

SOFTWARE INDUSTRY IN BANGLADESH



Small and Medium Enterprise Foundation

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Study Report



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Software Industry in Bangladesh

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Preface

Software industry is one of the SME intensive high potential sectors in Bangladesh. Government has declared ‘Software industry’ as a high priority sector in the industrial policy-2016. Government also formulated National ICT Policy-2015 for achieving ‘Digital Bangladesh’ initiative along with the target of ‘Vision-2021’. This industry is not only contributing in the GDP, moreover it has been playing a very significant role in creating high quality employment for a sizable portion of young graduates of the country.

Government set up SME Foundation as an apex body for the development of SMEs in the country. As part of its intervention, SME Foundation intended to conduct a study on software industry in Bangladesh. As the software industry is rapidly changing its characteristics due to global demand for upgradation. Therefore, SME Foundation felt the need for analyzing the sector with every details. Eventually, the findings of the study will help to design development action plan for this sector.

The objective of the study is to find out the problems and prospects, market opportunities, global business trend along with future forecasting of software business and thereby recommending way forward.

This publication is prepared from the analysis of data and sample surveys, focus group discussions, key informant interviews, stakeholders consultation, review of international best practices and so forth.

We hope, this publication is useful for the policy makers, academician, researchers, relevant business people, investors and other stakeholders of software industry. It also make a view of competitiveness, growth prospects, constraints and time bound action plan for the development of software industry in Bangladesh.

Md. Safiqul Islam
Managing Director
SME Foundation

Acknowledgement

The Board of Directors of SME Foundation (SMEF) felt the need of identifying the potential of software industry to bring out the prospects of the sectors and ensuring sustainable and vibrant software industry in Bangladesh.

The study was conducted successfully with the co-operation of its stakeholders. Our special thanks to the ICT Division, Bangladesh Computer Council, Bangladesh Association of Software and Information Services (BASIS) and Bangladesh Computer Society for their involvement. We thank Dr. M. Rokonuzzaman, Professor, North South University and e.Gen Consultants Limited for providing insight and expertise that greatly assisted the study. We would also like to show our gratitude to all stockholder of the software industry for sharing their pearls of wisdom with us during the course of this study.

We are glad that Mr. Shyam Sunder Sikder, The then Secretary of ICT Division of Ministry of Post, Telecommunication and Information Technology attended the primary report sharing meeting as a chief guest. Special thanks to Dr. M. Kaykobad, Professor of BUET, Mr. Mustafa Jabber, CEO of Ananda Computers, Mr. A K M Fahim Mashroor, CEO of Bdjobs.com, Mr. Shafquat Haider, Managing Director of Ciporoca Computers Ltd for their comments to make the study report perfect.

Finally, SME Foundation acknowledges the valuable contribution of all the members of the study team who relentlessly worked to make this study a success.

Disclaimer

This information of the study is to introduce the subject matter and provide a general idea and information on the said matter. Although, the material included in this document is based on data/information gathered from the respondent listed through relevant government and private bodies; however, it is based upon certain assumptions which may differ from case to case. The information has been provided on as is where is basis without any warranties of assertions as to correctness of soundness thereof. Although, due care and diligence has been taken to compile this document, the contained information may vary due to any change in any of the concerned factors, and the actual results may differ substantially from the presented information. SMEF, its employees do not assume any liability for any financial or other loss resulting from this memorandum in consequence of undertaking this activity. The contained information does not preclude any further professional advice. The prospective user of this study is encouraged to carry out additional diligence and gather any information which is necessary for making any informed decision, including taking professional advice from a qualified consultant/technical expert before taking any decision to act upon the study report.

Executive Summary

This document reports findings of the study conducted by SMEF on the software development sector of Bangladesh. Findings are based on review of secondary literature, analysis of survey responses of 269 out of 309 firms and inputs received from FGDs and key informants. With less than 7,000 jobs in 309 firms generating less than USD 100 million revenue with USD 25 million export, certainly software development sector is insignificant in the overall economic volume of Bangladesh. But, with demonstrated performance of more than USD 12,000 value addition per person per year, this sector has the latent potential to make Bangladesh a smart nation, a rich nation by unleashing creative entrepreneurial potential of 30 million students--in the globally connected, software driven society.

Among many other factors, the presence of more than 100 firms in any market segment, whether product or service, indicates that the limited capability of these firms to benefit from economies of scale and scope is a major growth constraint. This is an indication of presence of extreme diseconomy of scale in the industry. As a result, more than 90% of software firms have less than 30 employees. Being constraint by limited investment capacity to pursue product innovation, most of these firms have opted for project based customized software application delivery. Such reality has been the underlying cause of continued increase of cost of delivery of software and services resulting in low market expansion and profitability erosion. Due to limited supply of risk capital finance, primarily caused by weak IPRs culture among software firms, customers and also Government, these firms are failing to benefit from the most attractive characteristics of software business: zero replication cost of software innovation.

Despite export track record of 185 software firms to more than a dozen well known countries such as USA, Canada, Germany, and Japan, only 3 firms have reported to have export revenue of more than BDT 5 crores in 2014. Although the success of India triggered by Y2K discontinuity-- beacons us, but due to low marginal cost of expansion around epicenters of India, it has become largely impossible to replicate India's success. On the other hand, due to weak focus on developing the domestic market, despite our early success in banking software, we have lost our local market to foreign firms. Some of the recommendations to enable the software sector of Bangladesh to address growth constraints are as follows:

1. Focus on developing IPRs culture and risk capital financing, so that Software firms can pursue the product innovation based growth strategy.
2. Focus on software innovation based growth strategy for public and private sectors and empower local firms to be globally competitive in offering solutions.
3. Empower software firms to benefit from economy of scope and scale so that cost of delivery decreases, quality increases, and market expands, careers of professionals' progress and profitability grows.
4. Instead of just offering IT education for all, focus should also be on using IT for improving performances of all kinds of work processes such as education, health, etc.
5. Invest in R&D and empower youths to pursue creative entrepreneurship in software.

Extended Summary

To implement the mission of undertaking and implementing multi sector action plan for proper growth of SMEs and make them competitive in the free market economy, SMEF has focused its activities around 12 objectives. One of these 12 objectives is to conduct sectoral study to “ensure availability of latest information, identify challenges and recommend preventing measures”. One of the SME intensive high potential sectors in Bangladesh is Software Development Sector. The focus of this study on software development sector of Bangladesh is to acquire detailed information about the sector. It's understood that this study is going to contribute to address one of the major objectives of the SME foundation that is to identify and report policy anomalies and market and institutional failures that are prejudicial to the legitimate interests to the SMEs function in the software development sector, based on in-depth research, and stakeholders' consultation. Findings are based on review of secondary literature, analysis of survey responses of 269 out of 309 firms and inputs received from FGDs and key informants.

DECades in Review

1. Bangladesh's software industry has more than 30 years of history of creative entrepreneurship. Despite shattered hopes and frustration, this industry has created the window of opportunity for youths to pursue the path of innovation led growth—which is rare in Bangladesh. More than 300 home grown entrepreneurial firms have demonstrated that Bangladeshi youths are willing to take the risk and experiment with new ideas to create path breaking development opportunity for the nation. Per person more than USD 12,000 annual value addition capacity in exporting software engineering service, significant scope of spillover effect in local economy and possibility of creating disruptions in every sector of the society through software innovations, Software Development Sector is no parallel to any other economic sector of the nation. With less than 7,000 jobs in 309 firms generating less than USD100 million revenue with USD25 million export, certainly software development sector is insignificant in the overall economic volume of Bangladesh. But, this is the sector, which has the latent potential to make Bangladesh a smart nation, a rich nation by unleashing creative entrepreneurial potential of 30 million students--in the globally connected society.
2. There has been a strong global trend of creating wealth through software innovations. According to many analytical reports, major driver of industrial innovation over next several decades will be the software. So far, software has been the efficiency and control innovations tool in the enterprise computing segment. In industrial products, software has been playing the role of sustaining innovation. Although these two innovations improve efficiency, increases utility and reduce cost, but they do not create new jobs. Due to the improvement of connectivity and low cost availability of labor force, some of the software development jobs migrated from advanced nations to developing nations—India is one of the many examples. Over the last decades, there have been multiple initiatives in many countries, including Bangladesh, to replicate such model to create export oriented software service industry.
3. Over the decades, there has been some progress of developing software firms offering project based customized solutions—primarily in the enterprise computing segment. The primary

value proposition of these firms is largely the offering of efficiency and control tools for management areas of enterprises, such as Accounting, HR, Inventory, etc. Offering of such solutions appears to be jobless growth proposition. In a labor surplus nation, such proposition does not appear to be attractive. Moreover, potential of cloud based offering of enterprise applications by major global firms, such as SAP and Oracle, existing domestic market of such applications is about to experience major transformation.

