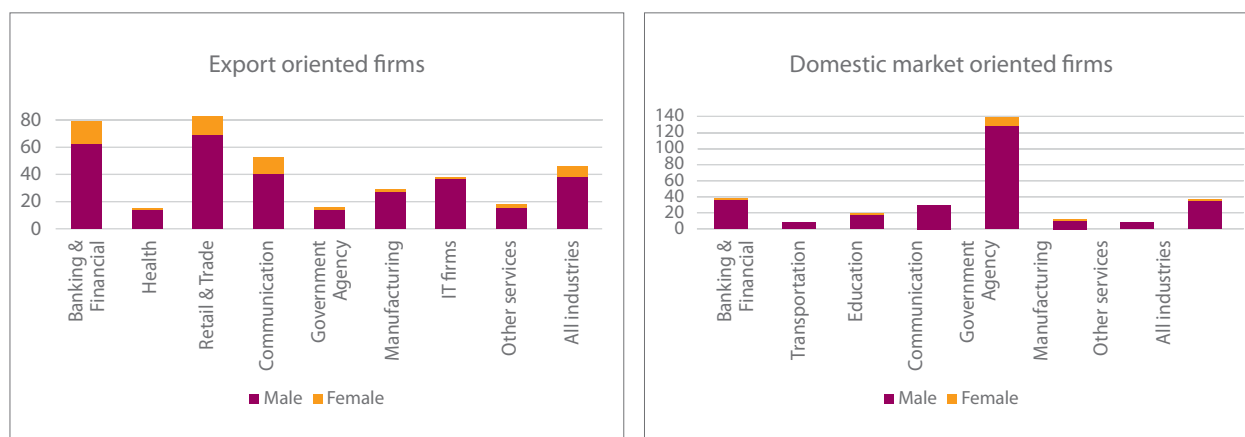
Note: One firm serving the domestic market was omitted as it housed 1800 total full-time employees.

Table 4 summarizes the most used skills/languages, by most served industry verticals, where an overwhelming use of PHP in web design/development, python in data administration and Java/JavaScript is observed across the mentioned industries. Notable use of C# in web design/development is also observed. Use of graphic design is observed neither in Banking & Financial sector alone or coupled with Retail & Trade. Mobile application development also has no precedence among firms serving both Banking & Financial and Retail & Trade sectors.

Table 4: Required skills according to notable most served industry verticals (no. of firms)

Category	Program	Banking & Financial (1)	Retail & Trade (2)	Communication	Manufacturing	Both 1 & 2	Total	Share
Web design/ development	WordPress	2					2	5%
	.NET	4			2		6	15%
	PHP	4	2	6	6	2	20	50%
	Ruby on Rails	2		2			4	10%
	C#	2	2		2	2	8	20%
Graphic design	Adobe Suite				2		2	33%
	Illustrator		2				2	33%
	Visual Studio			2			2	33%
Mobile	Native Android	2			2		4	50%
	Objective C	2		2			4	50%
Database administration	MSSQL	2					2	9%
	MYSQL	2	2			2	6	27%
	SQL				2		2	9%
	Python	4	2	2	2	2	12	55%
Document archiving	MS Office Suite				2		2	
Java/JavaScript		8	2	2	2	2	16	
HTML		2	2			2	6	

Note: Despite web design and database administration are adjacent activities, database administration has a wider scope. Hence the demand derived for database administration does not match the demand for web design/development. Relative share of each skill demand in their respective broad task category is presented in the last column. The same approach was not taken for Java/JavaScript and Html category as the application of these skills vary across broad task categories.

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[45] Java is a general-purpose, object-oriented programming language which (and/or versions of which) is widely used in desktop, web applications, cloud-based applications and database programming. JavaScript, Nuxt.js andAngular.js are additional scripting languages to the Java compiler language.

Unlike software related tasks/activities, hardware & network related activities are not omnipresent at serving all service sectors. As hardware & network related tasks/activities are more regionally and internally required by many firms, majority of the firms create/opt for an in-house IT or IT-support department/team to provide native hardware & network support. Activities include OS/server/network maintenance, installation and troubleshooting. Router, intranet, internet and external network related connections are also setup/maintained by this team. However, sometimes, IT product/services provided by the IT firms require some special hardware or network installation and deployment. In such cases, the vendors usually provide hardware or network support till the product/service is discontinued or till the in-house IT team takes over the IT support activities. Some IT firms also provide dedicated hardware or network support services as third-party agencies. Table 5 below depicts the average number of employees allocated in hardware and network related activities, according to market orientation and industry verticals served. Firms, operating in both domestic and foreign markets, serving the Banking & Financial, Manufacturing and IT sectors exhibit a relatively higher average number of employees engaged in hardware and network activities. These industries are relatively more dependent upon specialized hardware and networks, which demands a larger quantity of employee allocation. Even the software product/services that are provided to these industries sometimes require constant server monitoring and maintenance, which is taken care of by these workers. Removing the outlier firm, operating in the domestic market only, shows very few average numbers of IT resources engaged in hardware and network related activities, pertaining to more in-house activities to sustain the IT product/service provider firms.

Table 5: Number of employees with specialized skill in Hardware/Network related activities

Industry Verticals served	Exports			Domestic	
	OS support	Network & security		OS support	Network & security
Banking & Financial	7.3	8.5		1.2	1.0
Health	0.5	0.5			
Retail & Trade	2.8	4.5			
Transportation				1.0	1.0
Education				1.0	1.0
Communication	6.0	6.0			
Government agencies/ autonomous bodies				4.0	4.0
Armed forces/ Other Security agencies				30.0	120.0
Manufacturing	9.0	11.5		7.8	30.3
IT firms/service providers (backend)	7.3	10.7			
Other services	1.0	1.0			1.00.0
All industries	4.7	5.9		4.6	15.8

Table 6 presents the rankings of skills/programming languages/development tools that are sought in the IT product/services provider firms. The ranking of skills under the '2019' column showcases the rankings purported from the current study in comparison with skills ranking from Skill Survey Report 2016. The table is truncated to show only the rankings relevant for the purposes of the current study. In terms of general programming language skills, Java (being a highly utilized language across multiple domains of tasks) has held strong for 3 years and the demand is not expected to decline in anytime soon. Python has been receiving a soaring demand in the years and is expected to boom in the future. Like Java, JavaScript retains good demand in the scripting language field. Although PHP has been the highest ranked tool for web application development,

Table 6: Skills in demand (truncated)

Skills		2016	2019
		Rank	Rank
A.	*General Programming Languages*		
1	Java	1	1
2	C++	3	2
3	Python	4	3
B.	*Scripting Languages:*		
1	JavaScript / Jscript	2	1
C.	*Web Application Development:*		
1	PHP	1	1
2	WordPress		2
D.	*User Interface Technologies:*		
1.	CSS	1	1
E	*Middleware/Application Server:*		
1	Node.js (JS)	3	1
F	*Database Platforms:*		
1	MySQL	1	1
2	MS-SQL Server	3	2
3	SQL		3
G..	*Content Management System (CMS):*		
1	WordPress	1	1
H.	*Mobile Application Development:*		
1	Android SDK – Android apps	1	2
2	Objective C – iOS	2	1
I.	*Network Support & Administration*		
1	CISCO	4	1
2	MikroTik	5	2
J.	*Application*		
1	Adobe Suite	1	1
2	Visual Studio		2

Note: The skills that have no ranking in 2016 were not considered in that survey report.

Source: IDB Skill Survey Report (2016) and ERG (2019).

[46] Please see Skill Survey Report 2016, IDB, Bangladesh Islamic Solidarity Educational Waqf (BISEW)

[47] A major category of skills that was omitted in representation is CAD related skills/competencies

WordPress has been growing steadily and is expected to turn full-stack website development obsolete soon. Demand for CSS stands strong while the demand for Node.js has increased since 2016. In terms of database platforms, all types of Structured Query Languages (SQL) – MySQL, MSSQL, etc. exhibit relatively similar demands. Mobile application development for Android and iOS has seen similar demands over the years. In the hardware/network domain, CISCO and MikroTik certification demands have soared in the last three years, and now considered a staple for every employee willing to work in hardware/network related activity/jobs. In graphic designing, Adobe Suite stands as the uncontested software in the market. Visual studio has entered the market recently but is demanded for few specific types of tasks. Furthermore, visual studio fails to offer comparable range of functionalities offered by the Adobe Suite.

V.1.3 Hiring Practices and Perceived Future Demand

Employers of the IT product/service providing firms were asked to assess the perceived difficulty they face while recruiting in each of the major job categories. Highest level of difficulty is observed while recruiting project managers, followed by system analysts and system engineers (Figure 6). In case of the software related jobs, recruiting software developers, QA engineers and document specialists was the easiest, whereas recruiting line staffs and IT support staff was easiest for hardware/network related jobs. This ease is attributed to the abundance of labor force with these skill categories, a saturation seemingly reached due to availability of graduates from polytechnic and TVET institutions.