4. Due to zero cost of replication and very low cost of developing complementary applications around core assets, software industry has the potential to enjoy very high economy of scale and scope benefit. The realization of such benefit produces sharp cost reduction and improvement of value proposition. The successful application of such potential into business practice results in rapid market expansion and accelerated growth of software firm size. The failure of its application produces opposite result. The success of Microsoft in offering extremely powerful software applications at very low price (USD300), such a Microsoft suite, is an example of application of this potential. As a result, software industry has a very high tendency of monopoly. The trend of consolidation of global ERP application market is also such an example.
5. Natural complementary roles played by software professionals are very limited, may be handful. Among many factors, communication & coordination overhead, rework due to poor delegation, and waiting time for inter-task dependency pushed software production to diseconomy of scale. Without building the capability of addressing this natural diseconomy of scale, software firms in Bangladesh have been largely very small enterprises. Due to poor economy of scale and scope benefit, both cost, value propositions and profits of offerings of these software firms are not improving. Due to small size, large number of firms are operating in the same market segment. Due to information asymmetry, these firms often time compete to be least cost bidder. Such strategy neither contributes to growth of winning firms nor to the expansion of market. Due to poor economy of scale and scope benefit, software firms fail to grow resulting in stagnation of career path of professionals. In course of time, being frustrated, experienced professionals leave, along with most precious tacit knowledge, creating vicious cycle in these firms. From survey data, it appears that despite significant potential of growth, most of the software firms in Bangladesh are caught in such vicious cycle.
6. In 1990s, Y2K bug fixing caused a large discontinuity in global software labor supply and demand. Usually, at such discontinuity, either caused by large supply and demand gap, or breakthrough technology inventions, new model of business develop. Due to economy of scale and cluster benefit, such model keeps growing around suitable epicenter. For the software engineering services, it happens to be India, such epicenter. For the RMG, Bangladesh is the epicenter. There has been strong basis of argument around economics of production and theory of Industrial Organization that such model is extremely difficult to replicate, once new delivery center accumulates enough strength. Bangladesh's attempts of replicating such model through participation in foreign trade shows, opening office in Silicon valley, giving tax incentive, making HW import tax free, obtaining SW-CMMI or ISO certification, providing uninterrupted power to software business center, branding Bangladesh as next destination, global ranking of one of attractive outsourcing destinations, giving basic IT training to thousands of youths and many others are yet to produce tangible result.

7. Due to weak focus on developing the domestic market for software, despite our early success in banking software, we have virtually lost our local market to foreign players. Such development has not only weakened the position of local software firms, but also deprived local clients to benefit from continuous innovation through close engagement with software developers.
8. Shared negligence to IPRs issues not only resulted in loss of revenue for software firms, but also failed to develop reference to package, assess and make valuation of software assets—starting from idea to finished products. Absence of such IPRs culture has created enormous difficulty among potential risk or venture capital investors to make valuation of primary assets of software firms and make investment to take ownership. As a result, early participation of local angel investors did not scale up to institutional risk capital financing for the software sector. The EEF experience indicates that absence of IPRs culture makes it extremely difficult to assess value of software assets, which are yet to generate revenue. As a result, the industry has seriously failed to develop key building block: risk capital finance.
9. It should be noted that smart acquisition management practices of different government Agencies of USA created the core software production capacity of the software industry of that country.
10. Despite more than 30 years history, more than 90% of 309 software firms in Bangladesh have size less than 30 people. More than 100 firms are active in any market segments, whether product or service. This is an indication of presence of extreme diseconomy of scale in the industry. Persuasion of certification such as SW-CMMI or ISO, instead of focusing on process and strategy improvement to benefit from economy of scale and scope, these firms are failing to offer lower cost, better product leading to market expansion, or to experience growth in revenue to offer career growth path to professions.
11. The focus on just technology education to address HR need to benefit from potential of software industry appears to be incomplete. It appears that IT academic curricula of Ministry of Education should modified to include components to educate students to figure out the scope and integration of IT/software solutions to business or work process for improved performance. Weak focus on R&D and only focus on undergraduate teaching, by both private and public universities alike, have put us in very disadvantageous position to pursue the path of software led growth by taking advantage from economy of scale and scope.
12. It has been noticed that there is significant scope of improvement of addressing policy issues to pursue the path of software led growth of different wealth creation sectors of the nation. Instead of defining the role of software to address common business processes such accounting or HR, different ministries should look into policy issues to use software as strategic tool to address core agenda, such as improving agricultural productivity through software.

NEW POSSIBILITIES

1. Although software innovations have been playing an important role in efficiency and control in enterprise computing, and sustaining innovations in industrial products, but its most powerful capability is just emerging: breakthrough innovation capability. Two of the successful demonstrations of such breakthrough ability are the growth of cellular service and multi touch based smartphones. Due to software's extreme powerful role, cellular service grew as strong force causing breakthrough to conventional wire line based telephone industry. Such breakthrough has created enormous new wealth for the society, making phone service available for all within just couple of decades. Due to emergence of low cost smartphones, wireless connectivity, and cloud based back end computing platform, almost every sector of the society is waiting to experience breakthroughs caused by software innovations.
2. Due to growing scope of improving performance or adding news features to industrial products through software innovations, there will be increasing demand for such software development work from large number of conventional companies of industrial economies. According to many studies, it indicates that many such firms do not have adequate in house software innovation capability. Such reality appears to create discontinuity in demand and supply. Bangladesh may position to benefit from such discontinuity to develop new type of software industry.
3. The dynamics in the global innovation ecosystem of software is creating numerous discontinuities; such discontinuities are essential for finding entry opportunity for new firms or creation of new industry. The spectacular success of WhatsApp or Instagram are just few of many such global examples. Affordable broadband connectivity and business model innovations in global job market in creating single virtual market is a significant opportunity for Bangladeshi 30 million students to pursue creative entrepreneurship in this global market. The spontaneous participation of thousands of youths in on-line job market, commonly known as freelancing, is demonstration of mental eagerness of Bangladeshi youths. The institutional capacity development to support and foster such creative entrepreneurial opportunity is going to determine our success, as a nation.

RECOMMENDATIONS

1. Improve Firm level capability to benefit from economy of scale and scope. The focus on process and product innovation should be given high priority to make progress along this line. Progress in economy of scale and scope has the potential to create snowball effect, which will keep decreasing the cost of delivery and increasing profit. As a result, market will be expanding and individual software firms will be growing creating career growth path for software professionals.
2. Improve IPRs culture among all stakeholders of the software industry. Such improvement will address information asymmetry, which is critically needed for market expansion and investment mobilization.
3. Invest in university based collaborative R&D focusing on software innovations, targeting different domestic sectors. For example, image processing based inspection software has significant scope to reduce wastage and improve quality in our export oriented RMG sector.
4. Promote University based entrepreneurship to unlock creative entrepreneurial capability of youths, which may open path breaking development opportunity.
5. Bring change in academic programs to educate students to figure out the scope of improving diverse work processes through software innovations. Education related to software production economics, innovation and new product management should also be included in CSE, EEE, and BBA programs.
6. Develop a micro innovation and entrepreneurial ecosystem in the form of software Innovation Park, preferable at prime location of Dhaka city. Investment in such facility should be looked upon from the perspective of public goods to create new growth opportunity. This software park will not only support local entrepreneurship, but also will facilitate the piloting of foreign investments.
7. Policy of different ministries should be updated to use software innovations as strategic tool to address agenda of corresponding ministries. For example, software innovations could be strategic tool to increase productivity of Agricultural or Health sectors.
8. Long term development agenda around software innovations should be formulated. Public procurement should be in sync with the growth of local software industry to address such long term software led growth agenda.
9. A virtual software innovation and industry R&D center should be developed having nodes among most of the public and private universities. Under the coordination of central body, these nodes will be conducting research in collaboration with the industry to address each of 78 issues, looked into in this study.
10. Improve the capacity of demand side for intelligently figuring out the scope of use of software to improve organizational performance. The capacity improvement should include planning and acquisition management to develop software asset in an incremental manner.

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List of Acronyms

ADB	Asian Development Bank
ANS	Access Network Services
BASIS	Bangladesh Association for Software and Information Services
BCC	Bangladesh Computer Council
BCS	Bangladesh Computer Samity
BSCCL	Bangladesh Submarine Cable Company Ltd
BTRC	Bangladesh Telecommunication Regulatory Board
CEO	Chief Executive Officer
CMMI	Capability Maturity Model Integration
COTS	Commercial Off the Shelf Software
CSE	Computer Science and Engineering
DoD	Department of Defense
EEF	Equity and Entrepreneurship Fund
EPB	Export Promotion Bureau
ERP	Enterprise Resource Planning
GDP	Gross Domestic Product
GE	General Electric Company, USA
GoB	Government of Bangladesh
HEQEP	Higher Education Quality Enhancement Project
HR	Human Resources
HW	Hardware (Computer)
ICT	Information and Communication Technology
ICX	Interconnection Exchange
IGW	International Gateway
IIG	International Internet Gateway
IPR	Intellectual Property Right
ITC	International Terrestrial Cable
ITES	Information Technology Enabled Services
ITES	Information Technology Enabled Service
LICT	Leveraging ICT for Growth, Employment and Governance
MoPT	Ministry of Post and Telecommunication
NBR	National Board of Revenue
NCTB	National Curriculum & Textbook Board
NIX	National Internet Exchange
NTTN	Nationwide Telecom Transmission Network
OTT	Over the top content
POS	Point of Sale
PSTN	Private Switched Telecom Network
R&D	Research and Development
RMG	Ready Made Garments
SAP	Systems, Applications & Products
SME	Small and Medium Enterprises

SMEF	Small and Medium Enterprise Foundation
SPDB	Strategic Priorities of Digital Bangladesh
SW	Software
UGC	University Grants Commission of Bangladesh
UNCTAD	United Nations Conference on Trade and Development
USD	United States Dollar (1 USD = BDT78 approx.)
VAT	Value Added Tax
VC	Venture Capital
VoIP	Voice over Internet Protocol
WSIS	World Summit of Information Society
YoY	Year on Year

Chapter 1: Introduction

1.1 Background

The genesis of entrepreneurial initiative to develop software firms in Bangladesh dates back in early 1980s---relatively at the very early stage of growth of global software industry. Over the last 30 years, numerous entrepreneurial initiatives have created many lessons to learn to develop and support scalable growth model to develop large-scale software industry in Bangladesh. Despite not achieving spectacular growth to meet our dream, Software Industry is an opportunity for us to create path breaking development opportunity to make Bangladesh a smart and rich nation.

From the trend of human civilization, it appears that Software is going to be the indispensable component of any industrial product. Like minerals and energy, Software is finding its position as the core ingredient of industrial wealth creation capacity. According to Jeffrey R. Immelt, the CEO of GE, known as market leader of conventional industry, every industrial company will grow as a software company. As of today, the number of top 100 product and service companies that are software dependent has doubled, to nearly 40 percent, over the last 20 years; and this trend is likely to continue for the foreseeable future. Main driver of innovation and competition will be derived from software. Already, software enables an estimated 80 percent of automobile innovation, from entertainment to crash-avoidance systems. According to McKinsey Quarterly's recent Article in February 2015, such performance leverage across all economic sectors will become even more important as the transition from hardware to software-enabled products accelerates.

Software is making inclusive delivery of critical services in developing economies, such as mobile financial services, a reality. With the proliferation of billions of smartphones, availability of low cost computing power, ubiquitous broadband connectivity, and dependable sensors, major countries as well as companies across the world are reshaping competition strategy by placing software at the core¹. The enormous scope of improving local wealth creation capacity through software, globalization of software value chain, creative entrepreneurship opportunity of youths for creating path breaking development opportunity, and low capital investment need are among many factors which are making Software industry as the opportunity of making Bangladesh a rich nation. Software is unfolding opportunity for Bangladesh, a resource starved, densely populated nation, to be rich nation, environmentally healthy nation--by empowering 30 million students in creative entrepreneurship of software innovation led wealth creation.

The Small and Medium Enterprise Foundation (SMEF) is an independent center of excellence--created and generously capitalized by the Government of Bangladesh. SMEF has been functioning since 2007 to enable SMEs to function as high performance engines of economic growth and employment generation for sustainable industrialization in Bangladesh. To implement the mission of undertaking and implementing multi sector action plan for proper growth of SMEs and make them competitive in the free market economy, SMEF has focused its activities around 12 objectives. One of these 12 objectives is to conduct sectoral study to “ensure availability of latest information, identify challenges and recommend

¹ A NESSI Position Paper: European Software Strategy, June 2008 (www.nessii-europe.eu)

“preventing measures”. One of the SME intensive high potential sectors in Bangladesh is Software Development Sector. The focus of this study on software development sector of Bangladesh is to acquire detailed information about the sector. It's understood that this study is going to contribute to address one of the major objectives of the SME foundation that is to identify and report policy anomalies and market and institutional failures that are prejudicial to the legitimate interests to the SMEs function in the software development sector, based on in-depth research, and stakeholders' consultation.

1.2 Objectives and Scope

It's the understanding that the main objective of SMEF in undertaking this study is to conduct research on the software development sector is to find out the status of the sector, including but not limited to number of firms, total employment, and contribution to GDP, barriers towards development and recommendations to overcome those along with market opportunities and global business trend of this sector with future forecasting. So that SME Foundation can advocate in favor of this sector to the government for making necessary arrangement to ensure sustainable growth of this sector.

Broad categories of outputs required by the study to produce are as follows:

1. Basic characteristics of the software development sector of the industry
2. Market analysis
3. Technological progression and its implications on the software development sector
4. Competitiveness of the industry
5. Growth prospects
6. Constraints limiting the scope of exploitation of the growth prospects
7. Recommendations for key stakeholders to implement to address constraints and to exploit growth

1.3 Based on findings of secondary data and key informant interviews, following list of Industry Segments were investigated in this study:

1. Discrete software applications as off the shelf products
 - a. Accounting and Finance
 - b. Human Resource Management
 - c. Pay roll
 - d. Point of sells
2. ERP Software for
 - a. Ready Made Garments
 - b. Textile
 - c. Pharmaceuticals
3. Industry Specific Software solutions
 - a. Banking and finance
 - b. Insurance

4. Algorithm centric Software products
 - a. Biometrics and access control
5. Domestic market focused
6. Export market focused
7. Import of software implementation services
8. Captive foreign software development centers
9. Large scale foreign direct investment
10. E-governance projects
11. Mobile Software Apps
12. Real Estates, Hospitals and e-Commerce

1.4 Methodology

The study went through different phases, as summarized below:

Phase 1: Having dialogues with key industry insiders and studying relevant literature such as reports, books, newspaper articles, blogs, publications made by BASIS, presentations were major activities in Phase 1. A base line qualitative understanding about the Software industry of Bangladesh was developed and key dynamics of the industry were noted and analyzed. Relevant reports to understand the global trend and model of growth software industry in different countries were also collected and consulted.