Figure 6: Average difficulty in recruiting, by job category
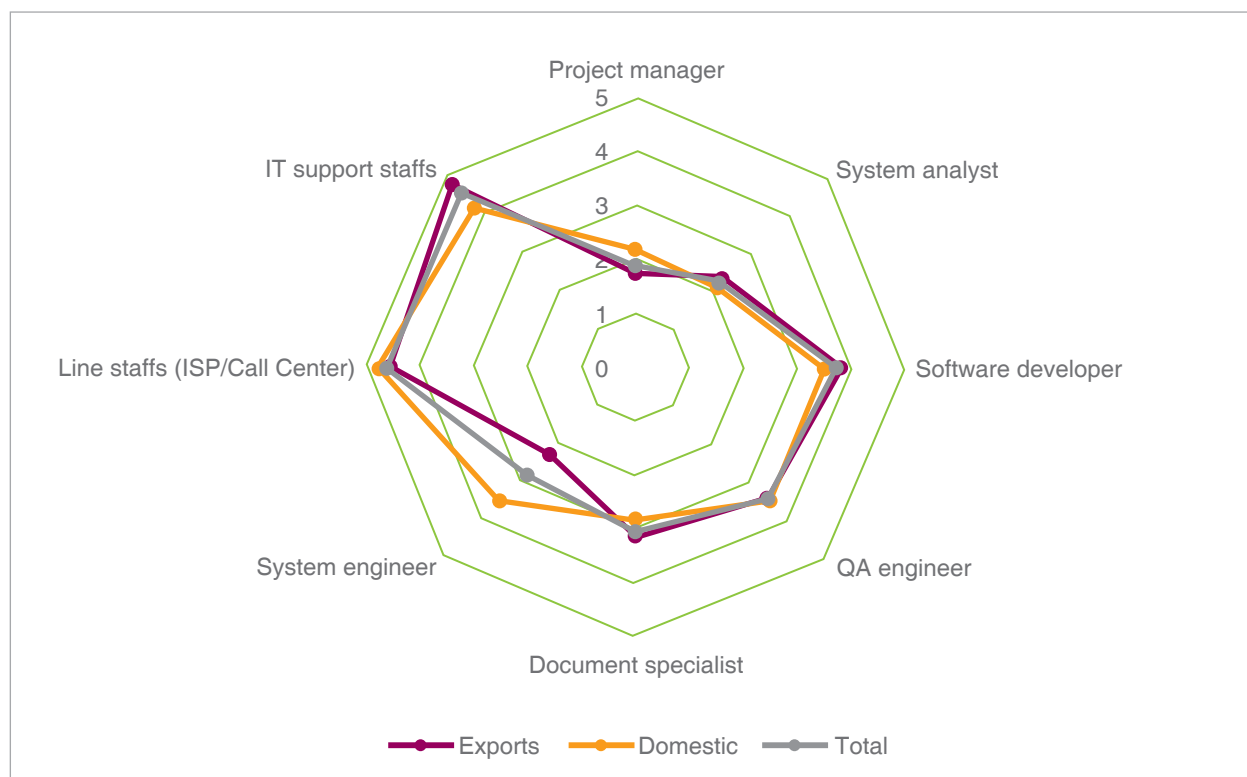
Note: 1 represents highest difficulty and 5 represents most ease.

The current IT skill demand and resource allocation will be shaped by the anticipation of the changes in IT products/services demanded by the end-consumers. Due to this interlinkage between the end-consumer service firms and IT product/service providing firms, employers were asked to reveal their perceived changes in the end-consumer service sector for the IT product/services provided by them. Table 7 presents their perception in terms of both domestic and External/BPO markets. Employers are anticipating that the product/services they are providing will be demanded more by the banking & financial industry. It is also anticipated that the health and retail & trade sectors will demand more IT product/services. Some firms expect that the demand generated from the government agencies or autonomous bodies will also see a surge in the domestic market.

Table 7: Demand Increases anticipated, services by Industry Verticals (% of Entrepreneurs)

Industry Verticals	General increase			External/BPO market		
	Export	Domestic	All	Export	Domestic	All
Banking & Financial	33.3	50.0	39.1	33.3	25.0	30.4
Health	26.7	12.5	21.7	6.7	12.5	8.7
Retail & Trade	33.3	12.5	26.1	40.0	37.5	39.1
Transportation	6.7	25.0	13.0	6.7	0.0	4.3
Education	6.7	25.0	13.0	0.0	0.0	0.0
Communication	6.7	12.5	8.7	13.3	12.5	13.0
Recreation & Culture	6.7	0.0	4.3			
Government agencies/ autonomous bodies	20.0	25.0	21.7	13.3	12.5	13.0
Manufacturing	13.3	37.5	21.7	0.0	25.0	8.7
IT firms/service (backend)	6.7	0.0	4.3	6.7	12.5	8.7

Table 8 below reports the entrepreneur's anticipation of changes in demand for IT product/services. Over a period of 5 years (2020-25), ERP development and cloud computing services are perceived to see demand increases across markets, whereas desktop application development is expected to become obsolete. Entrepreneurs also expect mild increases in demand for web applications and mild decreases in web designs. The perceived decrease in demand for web design is attributed to the rising popularity of theme-centric web design templates, such as WordPress, which enables anyone with basic computer literacy and internet navigation skills to create websites.

Table 8: Demand changes anticipated for product/services

Description of Products/Services	Increase			Decrease		
	Export	Domestic	All	Export	Domestic	All
ERP development	40.00	25.00	34.78	6.67	0.00	4.35
Desktop Applications	0.00	0.00	0.00	60.00	62.50	60.87
Web Design	6.67	0.00	4.35	20.00	12.50	17.39
Web Applications	13.33	25.00	17.39	0.00	12.50	4.35
Cloud Computing Services	20.00	37.50	26.09	0.00	0.00	0.00

V.2 IT Skill Demands in Platform Markets

Additional to IT product/service providers, freelancers or platform workers also cater to the demands generated by the end-consumable service firms. Publicly available information on Bangladesh based accounts from Freelancer.com, Upwork.com and Guru.com indicate that majority of the platform workers are in Dhaka & Chittagong districts (Figure 8), which is expected as the best infrastructure required for engaging in freelance work is present in these regions. Further 18% of the platform workers provided their location to be in the other divisional districts.
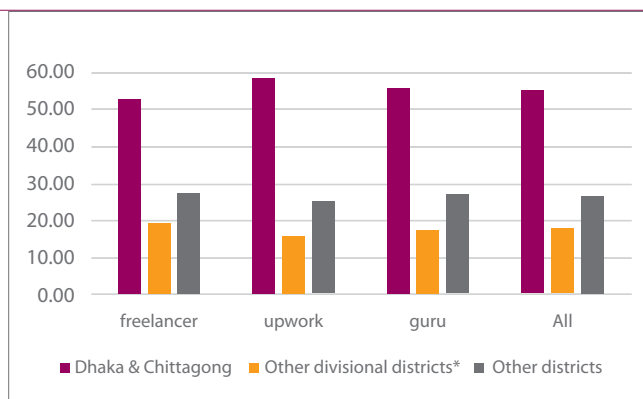
Investigating the growth of platform worker accounts, a pattern becomes apparent (see Figure 9). An inflection in growth rate can be observed around 2014 after which the Bangladesh based accounts grew increasingly. Perhaps, the introduction of 3G and NTVQF in 2013 instigated the observed growth.
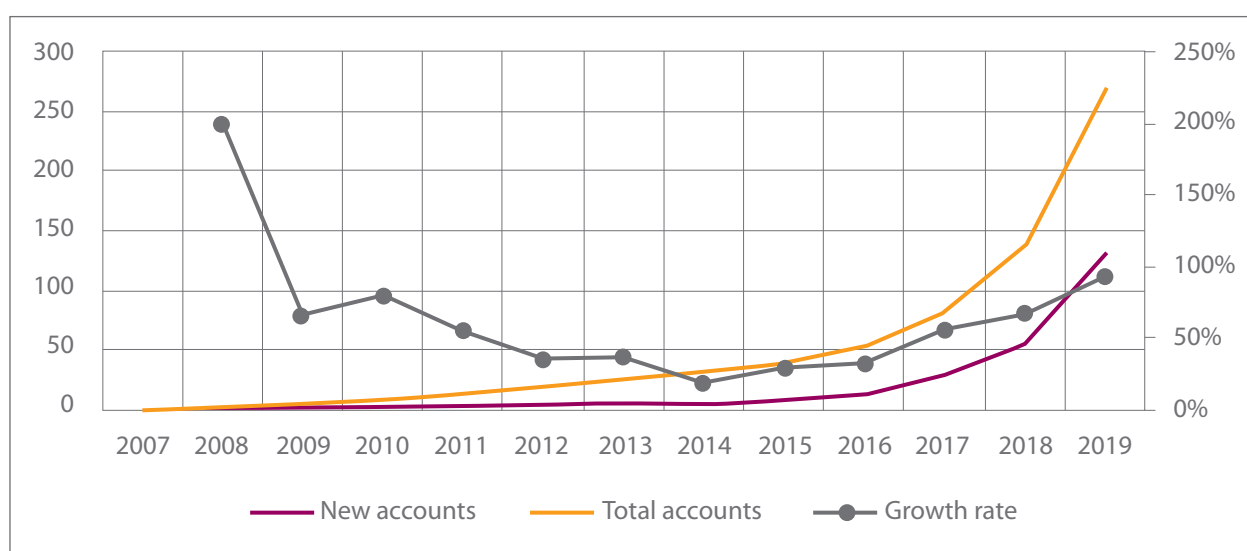
Figure 9: Growth of platform worker accounts

Note: Information on when platform workers created registered accounts were only available for Freelancer.com. The information depicted consists of 270 registered Bangladesh-based platform worker accounts.