Phase 2: This phase comprised of spelling out broadband level study topics to detailed issues and assessing data requirements to address those issues. In this exercise, 78 issues were identified and data sources were spelled out. Upon doing so, two sets of questionnaires were developed to gather relevant quantitative data; one set for CEOs and another set was for senior software professionals. Moreover, guidelines for Focused Group Discussions and Key Informant Interviews were developed to gather qualitative insights from key informants and major stakeholders of the sector.

Phase 3: In this phase, survey was conducted, data were compiled and frequency graphs were developed. Key informant interviews and focused group discussions were also conducted in this phase.

Phase 4: The development of the list of Software companies was a challenging exercise; there was no list available. Moreover, it was also found that a single IT company performs many other activities in addition to software development and commercialization. Some of these activities are HW retaining, bidding HW and supply contracts, computer networking, IT enabled services, etc. Data available about IT companies from multiple sources were compiled. Data about the nature of business of each of these companies were collected and verified by making phone calls as well as having physical visits to develop list of companies who had certain degree of software business to be considered as Software Firm in compliance with Industrial Policy, 2010.

Phase 5: Gathered data were analyzed to develop quantitative understanding about the software industry structure, growth patterns, and constraints facing different segments of the

industry and growth potentials. Upon doing so, relevant theories were mapped to reality reflected in data to draw lessons and derive recommendations to address constraints to facilitate growth. Root cause analysis within the context of industrial economics was investigated. Such analysis, findings and recommendations have been compiled in this report. The work progress form, this report has been shared with different stakeholders to collect feedback to improve both clarity and accuracy to meet the purpose of this study.

1.5 Study Design

Identified Total Software Companies: 309

Definition of software companies: Companies who are involve in designing the structure and content of, and/or writing the computer code necessary to create and implement systems software (including updates and patches), software applications (including updates and patches), databases, web pages, customizing of software, i.e. modifying and configuring an existing application so that it is functional within the clients' information system environment.

Population Size: Initial identified company lists through secondary data collection are shown in the following Table 1.1:

Table 1.1: Initially Identified IT Companies

SL	Sources relevant to the study	Available number of IT companies
1	Bangladesh Computer Samity (BCS)	733
2	Bangladesh Association of Software and Information Services (BASIS)	696
3	BCS Computer City List	156
Total Initial Identified company List		1585

Exhaustive population List through Field data Collection: After extensive communication with the all companies and combining all available company list, we sorted out the duplicate information from sources and prepared the exhaustive list by including company information's from BASIS, BCS computer city and other available list. According to population determination methodology additional 43 company information were added to complete our exhaustive population list of IT Companies as shown in the following Table 1.2:

Table 1.2: Exhaustive Population List of IT Companies

SL	Source relevant to the study	Available no. of companies after eliminating duplication
1	Bangladesh Computer Samity (BCS)	733
2	Bangladesh Association of Software and Information Services (BASIS)	375
3	BCS Computer City List	146
4	Additional companies list including other districts	43
Total Exhaustive Population List		1297

Not all of these IT companies are in software business. Upon screening, it was found that there are 309 IT firms who have commercial software development activities.

Identification Method: Following the definition of Software Company (mentioned before), following steps were taken to identify legitimate software firms, in compliance with the Bangladesh's Industrial policy:

- Physically visits to the companies.
- Communication over phone.
- Discussed with resource persons.
- Visits to available websites of individual companies.

The appropriate sample size for a population-based survey is determined largely by three factors: (i) the estimated prevalence of the variable of interest – Software Companies in this instance, (ii) the desired level of confidence and (iii) the acceptable margin of error. For a survey design based on a simple random sample, the sample size required can be calculated according to the following formula:

$$n = t^2 \times p(1-p) / m^2$$

n = required sample size

t = confidence level at 95% (standard value of 1.96)

p = estimated prevalence in percentage of the software companies in the population

m = margin of error at 5% (standard value of 0.05)

Sample size of Software companies for conducting survey: 279

Calculation Method:

t (confidence level) = 1.96

p (estimated prevalence in percentage of the software companies in the population) = 309/1297 = .2382

m (margin of error) = 0.05

Formula, n (sample size) = $[(1.96)^2 \times 0.2382(1-0.2382)] / (.05)^2$

Stratification of Software company list for conducting survey: This List is stratified in four classifications i.e. Large Industry, Medium Industry, Small Industry and Micro Industry as per the National Industrial Policy- 2010, (Page 10 & 11, Chapter 03, under service industry related section 3.3.2, 3.4.2, 3.5.2. 3.6.1, 3.6.2),

Followings are the stratification that we have prepared for the software companies:

Table 1.3: Stratification of Population of Software Firms

Stratification of Software Companies	Large Firms	Medium Firms	Small Firms	Micro Firms	Total identified Software Companies
Number of Companies	34	61	65	149	309
% of companies	11%	19.74%	21%	48.26%	100%

In designing the sampling frame, we selected all companies in the large industry category and remaining samples were taken from other classifications to fulfill our required number of software companies to be surveyed for the project.

Survey Instrument: For an in depth analysis of the software industry, researchers have developed a large questionnaire for the respondents. Questionnaire for CEO contains 88 questions and questionnaire for senior software professionals contain 20 questions. In the questionnaire, respondents were encouraged to add their personal opinions. Enumerates were given clarification about any unclear terms and were encouraged to recommend any issues they like during the training phase.

Directions for the both Questionnaires are worded in such a way as to avoid questions in which the respondent indicts himself/herself with a negative response.

Two survey respondents were selected from each company; one is senior software professional and other one is the CEO of that company

Chapter 2: Software and Wealth Creation

2.1 Wealth Creation through Software Innovation

Through the execution of numerous work processes, human beings create wealth for consumption. For example, at the early stage of human civilization, the work process of catching Fish primarily consisted of using humans' natural capabilities such as locating and targeting with visual perception or touch and grabbing Fish with bare hands. In order to improve the performance of work processes, human beings started to define role of technology in it. At the primitive stage, may be the introduction of projection of sharp tools as the technology in the work process of catching Fish improved the productivity—as grabbing requiring physical contacts was partly substituted with projecting sharp tool to targeted Fish. Since the beginning of civilization, human beings have been pursuing the invention of technologies and their introduction as innovation in work processes to increase the wealth creation capacity. A work process primarily consists of two subsystems: 1. Human, and 2. Technological tools. There are five categories of tools: 1. Non-computing hardware, 2. Computing hardware, 3. Software, 4. Database and 5. Connectivity. The introduction of software, database, connectivity and computing HW in our initial example of work process has improved the performance of Fish catching process, particularly deep water fishing, in many dimensions such as time, quality, cost, collateral damage, etc. In modern deep-water fishing, it's no longer uncommon that satellite images are used to locate Schools of Fish and to guide Fishing boat, in real time, to the target area. Fishing boats mounted with under water acoustic imaging capability develop underwater images, which are processed and patterns are matched with database to locate and classify Schools of Fish as well as underwater marine ecological features with high degree of accuracy. Such role of software in fishing not only increases the productivity, but also minimizes collateral damage to environment and avoiding catch of less desirable or unwanted species. It's to be noted that relentless human pursuit of improving work process will see no limit of giving additional role to software—making it endless opportunity of increasing wealth creation or reduction of wastage or minimization of collateral damage through software innovations.

In the history of human civilization, major technological inventions include 1. Paper, 2. Steam engine, 3. Electrical energy conversion, 4. Telecommunications, and 5. Computer. Each of these technologies played key roles in causing disruptions to existing of way doing things to unlock significant new wealth creation opportunity. Due to the miniaturization, little energy requirement and extremely low cost of production of computing HW devices, software is finding way in every conceivable industrial products and work process to improve their performances. For example, software innovations have caused disruption to conventional wire line telecommunication infrastructure, having very little software into it, by software intensive cellular infrastructure and smartphones. Such disruption has made basic telecommunication services affordable as well as accessible to basically every one. Software innovation is primarily driven by the capability of envisioning better way of doing things with increased role given to software; whether the strategy is being Good to Great² or to cause Disruptions³ to existing way of doing things.

Historically, computing technology or automation has been looked upon from the perspective of replacement of role of human in work process with technology. Such option

² Jim Collins, Good to Great, Harper Business, 2001

³ Clayton M. Christensen and Michael E. Raynor, The Innovator's Solutions, HBS Press, 2003.

does not appear to be economically attractive in a labor surplus nation like Bangladesh. The role of software innovations in improving work process, pursuing the Good to Great strategy, is commonly known as efficiency and compliance or control innovations. Although, such innovation does not create new jobs, rather reduces in some cases. But integration of software with the support of communication makes work process more competitive and globally more integrated than before. Such competitiveness improvement and global integration appear to be at the core of creating large-scale labor-intensive export oriented RMG industry in Bangladesh. India's success of developing export oriented software engineering service industry also falls into this category. Careful observations indicate that increasingly more role of software is being added to every function of production and management--starting from pattern matching, fabric cutting to managing payroll.

In the age globalization and on the backdrop of increasing demand for wealth, we need to produce more high value added outputs with less cost in less time--whether this is the production or more crops with less land or fertilizes or delivering public services costing less time to citizens.

As it has been discussed, software is at the core of improving efficiency of any work process and improving the quality of basically every industrial artifact. Although such efficiency and sustaining innovations do not create net new jobs, but the protection of existing jobs and migration of jobs from high wages countries to developing nations could be an attractive option for development agenda. But, the most powerful capability of software is not in efficiency or sustaining innovation, rather it is the capability of software of causing disruption to existing way of doing things and creating new industry, resulting in significant number of new jobs and new wealth for the society as a whole. For example, software intensive technology innovations have been causing disruption in oil and gas industry unlocking the supply of new energy, termed as Shale oil&gas⁴. Software intensive innovations driving three-dimensional seismic imaging allowed geologists to seek oil with greatly improved precision; directional drilling and in-hole, computer-aided navigation allowed drillers to reach previously inaccessible reserves; once they got there, hydraulic fracturing allowed for the extraction of deposits from rock formations which never in the past had given them up. Such disruption caused—of course by software-- has dramatically changed the energy outlook of the world—plummeting skyrocketing oil price to less than USD50 per barrel⁵.

In pursuing disruption strategy to create new wealth through software, managers target customers who are trying to get a job done, but because they lack the money or skill, simple, inexpensive solutions are beyond reach. At the beginning, customers will compare the disruptive solutions, having software at the core, to having nothing at all. As a result, they are delighted to buy at even though it may not be as good as other products available at high prices to current users with deeper expertise in the original value network. The software solutions that enable the disruption might be quite sophisticated, but disruptors deploy it to make the purchase and use of the product simple, convenient, and foolproof. It is the “foolproofedness” that creates new growth by enabling people with less money and training to begin consumption. Such disruptive innovations create a whole new value

⁴ The Oxford Institute for Energy Studies, The US Shale Revolution, 2014.

⁵ Jonathan Rauch , Disruptive entrepreneurship is transforming U.S. health care, The Brookings Institution, March 2015

network. The new consumers typically purchase the product through new channels and the product in new ways. Opportunity is waiting to create disruptions in a number of industries, both locally and globally. Cloud based offerings of enterprise management software to be accessed through smartphones has the potential to address non-consumption of computing services for managing millions of micro and small enterprises in Bangladesh. Both technology complexity and high cost of having on premise computing platform are causing non-consumption of enterprise computing services in getting the management job done of micro and small enterprises. Usually, it takes 5 to 10 years, even longer, to make disruptive software innovations as strong substitute to conventional solutions, serving a small group of elite users. The capability of managing such journey in unchartered territory over such a prolonged period of time appears to be main hurdle of creating wealth through software. Due to its very nature, entrepreneurs as well as professionals do not find parallel to compare and stay in course. Strong understanding of theory of innovation is the main reference point to keep progressing for creating new industry, new market with disruptive software innovations. Financing is a serious issue, more or less any source of finance looks for rapid growth. It may take years to generate lucrative cash flow from conventional investors. Due to its very nature, investors face serious difficulty to understand the nature of the journey, tracking progress and staying committed over very long period.

It appears that many industries are waiting to experience disruptions caused by software innovations. Among others, Agriculture, Health, Education, Enterprise management and Public services are ready to be targeted. Software innovations around smartphones and cloud infrastructure have the potential to develop new culture of management of field level farming knowledge. Such disruptions has the potential to increase agricultural yield, 10% yield improvement may lead to USD 2 billion additional agricultural output. Software disruptions to address widespread non-consumption of premium services in critical areas of the society have the potential to increase direct income of millions of families; most of these families are at the boarder of poverty or below poverty line. For example, software innovation based knowledge management to increase agricultural yield and reduced fertilizer or pesticide consumption has the potential to increase income level of more than 15 million rural households. Therefore, software innovations could be a new tool to eradicate poverty from Bangladesh. Such disruptions could be caused in Public services too. For example, the policy of integration of software in VAT collection and compliance may cause disruptions to existing ways of doing things by NBR.

Markets for software innovations could be divided into three concentric circles as shown in Fig. 2.1.

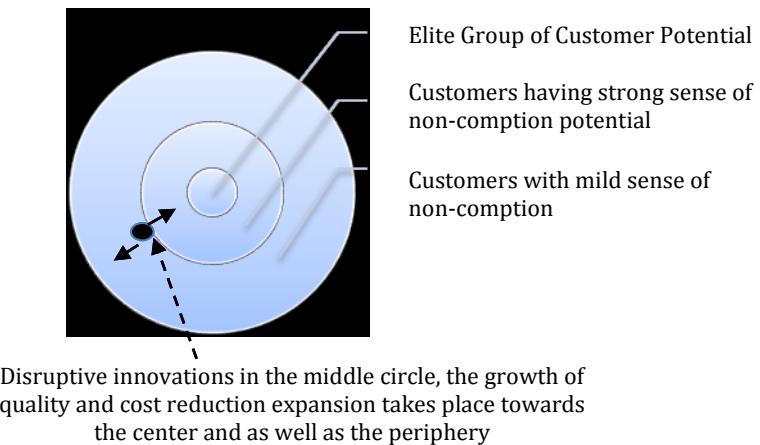


Figure 2.1: Market segmentation, penetration and expansion of software innovations.

Elite customers sit at the core; these customers are looking for software solutions either to improve efficiency or control of existing work processes or for improving features of their products. Such customers prefer to have project based delivery of customized solutions and buy IPRs. Due to their very nature, such customers are limited in any society. Particularly in developing nations like Bangladesh, number of these customers is extremely small. Majority of customers are at the 2nd and 3rd circles, particularly for disruptive innovations. To capture such market segments, entry point is at the middle circle; with growth of quality and reduction of cost due to high economy of scale, such solutions expand towards the center as well as the periphery, resulting in creation of new market, new wealth.

Among many building blocks, wealth creation through Software innovations needs following ones:

1. Availability of technology knowledge and competence of conducting R&D for absorbing technologies, inventing technologies and innovating software solutions around them.
2. Identification of role of software to create economic benefit for the users, to get jobs to be done easier: domain knowledge and idea generation.
3. Scope of creating surplus for both consumers and producers: profitable business proposition.
4. Entrepreneurial initiatives and management capability linking individual segments of the long journey, mostly without finding any parallel.
5. Availability of good risk capital finance.
6. Strong IPR culture for protection of intellectual assets and also having it reference to communicate the commercial value of those intellectual assets to potential investors and business partners.
7. Supportive public policy for creating the market for software innovations.

Public policy sits at the core of these building blocks. Basically, public policy play key roles starting from competence development, IPRs culture creation, demand creation to Risk capital financing.