Taking the proportion of location distribution of the platform workers and dividing by the proportion of corresponding population density results in the engagement intensity of each location, exhibited in Table 9. Highest degree of engagement in freelance activities are observed in the other divisional districts with a growing IT infrastructure to support freelance activities, more accessible skill development programs to facilitate operational skill upgradation mechanism, and inadequately growing formal jobs with equivalent remuneration which inadvertently makes freelancing a more lucrative earning option.

Table 9: Relative Intensity of Engagement in Freelancing Platforms, by Regions

Location	% of entity (1)	% of Population (2)	Engagement Intensity (3= 1/2)
Dhaka & Chittagong	55.23	8.74	6.32
Other divisional districts*	17.97	1.87	9.62
Other districts	26.80	89.39	0.30

Product/services provided by the platform workers are summarized in Table 10. General software development, web design and development, system architecture, graphic design, and Java & Html related product/services have the highest levels of incidence overall. Additionally, high incidence of data entry, data analytics, game development, content creation and management, and sales & marketing is also observed.50

Table 10: Products/services provided by platform workers

Products/services	Freelancer (%)	Upwork (%)	Guru (%)
General software		8.07	28.82
Web Design & Development	46.88	72.67	37.06
Desktop software			6.47
Relational data base Management system		14.29	6.47
System Architecture			22.94
Game Development		22.36	
Graphic Design	37.50	31.68	52.94
Data Analytics	21.88	16.77	31.76
Data entry	31.25	13.66	41.76
Write (content creation and translation)		8.70	48.24
Sales (campaign, e & tele-marketing, click worker)		10.56	42.35
e-commerce - platform maintenance		11.18	
Accounts & finance			5.88
Research (net search)			10.00
Human resource management			6.47
Java		30.43	7.06
Html		36.02	11.18
Number of accounts reporting at least one skill	*32*	*161*	*170*

Note: Blanks imply insignificant proportions. There are other skills mentioned as well: android, iOS, project, etc.

Observed co-existence of multiple skills in a worker may be of interest, though additional data is required to infer whether those reflect individual's choice of skill portfolio to face variations in market opportunities, or, the skills fall within similar structure, or both. Correlation coefficients among the skill categories of platform workers are portrayed in Table 11. The correlation coefficients for Guru.com workers reveal a strong correlation among general software skills and separately with each of the following: system architecture, graphic design, and writing. As system architecture is an integral part of any development activities, a strong correlation with general software skills is expected. Writing in the domain of software development often refers to technical writing (creating and drafting user manuals of software/hardware). Although graphic design has very little relation to software development, it is possible that platform workers with programming ability chose to engage in graphic design to protect earnings in case of lower demand for programming jobs.

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[48] Other divisional districts include Barisal, Khulna, Mymensingh, Rajshahi, Rangpur and Sylhet.

[49] Java & Html is separated from the other types of product/services as these programming languages can be used in generating multiple types of product/services (web design/development, software/API development, etc.).

Table 11: Likelihood of skills to be simultaneously embodied, Correlations between Skills

Skill Categories	General software	Web design/ development	System architecture	Graphic design	Data Analytics	Data entry/ extraction	Java
Guru							
System architecture	0.92	0.17					
Graphic design	0.64	0.21	0.63				
Data entry/ extraction	0.16	0.17	0.14	0.25	0.59		
Writing	0.61	0.20	0.65	0.71	0.28	0.41	
Research					0.50	0.43	
Java		0.40					
Html		0.53					0.56
Upwork	**Web design/ development**	**Game design**					
Java	0.42	0.11					
Html	0.52	0.67					
Freelancer	**Web design/ development**	**Android programming**	**Relational database**	**Data Analytics**	**Big Data/ AI**	**Data entry/ extraction**	**Writing**
Data entry/ extraction	-0.15	-0.10	-0.10	0.64			
Sales/ marketing	0.42	-0.10	0.29	0.37	0.29		
Research				0.61		0.47	0.53
Java	0.42	0.48	0.48	0.05	0.48	-0.02	-0.13
Html	0.31	0.42		-0.20			-0.14

Note: Correlation coefficient among all 26 categories is not shown. Cells highlighted in 'Red' holds a value of 0.50-1.00 [signifying high co-existence] & in 'Yellow' holds a value of 0.40-0.50 [signifying moderate co-existence].

The same argument describes the correlation among software architecture and graphic design or writing, and among graphic design and writing. Web design/development has a strong correlation with Html and notable correlation with Java. Java and Html are extremely popular languages that are used and integrated into every segment of the IT space, which is reflected in the strong correlation among these skills. Versions of Java and Html specialize in web design and development, and hence the observed correlations are expected. Data analytics has a strong correlation with data entry/extraction and research, which is only natural as any quantitative research is primarily based on, but not limited to, data collection and analysis. The notable correlation among data entry/extraction and research is also attributable to this argument. Moreover, data entry/extraction is very similar to transcription/translation (writing jobs) in practice, which would explain the mild synergy among data entry/extraction and writing jobs.

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[50] Guru reveals a large concentration (accounting for 66.47% of the Guru sample) of 3-6 skill categories, whereas Upwork platform workers show a large concentration (accounting for 47.21% of the Upwork sample) of 3-4 skill categories. Although, the Freelancer platform sample shows a larger concentration of singular skill categories being highlighted by platform workers, the sample size remains too low to derive concrete conclusions. Relative distribution of platform workers according to the number of skills reported is presented in the annex section.

Investigating the correlation coefficients of the Upwork.com workers only exhibit high degree of correlation among Html and web design/development conforming to the argument presented for the case of Guru.com workers. The use of Html5 in game designs may explain the correlation among Html and game design. Moderate correlation is present among Java and web design/development as well. Same as Guru.com workers, workers of Freelancer.com also exhibits high degree of correlation among data entry and research, and data analytics. High degree of correlation among research and writing is observed which is expected for the case of content creation and academic research activities. These correlation coefficients will be used to quantify the payoffs of various skill mixes.

Jobs, or product/service generation, platform workers are engaged in are reflective of revealed skill demands and the payoffs for each skill is tantamount to what the relative demands of each skill is. Table 12 reports the activity/skills and the corresponding earning (in USD) of freelancers employing said skills . The table reports payoffs corresponding to some selected singular skills, and few skill-mixes for whom the correlation coefficient was above 0.40. Freelancers in Upwork.com earn more than US$20 per hour employing any skills but network system administration, graphic design, data analytics, data entry, and html. Html marginally falls short of the US$20 cutoff. Network system administration, graphic design and data entry are relatively less skill intensive activities which explains the relatively lower payoff. Data entry is also a part of data analytics and accounting & finance, which pulls down the average payoff per hour. Highest payoff is observed in bigdata/AI skills for the Upwork.com workers. Employing Java additional to web design & development skills has increasing returns, whereas html is seeing decreasing returns. Employing both java and html additional to web further decreases payoffs, most likely due to improper allocation of skills. The same is observed for the case Freelancer.com workers as well, where Java additional to web skill have results in increasing payoffs. However, Freelancer.com caters to a relatively lower skilled market than both Guru.com and Upwork.com, attracting a larger pool of low-skilled platform workers. It is very possible that, exhibiting more than average skills pulls out the greatest payoffs in graphic design skill. Data entry skill has the lowest payoff in Freelancer.com. From Guru.com, it can be inferred that web and data analytics skills have the reasonably high payoff. As accounts are not restricted to any skill or skill-mix, it is plausible that those employing additional skills extract higher payment per hour which is being captured in the data entry skill category as well. Thus, caution is encouraged before drawing conclusions regarding this.[52]

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[51] Unlike the other two platforms, Guru reported average annual earnings (in USD) and total number of tasks competed. Average yearly earning was divided by the total number of jobs completed, on the assumption that they worked for only a year. The estimates on earning per task may be consider a lower bound. This method was adopted to attain some form of comparability among the skill-pay correspondence across platforms.
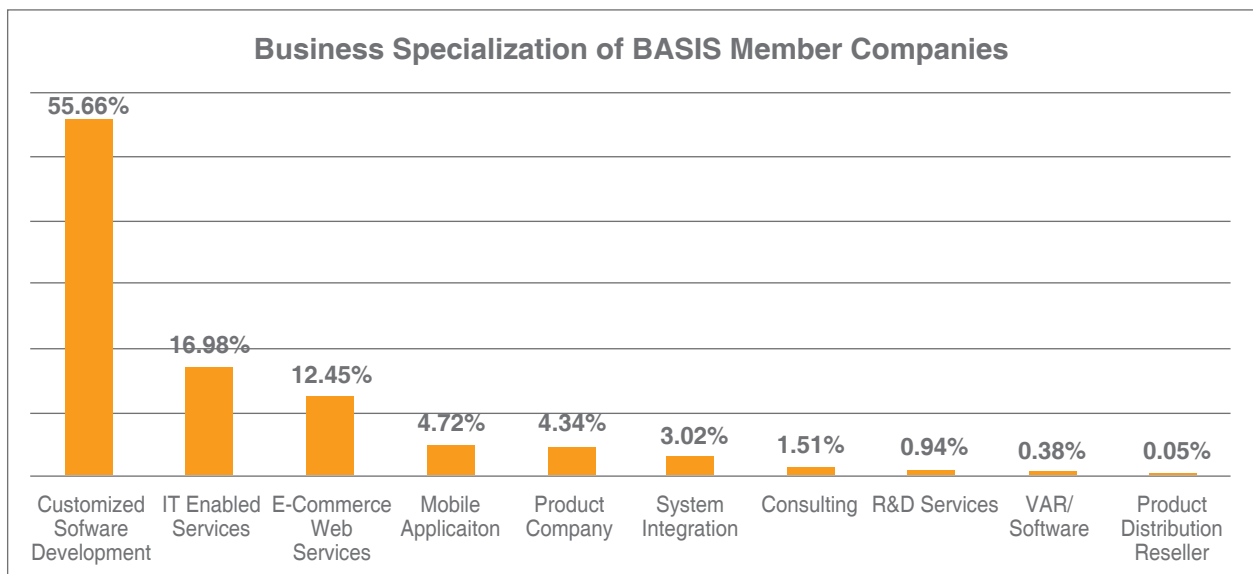
[52] Cross-tabulation of skills and hourly rates by education was feasible only in case of Freelancer.com, where 17 out of 32 cases were valid. 13 had bachelor's degrees resulting in no discernible pattern in education-ITES skill.

Table 12: Activities/skills and earnings of platform workers

Skills	Freelancer		Upwork			Guru		
	USD/hr.	n	USD/hr.	n	USD/yr.	USD/task	n	
Web	17.93	15	20.73	105	861.43	28.36	63
Network system administration			16.67	6	251.25	6.16	4
Game			20.59	32	177.50	0.38	2
Graphic Design	33.33	12	17.99	44	542.39	20.02	90
Analytics	14.71	7	18.67	24	1069.15	41.42	54
Bigdata/AI	20.00	1	36.67	3	41.67	1.55	3
Data entry	10.20	10	15.91	22	780.58	46.69	71
Write (content creation and translation)	33.50	4	21.21	14	691.12	18.03	82
Java	19.00	4	22.96	47	325.33	2.74	12
Html	14.20	5	19.87	53	314.58	7.91	19
Web + Java	19.00	4	22.20	45	352.64	2.84	11
Web + Html			19.87	53	317.63	3.65	16
Web + Java + Html			18.84	26	422.67	3.09	9

Annex to Section V

Figure V. 1: Business Specialization of BASIS Member Companies

Business Specialization of BASIS Member Companies

- Customized Sofware Development: 55.66%
- IT Enabled Services: 16.98%
- E-Commerce Web Services: 12.45%
- Mobile Applicaiton: 4.72%
- Product Company: 4.34%
- System Integration: 3.02%
- Consulting: 1.51%
- R&D Services: 0.94%
- VAR/Software: 0.38%
- Product Distribution Reseller: 0.05%

SOURCE: BASIS Software & IT Services Catalog

Note: Of the 280 phone calls made for ERG survey, 43 numbers were invalid, no one picked up in 76 cases and 12 reported of permanent closure.

Table V.1: Number of employees with specialization in Software, average per firm, by market orientation and Industry verticals served

Export	WD&D	MAD	DTAD	RDA	QA&T	GD	DS/AI	SA	CBAD	SA/PM	FT	PT
Banking & Financial	15.5	16.5	6.5	7.8	4.5	1.5	5.17	3.7	10.0	3.2	54.0	0.0
Health	5.0	1.0	0.0	4.0	2.0	0.5	0.00	1.0	1.5	2.0	9.5	0.0
Retail & Trade	17.3	19.3	4.8	5.5	3.3	8.3	5.25	2.5	9.0	2.5	54.0	0.0
Communication	8.5	12.3	5.5	6.8	4.0	1.5	2.50	4.3	4.0	3.0	40.5	0.0
Government agencies/autonomous bodies 5.0	0.0	0.0	0.0	0.0	1.5	0.0	0.00	0.0	0.0	2.0	13.0	0.0
Manufacturing	6.5	2.8	0.5	1.0	3.3	0.3	0.50	1.0	1.5	2.3	13.3	0.0
IT firms/service providers (backend)	1.7	3.0	0.7	0.7	2.3	10.3	0.67	0.7	0.0	1.3	18.3	0.0
Other services	4.0	9.0	0.7	0.7	1.0	0.3	0.00	1.7	0.3	2.0	12.0	2.7
All industries	9.5	9.1	2.9	3.7	3.1	2.7	2.20	2.1	4.1	2.5	30.7	0.5
Domestic	WD&D	MAD	DTAD	RDA	QA&T	GD	DS/AI	SA	CBAD	SA/PM	FT	PT
Banking & Financial	6.4	0.0	2.0	2.4	3.0	0.0	2.0	1.8	0.0	1.8	12.8	0.4
Transportation	0.0	0.0	8.0	8.0	8.0	0.0	4.0	1.0	0.0	1.0	8.0	2.0
Education	2.0	2.0	2.0	2.0	2.0	5.0	2.0	0.0	2.0	0.0	10.0	0.0
Communication	0.0	0.0	0.0	2.0	3.0	0.0	5.0	3.0	0.0	2.0	12.0	0.0
Government agencies/autonomous bodies	30.0	0.0	0.0	2.0	4.0	0.0	1.0	4.0	0.0	4.0	40.0	0.0
Armed forces/Other Security agencies	20.0	50.0	0.0	5.0	25.0	20.0	3.0	5.0	7.0	4.0	300.0	100.0
Manufacturing	6.0	13.3	0.5	1.8	7.0	6.3	1.3	1.3	2.3	1.0	78.5	25.0
Other services	2.0	0.0	2.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	3.0	0.0
All industries	7.0	6.6	1.5	2.4	5.4	3.1	1.9	1.8	1.1	1.6	47.1	12.8

Note: WD&D= Web Design/Development, MAD= Mobile Application Development, DTAD = Desktop Application Development, RDA= Relational Database Administration, QA&T= Quality Assurance & Testing, GD= Graphic Design, DS/AI= Data Science/Artificial Intelligence, SA= System Analysis, CBAD= Cloud-based Application Development, SA/PM= System Architecture/Project Management, FT = Full-time, PT= Part-time.

Table V. 2: Average Number of Employees in IT product/service provider firms

Industry verticals	Exports	Full-time			Part-time			Domestic	Full-time			Part-time		
		Male	Female	Total	Male	Female	Total		Male	Female	Total	Male	Female	Total
Banking & Financial	40.0	62	17	79	0	0	0	62.5	36	2	38	1	0	1
Health	13.3	13	1	14	0	0	0							
Retail & Trade	26.7	69	14	83	0	0	0							
Transportation								12.5	8	0	8	2	0	2
Education								12.5	17	3	20	0	0	0
Communication	26.7	40	13	53	1	0	1	12.5	30	0	30	0	0	0
Government agency	13.3	14	2	16	3	2	4	12.5	129	11	140	0	0	0
Armed forces								12.5	1300	500	1800	652	48	700
Manufacturing	26.7	27	2	29	1	0	1	50.0 (37.5)	332 (10)	126 (2)	459 (11)	163 (0.3)	12 (0)	175 (0.3)
IT firms	20.0	37	1	39	1	0	1							
Other services	20.0	15	3	18	3	1	4	12.5	8	0	8	1	0	1
All industries	15	38	8	46	1	0	1	8	188	65	253	82	6	88

Note: Numbers under the Exports and Domestic columns, corresponding to each Industry verticals, are percentage values. Firms included under an Industry vertical may also be serving other verticals. Figures in parentheses leave out a large industry group, considered an outlier. The same firm is singularly represented in the "Armed forces/Other security agencies". Industry verticals are based on first two choices.