2.2 Economics of Software Innovations

The creation of consumer and producer surplus, and ways to improve them simultaneously, are the subjects of economic analysis of software production and consumption. The consumer surplus is measured through the difference of perceived value from consumption of software and the actual cost for its procurement and usages. On the other hand, producer surplus depends on the difference between the cost of delivery and the price charged. Willingness to pay depends on performance of software; the actual price paid depends on competition and alternate investment opportunities. It should be noted that the capability of offering higher quality solution at increasingly lower price to make growing profit is the core issue of economics of software production. The ability to benefit from both economy of scale and scope is the key challenge to address such economic issues pertaining to software based wealth creation.

Product R&D activities capture smart insights about target customers' work processes or jobs to be done, assess emerging technologies, review features of competing products and generate ideas of product features to be offered to customers creating significant perceived value. Creative ability contributes to high value idea creation. The software production process largely determines the cost of production of software with identified features. Focused business strategy and appropriate production process increase reuse and reduce rework contributing to lower cost of delivery. Moreover, the enhancement of process capability to reduce rework also leads to improved predictability of delivery, resulting in better perceived value. Learning curve benefits as institutional capability in software production results in improved insights, better reuse and less rework, which are critical for increasing the consumer and producer surplus simultaneously.

The gradual software asset development, with high degree of reuse and synergy, minimizes cost of delivery and maximizes value from consumption. For efficiency and sustaining innovation, both consumer and producer should focus on both economy of scale and scope. For this reason, consumption should focus on developing software assets in an incremental manner, so that organizations adapt to benefit from software integration in a synergistic manner. On the other hand, supply side should start developing projects from similar market segments to offer software solutions to address common set of requirements, resulting in reusable core asset development. Instead of trying to offer a whole set of solutions, offering should focus on family of products to benefit from both economy of scale and scope. To benefit from such economics of software production and consumptions, both supply and demand sides should look for creating snowball effect or virtuous cycle of growth around software innovations.

On the other hand, for causing disruptions, supply side should look for the opportunity of addressing non-consumption with software innovations. Usually, there is a large time gap to recover R&D investment from such innovations. Pricing should focus on dividing the R&D cost over a large number of customers, may be millions. Due to zero cost of replication of software, economy of scale is the critical factor to succeed in this type of innovations. Careful market understanding and figuring out the expansion strategy by

remaining in sync with customers' behavior is the primary focus. Competition strategy around IPRs, brand value and continuous innovation should be the focus on increasing the value and reducing marginal cost, to benefit from economy of scale.

2.3 Role of Entrepreneurships and Firms in Maximizing Wealth Creation through Software

As it has been mentioned, wealth creation ability in software depends on innovation. Replication does not add value; moreover unauthorized replication and selling them is unlawful. It has been found that creative entrepreneurial activities are key driver to unlock wealth creation possibilities of software innovations. Creativity is often the biggest asset for young people who can afford to experiment and take calculated risks in the early stage of their lives and careers when a whole range of possibilities exists. However, it has been found that unless snowball effect around such creative aspirations is created to support the growth of firms, such creative entrepreneurial drive cannot be sustained.

A software firm grows by benefiting from both economy of scale and scope. Potential per unit cost advantage from producing more of the same product arise from economies of scale. The production of complementary products around core assets, which are already used in producing other products, produces economy of scope effect. Due to high coordination and communication cost, random generation of projects from diverse domains, and rework generated from misinterpretation of delegated works, typical software firms start experiencing diseconomy of scale at very early stage of growth. In absence of deliberate measures to improve the production function, software firms tends to tilt towards diseconomy of scale. Due to such unique characteristics, entrepreneurial initiatives, very often, fail to ensure consistent growth of software firms. Due to lack of such growth trend, software professionals employed in these companies start getting frustrated, resulting in low motivation and eventual departure. Such reality creates vicious cycle in growth dynamics of software firms-which appears to be the scenario of Bangladesh.

On the other hand, the virtually zero cost of replication offers the potential to benefit from extremely high economy of scale. The challenge to benefit from such opportunity is to develop product, around commonality of requirements of customers, to be sold to large number of customers, at a fraction of cost of development. The significant investment and management competence need and the scope to work in partnership with lead customers are primary barriers to benefit from such opportunity to grow software firms. Upon developing a successful product, a number of complementary products could be developed around core assets to benefit from economy of scope. Economy of scope also offers significant opportunity to support growth of software firms. These growth potentials must be exploited to develop software firms; otherwise early entrepreneurial initiatives will be leading to creating failure stories, which will eventually create repelling effect.

Customized application delivery to a group of selected customers should also take advantage of these opportunities: economy of scale and scope. The production process should focus to create reusable core assets and to reduce rework for continuously reducing cost of delivery. Software product line architecture for the target market should be planned and executed in such a manner that economy of scope benefit is realized through offering of complementary solutions.

At the end of the day, the success of entrepreneurial initiatives depend on building the institutional capability turning a start-up to corporation. Although ideas matter, but economies of scale and scope are the core competences for developing software firms to sustain growth; which offers career to software professionals and attracts smart youths to join the industry.

2.4 Missing Links in Software Engineering Education and Quality Certification

Computer science education in Bangladesh primarily focuses on explaining existing science and technology of computing. The acquisition of exiting knowledge, at best, develops the replication capability among graduates. Unfortunately, replication does not add any value in software based wealth creation. Unlike other industries, due to zero replication cost, the reengineering of existing software applications does not produce profitable business opportunity, or new wealth creation opportunity.

The software engineering, also programming skills, education primarily focuses on dealing with complexity of developing large-scale applications. The software body of knowledge, primarily originated from US Space and Defense programs, does not take into consideration of economics of software production. Over the years, the focus of software engineering research has been in developing a series of good advices to prevent defects and to deal with the development of large software systems. It's expected that such advices should be followed without taking into consideration of cost of adherence and derived benefits. The defect prevention and early detection have the focus of many quality assurance doctrines in the software engineering community. Some of the well-known, also famous, ones are SW-CMMI, ISO 2000, Six Sigma or IEEE software standards. Despite the extreme high benefit which SW-CMMI produces in preventing defects in developing applications for defense or space programs, their utility in reducing the cost of production of small scale software applications for enterprise computing market segment is limited. Cost of executing a series of practices of these doctrines is much less than the potential savings from prevention of even one defect, in many mission critical applications. The focus should be on process culture to benefit from economy of scale, rather than on having the certification.

On the other hand, mental model centric coding and testing, or agile, development approach does not offer managed approach of reducing cost and improving quality of software delivery. Without some degree of discipline in improving the production process, it may be impossible for managers to pursue the strategy of developing economy of scale and scope benefit, which sit at the core of software firm development capability.

It appears that separation of computing science and software engineering education from concern of underlying economics fundamental, it makes it very difficult to build software firm development capability around entrepreneurial initiatives.

The focus of IT education to teach only technology, in different branches as well as at different labels of education, also makes it very difficult to create demand for software innovation. In order to create producer and consumer surplus, students should not only focus on learning ICT or programming skill, but also there should be equal focus on understanding the role of ICT or software in improving for performances of diverse work process. There should be strong academic components in business education to model

work processes and to figure out the role of software to improve performances of them by integrating software innovations. It seems that components of innovation management, production economics and work process engineering with software should be included in academic programs of computer science and software engineering. Keeping economic fundamental separated from technology knowledge will not empower our graduates to lead the process of creating wealth through software.

2.5 Software Value Chain

The overall value chain of the migration of offerings of software firms is shown in Fig. 2.2. Home grown software firms usually enter the market to deliver project based customized applications to domestic clients, whether to private enterprises or Government offices.