Table V. 3: TVET training institute'sv course specific information

Courses/Training on IT	Offered (% of TVETS)	Capacity	Applications (1st batch- 2018)	Enrollment last year	Female Enrollment last year	Expected graduation (%)	Expected job placement (%)	Application per seat
Computer Technology/Operator	6.3							
Computer Programming	6.3	80	30	150	45	100.0		0.38
Computer Office Application	87.5	33	116	174	64	98.6	64.5	3.52
Database Programming	37.5	37	19	39	18	99.0		0.51
Computer Hardware & Networking	31.3	44	31	58	6	100.0	90.0	0.70
Graphics Design and Multimedia	81.3	33	67	96	27	98.8	54.0	2.06
Auto CAD 2D & 3D	50.0	21	26	52	12	97.1	82.5	1.27
Web Design	87.5	26	40	71	19	100.0	75.0	1.55
IT Support Technician	31.3	24	13	19	8	100.0	95.0	0.52
Other courses	31.3							
Of which, Digital marketing		27	19	54	9	100.0	96.7	0.71

Note: Information were collected from 16 TVET Training institutes (among those who offer ICT related courses) of metropolitan Dhaka.

Table V. 4: Education level of Account Holders in Freelancer.com

Education	Dhaka & Chittagong		Divisional Districts		Other Districts	
	Of all observations	Of reported observations	Of all observations	Of reported observations	Of all observations	Of reported observations
Masters	4.96	18.42	5.77	15.00	4.05	11.54
Bachelors	19.86	73.68	25.00	65.00	17.57	50.00
Diploma	0.71	2.63	3.85	10.00	10.81	30.77
HSC/SSC	1.42	5.26	3.85	10.00	2.70	7.69
No information	73.05		61.54		64.86	
Total	100		100		100	
Total (n)	141	38	52	20	74	26

Note: large proportion of the Freelancer.com accounts contained no information on the educational background of the account holders. The columns titled 'Of reported observations' shows the distribution of educational qualification of the platform workers for only those who reported information. Hence, there are blanks in the cells corresponding to the 'no information' row.

VI. Social Protection of Workforce in Growing ITES Environment

At the inception of the present study, global concerns with an emerging "Gig economy" creeped in and changes in the urban labor market got highlighted. The ERG research team had reviewed a sizeable literature on the subject prior to designing of questionnaires. Those reviews and subsequent observations and consultations with numerous actors in the markets related to ITES had influenced the team's views. Some aspects of it are discussed in VI,1, following which findings on current practices in work contracts among BE IT firms are presented. The same sub-section (VI.2) draws upon field level consultations and other findings of the Study to assess changes in the labor market and Social Protection of Workforce in a growing ITES environment.

VI.1 Understanding the character of a service market

Two entry points to the discussion on services are sought – textbook economics and the world of business. These are fleshed out at first to better comprehend the nuances associated with ITES, which is a service with some differences.

Textbook economics structures our thinking about goods markets. The literature on contracts shade lights on service contracts, and rarely do those lead us to one grand idea about a 'service market'! While 'labor' had traditionally been considered (in economics) an input to (factor in) production and its demand considered a 'derived demand' linked to optimal choice of output, comprehending it within a framework of market remained tricky. Thus, much of it was left to the statisticians involved in accounting of employment and unemployment, or, to the right activists and labor laws. With 'work' replacing 'labor' (and worker replacing laborer), the service element in it (work/labor) is expected to be firmly recognized and the various elements that embody a contract will come to fore.

In a business world that formally links various interests tied to corporate businesses and tie those to legal frames and governance, 'formal' is the term associated with those entities which come under the fold. It helps in shaping rule-based institutions and bringing all within the fiscal jurisdiction of sovereigns. Yet informality persists, often under the protection of so-called formal institutions.

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[53] Unlike economists, no legal connotation is attached to the term 'contract', which may be implicit or explicit.

Finally, it is important to note the presence of market forces – factors that drive demand for a service and the factors underlying the supply of services -- are real, even when a simple demand-supply analysis may not be appropriate. One obvious reason is the special characteristics of any service. Those include intangibility, perishability, inseparability, heterogeneity, ownership, simultaneity, quality measurement (non-uniformity in standard) and nature of demand. One may further add that certain marketing functions are irrelevant, and services are often directly distributed, which often leads to personalized nature of a service contract. Most importantly, skill orientation of services makes quality of work change, more so in a changing technology-led skill setting.

Given the above-mentioned characteristics, service contracts are tenable only if there is flexibility. Alternatively said, rigid formal contracts are often not enforceable. Recognizing this "gig" nature of service sector, that is, "a labor market characterized by the prevalence of short-term contracts or freelance work as opposed to permanent jobs", one may ask if entry of ITES makes a difference – make it more "giggy"? If the latter happens, one may further ask if the process leads to loss in social security for the workforce.

Economic activities under purview for probing into the issues are presumed located in "urban space", that "account(s) for close proximity and connectivity among large number of people". Franc (2009) recognizes that "dense package of activities (may) give rise to interferences and disturbances that have to be damped or prevented before the overall proximity becomes beneficial, if viable at all". ITES clearly counters the opposite forces that manifest in traffic congestions and can potentially ensure dense connectivity.

The empirical queries may be summarized as follows:

- If the production or service generation processes can be parceled into tinier segments in the ITES, each requiring contributions from separate workers, demand for regular worker would decrease among ITES firms.

- If the workforce turns highly competent acquiring IT-related skills, many may choose to go for flexi-hours and work from home.

- Options to engage and earn through open (freelancers') platforms allow one to look for flexible options in local market.

- One would observe out-sourcing of activities with reduced moral or contractual obligations to ensure social protection for the pool of workforce who may be linked to ITES provided by the outsourcer.

Generally, the contracts with workers and provisions for social protection may be viewed as outcomes of forces at both ends of the contract. The following sub-section presents the findings along with their interpretation.

## VI.2 Findings on Employment Practices and Workers' Social Protection

Share of part-time workers in total workforce is one indicator of casualization. Findings presented earlier in the report (see Annex to Section V) are recast in Table 13. Four groups of BE IT firms, defined in terms of industry verticals those serve and where the share of part-timers is equal to or more than one-fifth (20%) are, transportation (share rides in domestic market), government agency (export), armed forces and manufacturing (domestic). It appears to be in the nature of work demands from the verticals which compel the BE firms to rely more on part-timers. Three possibilities are, (i) need for high skills at consultant levels, (ii) production/delivery processes require short involvements that may not be amenable to predictable long-term patterns and (iii) irregular bulk jobs to be delivered within a finite time.

Most firms (80 to 100%) offer written contracts to their full-time workers. It is less commonly practiced for part-timers (see Figure 10). Survey of employees also reveal that the worktime per day, workdays per week and number of holidays (including weekends) per year are in line with provisions for government employees in the country. Details on various kinds of social benefits offered to employee are summarized in Figure 11. Since most firms employ fewer employees (less than the cut-off of 100), incidences of group insurance, health insurance and provident fund are negligible. Figure 12 summarizes information on occupational safety measures in place at the office/office building. Fire extinguishers and first aids are reported to be in place almost everywhere. Major lapses are reported to be in (not) having fire exit.

Table 13: Incidence of Part-timers and Female Workforce

Industry verticals served	% of Part-timers in total workforce		% of female in total WF	
	Exports	Domestic	Exports	Domestic
Banking & Financial	0.0	2.6	21.5	5.1
Health	0.0		7.1	
Retail & Trade	0.0		16.9	
Transportation		20.0		0.0
Education		0.0		15.0
Communication	1.9	0.0	24.1	0.0
Govt agency/ autonomous bodies	20.0	0.0	20.0	7.9
Armed forces		28.0		21.9
Manufacturing	3.3	27.6	6.7	21.8
IT firms	2.5		2.5	
Other services	18.2	11.1	18.2	0.0

Figure 10: Percentage of employees provided written contracts
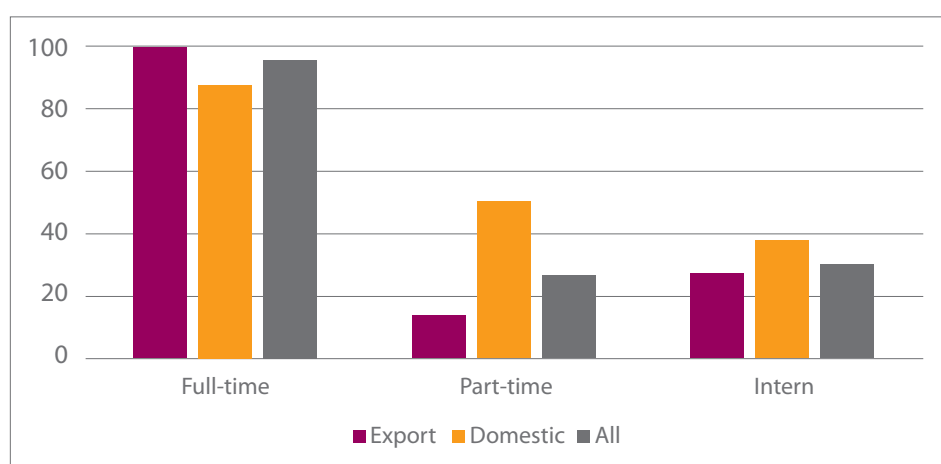
Table 14: Worktime, holidays and termination notice period

|	Export	Domestic	All
Number of workhours per day	8.0	8.1	8.0
Number of workdays per week	5.3	5.1	5.2
Annual number of holidays (including weekends)	124.7	121.4	123.6
Notice for termination of contract (days)*	29.8	30.4	30.0

Note: * One of the firms switched to zero day for termination and has removed it from the contract

Figure 11: Percentage of firms offering social benefits
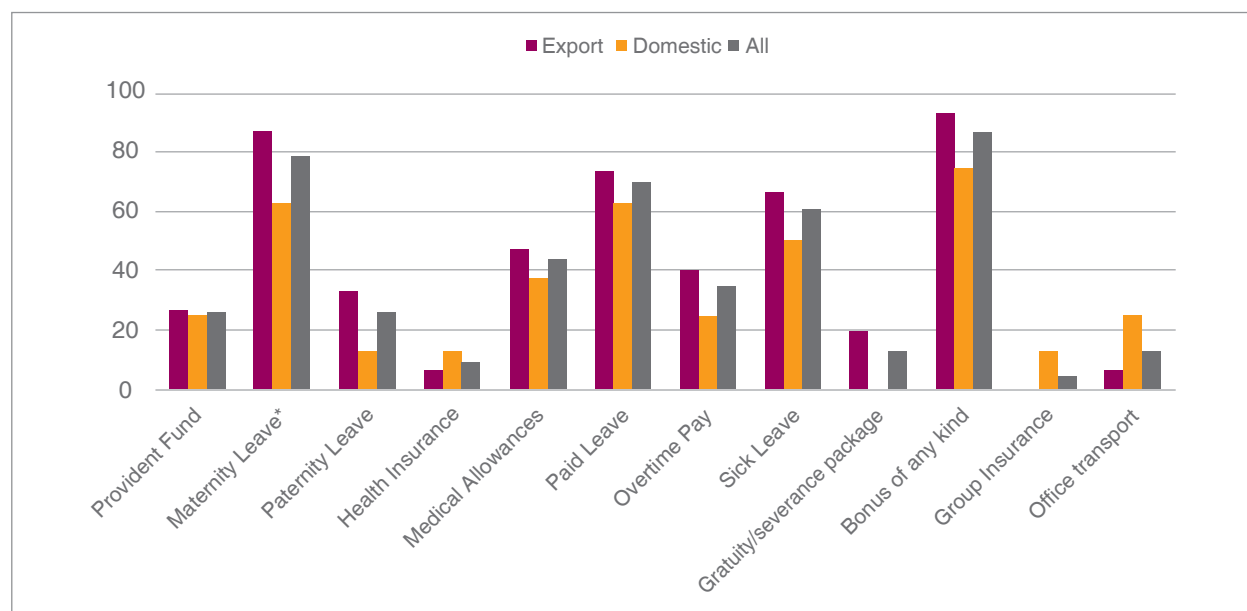
Note: Pension, Car/Home loan and Life insurance is not provided by any surveyed firm. 2 of the export firms did not have women employees and had been excluded.

Figure 12: Percentage of firms attending occupational safety
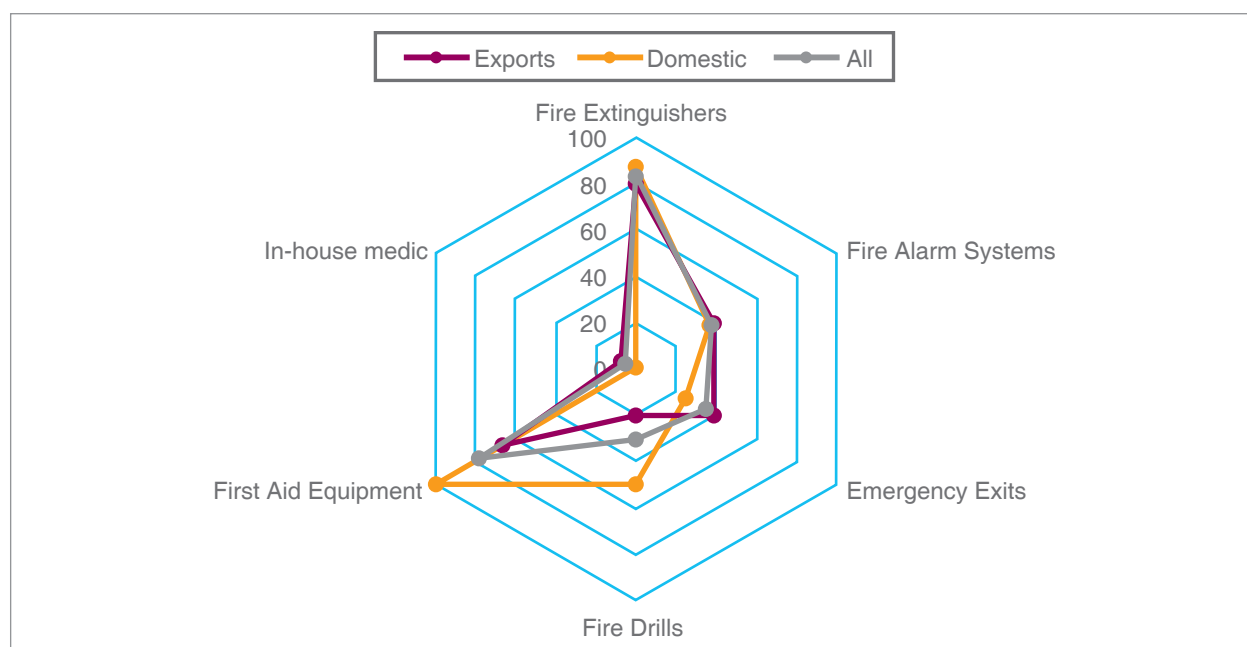
Talking to both employers and employees in the BE IT firms, it is evident that established legal entities prefer to employ workforce on a full-time basis. However, those offers do not come with any assurance of long-term employment like the old days. At the same time, those who are competent and have versatile skills to contribute in changing environment, are unwilling to commit to long-term engagement in any meaningful manner. As a matter of fact, both parties recognize that none can make credible commitment (or threat) in a work environment that depends crucially on project and selected individuals. The same principle applies in almost all spheres of privately-run service sectors and for all skill types. It is therefore no wonder that more than 80% of all firms identify 'lack of skilled workforce' as the major challenge that the industry is facing. There are many entrepreneurs who are willing to offer part of their equity in the firm to retain well-groomed employees.

Similar problems however exist in many other sectors, some of which may have little to do with ITES. There is however one important element that differentiates ITES sector, Scope of outsourcing parts of the regular activities have been made possible, making employers, allegedly, less accountable to the workers carrying out the outsourced jobs. Such status prevails amongst (say) 'share-ride' drivers, vendors facilitating money transfers through MFS, commission agents selling financial instruments on behalf of financial institutions, and many other segments of the workforce. However, current concerns are reported to be one of finding optimal contractual arrangement to ensure accountable governance in each of these sectors. Since the pool of the workforce would either remain unemployed or have been drawn from the 'informal' sectors, the society is not ready yet to address the issues pertaining to their social security.