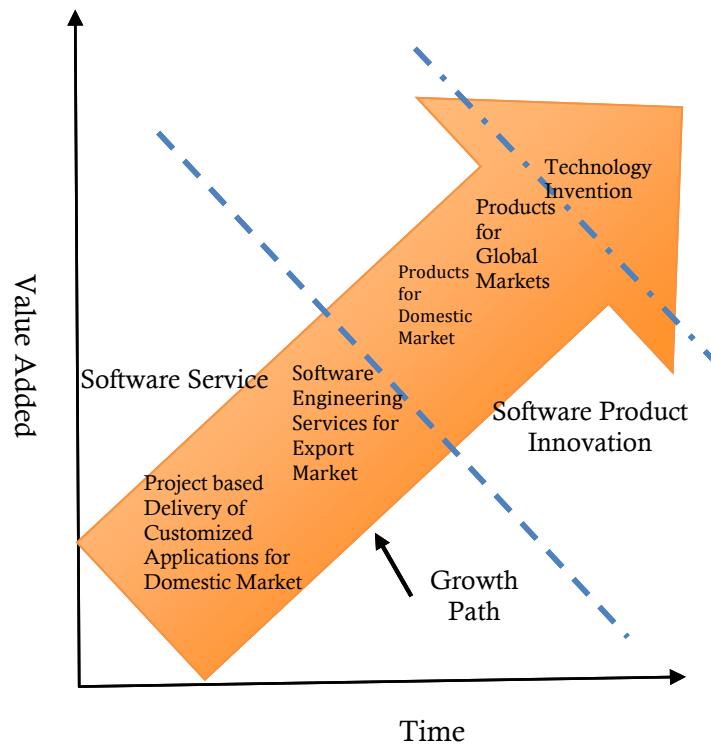


Figure 2.2: Very High Level Value Chain of Software Industry

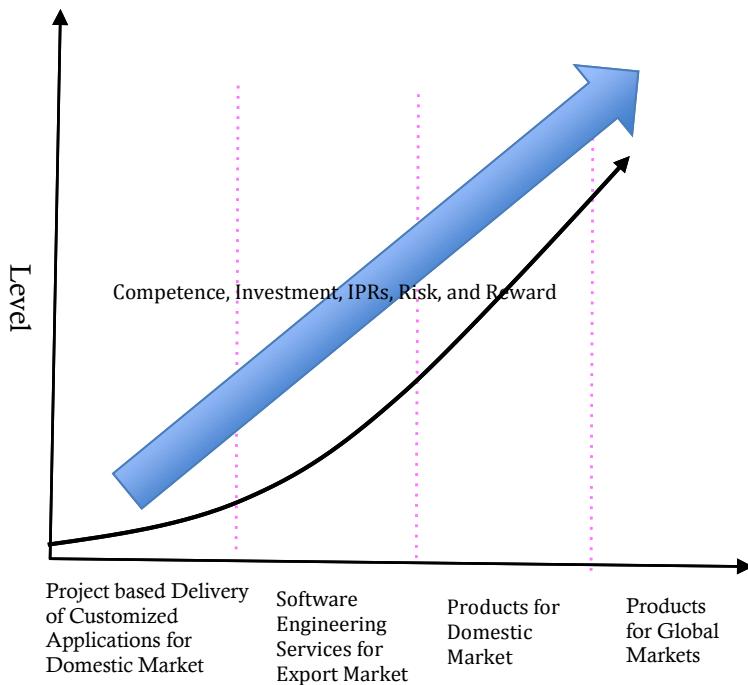


Figure 2.3: Growth pattern of capability, risk and reward over the value chain

Upon developing certain capability in software application development, they approach foreign clients to offer software engineering services—primarily coding, testing and technology migration. In course of time, they start capitalizing project based delivery to develop products for the domestic market. Significant technical and management competence, high risk capital financing, and close associations with lead customers are required to succeed in software product business—particularly in the global market. Some software firms such as Samsung and 20-20 Technologies (source KII), particularly from advanced countries, entered in Bangladeshi software industry by developing captive facility to offer software engineering services to support their product development need. In the technology invention category, there is none in Bangladesh though; Firms develop technology to license to other companies, who develop product features around those licensed technologies. All major indicators keep increasing exponentially with the upward migration through the value chain, as shown in Fig. 2.3.

Overall production function of Software Firms is shown in Fig. 2.4. At the beginning, software firms experience economy of scale due to complementary roles played by additional recruits, such as designer complements coders. But due to recruitment of multiple professionals for doing the same job, such as several programmers for doing coding in the project, marginal productivity starts falling due to communication & coordination overhead, increased rework caused by poor delegation, and waiting for limited scope of task division for parallel execution. Upon reaching to employee size S_1 , marginal productivity or additional revenue due to new recruit starts falling. At the size S_2 , marginal revenue equals to marginal cost. The shape of this production function basically limits growth opportunity. At the beginning of the value chain—that is project based customized application delivery-- due to low willingness to pay and limited scope of value creation opportunity in the domestic market, software firms in Bangladesh reaches to growth limit, S_2 , very quickly. Upon reaching to the growth limit, local software firms have

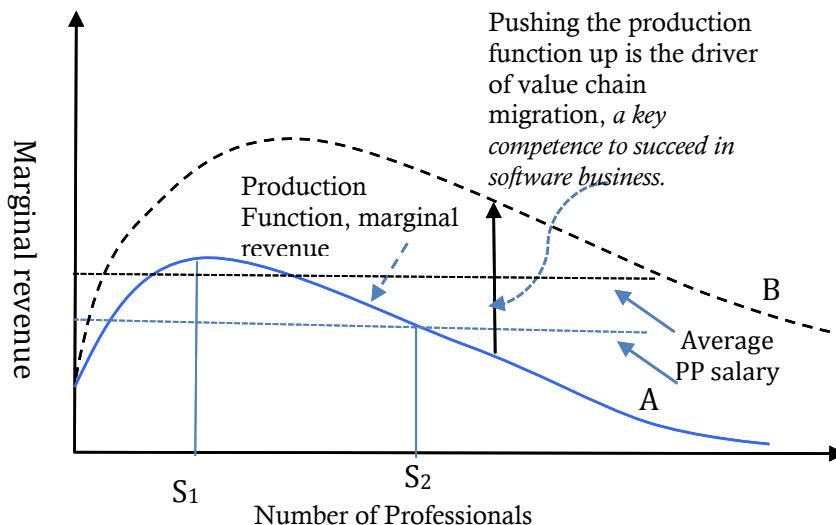


Figure 2.4: Short Run Production Functions of Typical Software Firms

two options: 1. Improve the software production process, or 2. To access customers having higher willingness to pay, so that production function is pushed towards upward. The other two options for improving the production function are 1. Software product for domestic market, and 2. Software product for global market, to benefit from reuse for enjoying higher economy of scale. After development, the cost of reproducing software is near zero and the cost declines with every additional user, thus resulting in increasing returns to scale. Also, the electronic distribution of software products is much less expensive than shipping physical goods. The last option is Technology invention and licensing. High performing software companies take number of steps to continuously improve the production function. Some of them are codification of tacit knowledge to scale up on job learning benefit, process improvement for reducing rework, increase reuse and lower communication & coordination overhead, and improving task division for higher parallelization. Instead of developing projects from diverse application areas and technology base, they also focus on specific market to develop projects to meet similar requirements. Such strategy increases reuse of both tacit and explicit assets resulting in lower cost, higher quality and enhance brand value. They start investing in developing core software assets to be used in subsequent projects to deliver similar solutions in the same market segment. Such strategy leads to productization of core software assets leading to very high reuse. Expansion of company size basically focuses on marketing and implementation creating the opportunity of high degree of economy of scale.

2.6 Software Market and Theory of industrial Organization⁶

Market power of Software Firms lies in the potential of decreasing price and increasing profit simultaneously. By turning individual learning or tacit knowledge to codified knowledge, software firms are capable to increase reuse and reduce rework; these are most influencing cost and profit factors in software production. With such ability, high performing software firms are in a position to develop advantage over competing firms. This is the genesis of creation of market power in software firms. With the accumulation of market power, dominant software firms will also deter new entry. But due to dynamic

⁶ Jeffrey Church and Roger Ware, Industrial Organization: Strategic Approach, The McGraw-Hill Companies, 2000

nature of competition, discontinuities in the growth dynamics of the software industry will be highly prevalent. Such discontinuity will create profitable entry opportunity for competent new entrants. Therefore, through the creation of market power, the software industry will not end up in monopoly. Due to very high scope to benefit from economy of scale and scope, software industry has tendency to tilt towards monopoly, but this is not natural tendency. Such tendency should be meticulously created through appropriate business strategy, investment in R&D for developing reusable assets and continuous improvement of production function through codification of individual learning to organizational capability. Successful strategy to benefit from such opportunity will also lead to lower employee turnover and continuous career growth of experienced professionals.