Figure 13: Percentage of firms identifying challenges faced
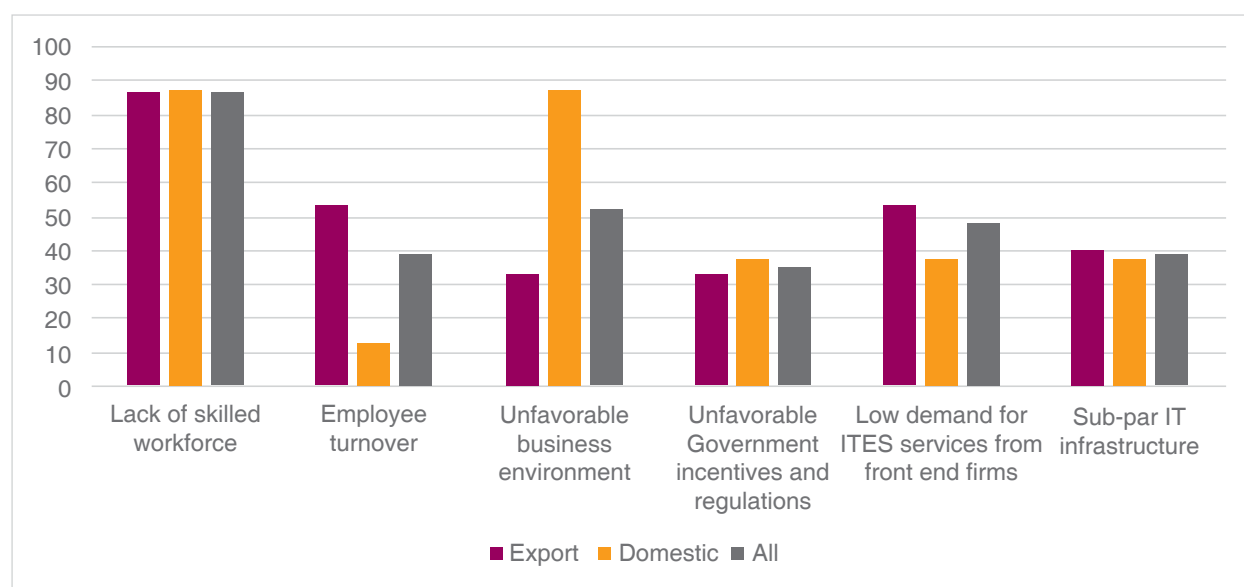
VII. Summary and Recommendations
VII.1 Summary

Skill is narrowly perceived within the ICT domain. Though occasional remarks have been made on the processes of its acquisition, limits and sustainability tied to complementary attributes in individuals, and on the unpredictability of its sustained employability, much of those were outside the scope of the present study. A brief review of NTVQ framework was presented in this report, avoiding repetition of the details discussed in the previous ERG report (ERG 2019). Much effort was however given to identify skills (Tools, Scripting Language, Programming) and Micro-level Tasks, and group those under several broad categories and sub-categories. The exercise is by no means complete, and, will hopefully be pursued by other researchers to improve the classification, update and further fine-tune for meaningful analyses. Broad categories identified are Software Systems or Software Application, Hardware and OS, Network, Connectivity and Communication, and Specialized sectors (e.g., gaming, graphic design, data science analytics, e-commerce, accounting software, etc.). Since the list of skills and micro tasks got extended with progress in field work, not all of those could be addressed in the questionnaire surveys.

IT related skill demands originate from several distinct sources; end-consumable service sectors inside the country, end-consumable service sectors and the IT (enabler) sectors in foreign land. In case of the former, demand may arise from organized sectors (such as, banks, hospitals, ISPs). Households availing IOTs, or, availing other facilities through accessing internets, also demand services that demand IT-related skills. . Such services may be directly procured by hiring employees, or by contracting services of individual worker/consultant. Services may also be procured (provided), through platforms of 'free workers', by (to) anonymous local or foreign firms. The present study assessed skill demands originating from three of these routes. Section IV dealt with a select group of

service providers who adopted ICT in the generation and/or delivery of their services. The second and third are respectively, (i) the backend firms who deliver intermediary services to the first group (of FE firms), and (ii) the freelancers, on whom information was obtained from three widely known platforms (Upwork, Guru and Freelancer). Additional information was obtained from skill-providing agencies (TVET institutions and polytechnics). This section summarizes some of the findings on IT-related skill demands.

- Service sectors in Bangladesh are increasingly adopting IT in G2B, G2P, B2P, and all those involve reverse transactions as well (e.g., utility payments by general public). Thus, demand for basic literacy in ICT is bound to increase among general public. It is anticipated that the future developments in ICT will rely on mobile as the vehicles of connecting with individuals, bypassing many existing intermediaries. Understanding the dynamics is critical in assessing the possible pathways of skill demands arising from ITES sector.

- Case studies on FE service sectors where traditional services are modified or replaced by IT-enabled services/products (e.g., banking, healthcare, transportation, retail trade and government services), there are two broad sets of skills in demand.

> **Occasional remarks have been made on the processes of its acquisition, limits and sustainability tied to complementary attributes in individuals, and on the unpredictability of its sustained employability, much of those were outside the scope of the present study.**

The first includes the basic computer literacy, that is, ability to operate desktop computers and be able to use MS Office (Suite). Ideally, familiarity with specific domain knowledge (e.g., banking, healthcare, etc.) along with communication skill will enhance the likelihood of getting gainful employment. Beside the specialized knowledge, the second set includes higher skills in ICT, mostly in the areas of software developments.

- For a more inclusive society in the future, universal programs may be designed to impart the first set of skills to all. A proposal along that line is made in the end of this section (sub-section VII.2).

- While skills of higher level are reported to be in shortfall, their prospects in future remain uncertain. Apathy towards science & technology in the past resulted in a thin base of professionals in the area, which, along with under-developed ICT ecosystem, are not conducive to R&D for software development. Moreover, as discussed in relation to case studies on startups, initial sparks may fizzle out with encroachment from supra-national ICT companies. The signs are already visible suggesting slow-down in the growth of once-successful startups, and the rumor abounds that many of them may sell their equity to foreign investors!

- Of various products and services looked into, ERP, mobile applications (consisting of iOS, android and windows systems) and web applications developments are found to be in high demand. In the local market, hardware & server installation is also in good demand. Clearly Java and HTML remain in high demand. Of all the programs under web design/development, PHP is found to be demanded most, and there are reports of increasing interest in WordPress, Abode Suite, Illustrator and Visual Studio rank equally for Graphic Design. Though MYSQL is highly valued, Python has come up in the list of programs for database administration.

- It is perceived that the demand for ITES from BE firms will increase in banking & financial industry, and to a lesser degree, from health and retail & trade sectors. It is also anticipated that the demand generated from the government agencies or autonomous bodies will also see a surge in the domestic market.

- In the next 5 years, ERP development and cloud computing services are expected to increase across markets, whereas desktop application development is expected to become obsolete. Entrepreneurs also expect mild increases in demand for web applications and mild decreases in web designs. The perceived decrease in demand for web design is attributed to the rising popularity of theme-centric web design templates, which enables anyone with basic computer literacy and internet navigation skills to create websites.

> **It is perceived that the demand for ITES from BE firms will increase in banking & financial industry, and to a lesser degree, from health and retail & trade sectors.**

- Current demands met by Bangladeshi 'freelancers' are mostly concentrated in general software development, web design and development, system architecture, graphic design, and Java & Html related product/services. Additionally, data entry, data analytics, game development, content creation and management, and sales & marketing are also in significant demand.

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[54] IOT system consists of sensors/devices with sensors which operate without user intervention. These systems utilize connectivity, software programs for Big Data Analytics, and user interface (UI). IT skills in the realm of UI/UX design, information security, mobile development, hardware interfacing, IP networking among many (see Rabah, 2018). Parts of the demand is captured through segmented broad categories in this report.

VII.2 Additional Observations and Recommendations

It is presumed that each occupation is expected to perform a single or several tasks, and performing each task requires certain competency level involving one or more skills. 'Abilities' in individual workers are considered a set of attributes, which includes skills as well as cognitive and other abilities. While the overall abilities of a worker, all other things given, determine how much a worker may contribute towards value addition in the economy and (therefore) be employable, there are limits to skill acquisition set by the initial endowment of 'non-skill' abilities in an individual. The non-skill attributes may include cognitive ability, critical thinking, discipline, drive/motivation, etc. Thus, there are two spheres where skill development programs (such as, the SDP) may like to intervene.

- Directly assisting individual (potential or active) workers to acquire certain skills, and

- Indirectly facilitate activities that enrich 'non-skill' endowments in younger individuals.

In both areas, identifying processes are no less important than the subjects/skills and areas/activities where interventions need to be made. To illustrate, a skill may be imparted through classroom and lab-based lessons/trainings, or, by involving individuals in specific projects. There may be wide choices in the latter case, ranging from course-centric projects to ones backed by business models. Similarly, promoting children activities in communities, or initiatives to improve the quality and methods of teaching in schools, or promoting ICT based extra-curricular activities to increase computer and internet literacy, may contribute towards developing the cognitive abilities of future workforce. Even a talent hunting program, similar to, 'Spelling Bees!', through short-listing of more competent ones groomed through bootcamps, with or without

There are limits to skill acquisition set by the initial endowment of 'non-skill' abilities in an individual.

addons, may be considered a project activity. Needless to mention, a skill development program may seek multi-track approach.

Many of the IT-related trainings aimed at marginalized segments of the population are pitched primarily at pre-vocational level. The ERG study did not focus on such activities. However, limited information gathered on the courses offered in such programs suggests that the bulk of 'IT-related trainings' (68%) are on Mobile Phone Servicing and the rest (32%) on IT support technician. Field-level consultations lead the study team to believe that the latter did not adequately cover the contents expected in Level 1 of NTVQF. In terms of employment in rural towns and district-level businesses, skill on mobile servicing increases employability. However, other than downloading software into mobile sets , mobile servicing workers rarely engage in IT tasks.

A skill development program may seek multi-track approach.

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[55] Rokonuzzaman (2019) suggests that "every production-related task … demands additional codified skill that can be acquired through training. Over the years, tools are being developed to gradually take over this segment, consequently increasing productivity and lowering the demand for labour. To facilitate this, tasks are divided into an increasing number of sub-tasks, and machines are developed to take over the codified knowledge component in executing them. As a result, contrary to common perception, training-needs for workers in performing these tasks have been diminishing."

Given the educational background of marginalized population, imparting higher skills on software may fail to generate adequate value for money. The (backend) employers' survey reveals that more than 60 % of the firms anticipate demand for desktop applications to decline. Quite a significant proportion of the firms expect declines in web design as well. Even the TVET institutions (covered by ERG study) are anticipating an overall decrease in demand for hardware/network maintenance.

It may also be noted that the extent of importance given by (backend) employers on training & certificates is rather low – the ERG study finds the average of responses on a 5-point Likert scale to be 3.1, where 5 is considered the least important. Higher educational degrees do not add much credential either (average of 2.8). It is the subject-specific knowledge which is considered very important along with requisite skills for recruitments at the entry level (average of 1.5).

Employers of backend ITES sector have least difficulty in finding/recruiting Line Staffs (ISP/Call Centers) and IT support staffs (average score is 4.6 where 5 is considered very easy). They face difficulties in finding mid to higher skilled workforce (system engineer, system analyst and Project manager, where the average score range between 1.9 to 2.8). 87% identify 'lack of skilled workforce as the major problem that the industry faces. The study also finds that more than half of the employers look for work discipline in new entrants, and 43% give priority to adaptability.

The above findings generally indicate of serious failures in our schooling as well as training system and call for "thinking differently to cultivate breadth of skills". Winthrop and McGivney (2016) is quoted at length in Box 3 to hint at the desired (or, non-desired) attributes of a socially desired education system. A proposal is put forward along that line, particularly meant to propagate IT skills in poorer communities. It is partly captured in Figure 14 below.

Box 3: Thinking Differently to Cultivate Breadth of Skills

Learning and cultivating breadth of skills requires us to rethink how we educate young people. For more than a century, the dominant form of education has been mass schooling, employing a teacher-centered, "knowledge transmission" model. This is what will likely sound familiar to most as a definition of school. Teachers are responsible for imparting knowledge to students, generally placing them at the front of a classroom, with a chalkboard and rows of students facing them. This makes the role of the teacher a content expert and lecturer, the social and collaborative nature of learning is often ignored and learning is supposed to be an individual, "in-the-head" endeavor.

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[56] Downloading videos and music in SD cards is a very common service provided in the rural areas, additional to mobile hardware servicing

[57] While WEF identified "non-skill abilities" are important for labor market, concerted efforts are needed to enrich the technical skills of the workforce in Bangladesh.

Yet we know from education and learning experts that in order to reach a deeper level of understanding takes practice. It requires being able to demonstrate that knowledge learned in one setting can be transferred and applied in other contexts. Active learning strategies that place the child at the center and allow them to guide and practice their own learning through projects, collaboration, and inquiry are effective ways for teaching content knowledge as well as developing a range of other competencies. Because skills build off one another, effective teaching and learning practices will teach children how to be good communicators and critical thinkers through literacy and numeracy education, what Nobel laureate James Heckman argues, "Skill begets skill...learning begets learning." So, while many make distinctions between teaching content versus character, or "hard" skills versus "soft" skills, this is a false dichotomy. In order to improve in science, literacy, and numeracy we need to effectively foster the full breadth of skills. But doing so will take a big shift in our educational environments, both inside classrooms between teachers and students as well as outside the classroom.

Source: pp. 14-15, Rebecca Winthrop and Eileen McGivney, *Skills for a Changing World: Advancing Quality Learning for Vibrant Societies,* Skills for a Changing World, May 2016

Figure 14: General Framework proposed for SDP programs for developing IT Skills
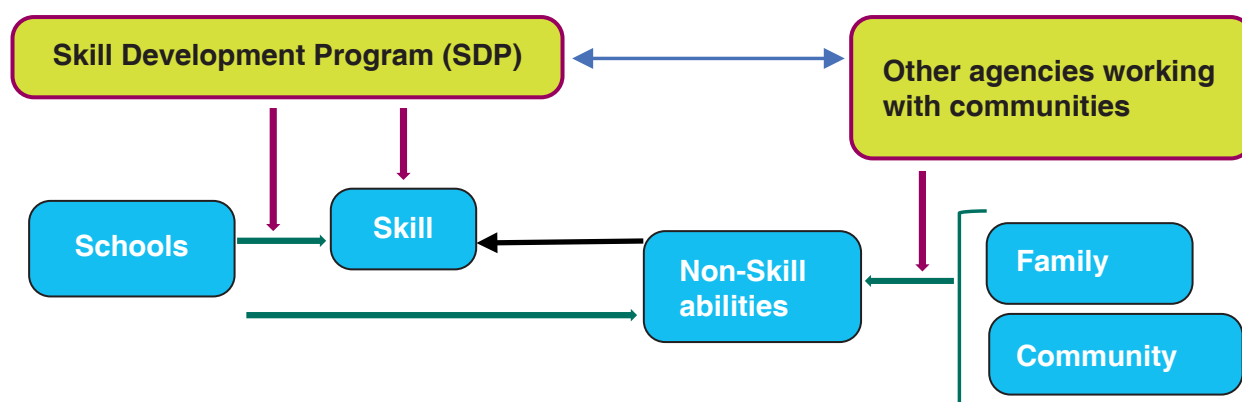
Note: 'Non-Skill abilities' refer to psychometric abilities such as cognition, problem solving capacity etc. and interpersonal, communication abilities. Since 'Skill' is perceived within a narrow prism, such usage is made to differentiate these abilities from skills. See discussion in sub-section III.3.

Figure 14 sketches the areas of engagement for a skill development program. Its primary tasks of imparting skills may be supplemented by two additional initiatives – (i) working through schools within appropriately designed projects, business initiatives and trainings, and (ii) collaborate with other agencies, which are closely working with local communities, to bring about changes in work habits, and by introducing and nurturing spaces for practices in science and technology. The latter effort may also be pursued by the SDP directly through the 'school' route.

It is proposed that two tracks may be pursued in the educational (and intellect) space: (i) HSC graduates who are relatively advanced, to be groomed for more specialized skills; and (ii) SSC/ HSC graduates who are less quick to learn, may be exposed to (trained in) basic computing, and in hardware and network activities.

Drawing upon the findings of the ERG survey, it is suggested that the skill trainings cover the tasks, such as, web design , graphic design and data entry. At specific skills on programming, Java and Html are considered relevant in platform engagements. More specifically, it is recommended that specific skills mentioned below under different tasks be given priority:

php in web design; Adobe Suite in Graphic design; Python and MySQL in Database administration; and MS Office Suite in Document archiving/data entry.

In addition, trainings on database programming and computer office application be extended to female aspirants since such bias is revealed in current enrollments in TVET institutions .

Figure 14 captures the concerns for long term need to ensure higher capabilities in future generation as well as short term needs to make youth employable and ensure respectable payments for them in a changing world under 4IR. On the assumption that SDPs will be undertaken in urban areas, particularly in the divisional districts, some suggestions are made below on the likely operationalization of the ideas embedded in Figure 14.

Involve high school teachers, initially the motivated young ones. Training is an easy option, which may fail to make sustainable entry into regular school activities. Thus, few other options may be tried out: (i) involve a group of teachers in project activities who may be linked to other activities of the Program, (ii) facilitate business contracts between one or more teachers in a school with a commercial IT firm, along with motivating school administration to allow students to work for the teachers (as interns) in pre-agreed set of IT-related activities, and (iii) facilitate use of IT equipment and use of net in enriching classroom activities with strict discipline in place.

- Talent search and bootcamp in collaboration with wider organizational network.

- Since mobile is expected to be important conduits between a large segment of population with the virtual world, connecting telecoms with local groups to improve various service products will benefit. Piloting may also be done to create infrastructural hubs to improve connectivity that allow use of mobiles beyond tweeting and Facebook.

- Revisit the pedagogy most relevant for critical and yet structured thinking.

There are other on-going programs on digitization with which school-level IT-based knowledge acquisition programs may be tied as well.[60]

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[58] About two-fifth of the (backend) firms engage in web designs.

[59] Of total enrollment per year in Database programming and Computer office application, respectively, 50% and 33% are females.

[60] SHIFT recently introduced six innovative business models: (i) digital payment and credit. services for micro-merchant, (ii) mobile money payments and credit for micro-merchants, (iii) DFS aggregator platform for micro-merchants, (iv) digital financial services for women micro-merchants, (v) Inducts micro merchants as E-commerce agents and transaction points through aggregator of e-commerce platforms, and (vi) Managing purchases, stocks, payments and leveraging transactional data to assess credit worthiness. [Shift DOKAN, Issue 01, September 2019]

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