The economy of scale benefit from software product solution appears to be larger than market size of a nation or the world as a whole. For this reason, global ERP market has been consolidating to just couple of companies: Oracle and SAP. The office computing has consolidated around only one company: Microsoft. It seems that policy makers and regulators should allow the creation of market power so that capable software firms will start benefiting from economy of scale, which will result in lower price and higher quality. Due to absence of market power, the Software industry in Bangladesh has become perfectly competitive market. The entry barrier is very low and the competition strategy primarily lies on quoting the least price, instead of finding the way to reduce price and increase profit simultaneously. Due to very limited economy of scale and scope, such perfect competition is keeping the price of outputs the software industry very high. Market should be enabled to tilt towards imperfect structure to address growth constraints facing the software industry of Bangladesh.

In an imperfectly competitive market, only a handful of large firms will grow, by taking the advantage from economy of scale and scope. As a result, efficiency of resource utilization in these firms will sharply increase resulting to lower price for consumer, high dividend for shareholders and improved career path for software professionals. Progress towards this direction will increase investment capability of these firms for expanding product business and also software engineering service export.

2.7 Globalization of Software Value Chain

Product based software companies are primarily located in USA and Europe. Also, large investments in developing customized software applications have been primarily made by American and European companies and government organizations. There was a surge of software maintenance work in USA and Europe to address Y2K in the last decade of the 20th century. The organic growth of supply of programmers could not keep up the demand caused by such Y2K surge. To address this gap, American and European organizations were looking for alternative options. Such gap created discontinuity resulting in creation of large software service export industry in developing countries, particularly in India.

India: Although India has long history of computing, but Indian Software companies were struggling to generate enough business from the domestic market to grow. In 1980's, most or all of the Indian software firms were basically working at the first leg of the software

value chain—project based delivery of customized applications to domestic clients⁷. The story of Infosys facing bankruptcy at the early life is very much well known. The situation changed with the Y2K surge. American and European organizations were looking for short-term work force to address the HR gap, cased by Y2K. Indians working in the Tech sector of USA played an important role to link nascent Indian Firms to large mundane Y2K routine work demanded by American and European clients. The influx of foreign TNCs, such as Citicorp Overseas Software in Bombay in 1985 and Texas Instruments in Bangalore in 1986, had an important demonstrative effect on the decision making process of foreign companies to contract out such Y2K work to Indian firms. Such demand led opportunity started to create snowball effect to the growth of software engineering service export business in India. Through the process of Y2K bug fixing, Indian programmers got familiar with code structure of those applications. With the growth of PC industry, most of the American companies felt the necessity to migrate their applications from Mini and Mainframe to client server based PC platform. American and European firms started to use the already developed programming capacity to address this migration work. Still to date, most of the Indian firms are basically operating at the 2nd leg of the value chain—offering coding and testing services to Americana and European firms. In the process, although many foreign companies have established their software development facility in India, but success of Indian companies in innovating software products—both for domestic and global market—is virtually negligible⁸. Over the years, there has been also significant growth of the ecosystem surrounding the large software engineering service export industry of India. Due to rapid growth of supply capacity of such a large population, marginal benefit of looking for alternate destination, like Bangladesh, for large scale software engineering service alternative destination is still not attractive. For this reason, replication of Indian model to start developing software industry has largely failed to deliver intended result in Bangladesh still to date.

There is increasing evidence of growing software development operations in countries such as India. For example, the Microsoft India Development Center (located in Hyderabad) has grown from two products and 20 employees in 1998 to 70 products and over 1,500 employees in 2009. SAP Labs India is now that company's second-largest Research and Development and Global Services and Support center, with 25% of its employees engaged in research and new product development. IBM's India Software Labs similarly have large operations in Bangalore, Gurgaon, Pune, Hyderabad, and Mumbai. Yet, despite these anecdotes, software innovation is not primarily taking place in India. While software production takes place in many countries, innovative software is not created everywhere.

A key determinant of nature of innovation in development activities in software is the location of the user. This is particularly true with business software, which is often bundled with a set of business rules and assumptions about business processes. The analysis of patent data suggests that multinationals—U.S. software firms—can serve as a partial, though highly imperfect, conduit for the needs of lead users. Although U.S. software firms appear to be a potential conduit for user needs, they appear to be moving their innovative activity offshore much more slowly than they are moving some programming and maintenance activity. As a result, Indian software firms are still to date growing in the same segment of the value chain—exporting software engineering services. Growth in

⁷ V.RAJARAMAN, HISTORY OF COMPUTING IN INDIA (1955-2010), The Computer Society

⁸ Ashish Arora, Matej Drev, and Chris Forman, Economic and Business Dimensions The Extent of Globalization of Software Innovation, The Communication of the ACM.

emerging economies translates into more lead users, and, thus, more scope of local innovation to develop software products to address local demand.

Although, India's success is largely in Software/IT service export, but there has been steady growth in software product. While Indian entrepreneurs have been working to build 'world class' products, Nasscom said, the domestic market is the mainstay for the software product segment, unlike Software Engineering service where exports are stronger. Of the \$6.1 billion revenue estimated for FY15, Nasscom expects domestic revenue to be \$4.2 billion and exports to touch \$1.9 billion. It has also been reported by Nasscom that India has the third largest base of software product start-ups in the world. It estimates India has close to 3,100 start-ups, with a little over 800 new ones every year. Such trend is expected to enable India to have 11,500 start-ups by 2020, employing 250,000 persons⁹.

Ireland: Integration of Ireland in EU started the snowball effect of creation of large export oriented software industry in Ireland. EU incentives and relative low wages, among EU member countries, Ireland quickly became the preferred destination for American and European Corporations' for their European development centers. In value terms, Ireland is the leading exporter, both in absolute terms and relative to GDP. The country's computer software and services exports almost quintupled between 2000 and 2010, from \$7 billion to \$37 billion, and appear to have been relatively unaffected by the global financial crisis¹⁰. Such model of growth of software Industry does not appear to be replicable for Bangladesh either.

Israel: Another global example is Israel. This country's success relies on invention and licensing of core software technology to software product companies. Leaping almost 400 percent in a decade, Israeli software exports rose from \$1.5 billion in 1998 to \$6.2 billion in 2009¹¹. Software developed in Israel powers everything from PC motherboard chips to cell phones, and is deployed in business, consumer and technical applications around the world. The core strength of Israeli software industry is envisioning revolutionary solutions, including some of today's most common software solutions, and developing licensable technology for innovating those solutions. Instant messaging, voice over IP, voicemail, public key cryptography, Internet firewall and cellular billing are technologies envisioned and developed by Israeli companies. Many of the large global software companies entered in Israel through acquisitions of local companies who were at the forefront in key technologies. Most of these Israeli companies span off from defense related R&D projects. To take the advantage of the growth of rich cluster of software technology, others established local R&D and manufacturing centers, many of which now play a significant role in their parent companies' operations. Multinationals with Israeli operations export more than \$3 billion annually.

The success of this model lies in the R&D financing made by the Defense. Due to several reasons, Israeli institutions work with NATO member countries to develop strategic technologies for defense purposes, which lead to licensing of technology for commercial benefit. To some degree, Israel's success in software industry is partly attributed to smart

⁹ http://www.business-standard.com/article/technology/india-well-behind-us-europe-in-software-products-115022300722_1.html

¹⁰ UNCTAD, INFORMATION ECONOMY REPORT 2012, *The Software Industry and Developing Countries*.

¹¹ Israel inspired by innovation, Software industry, he Israel Export & International Cooperation Institute, 2009

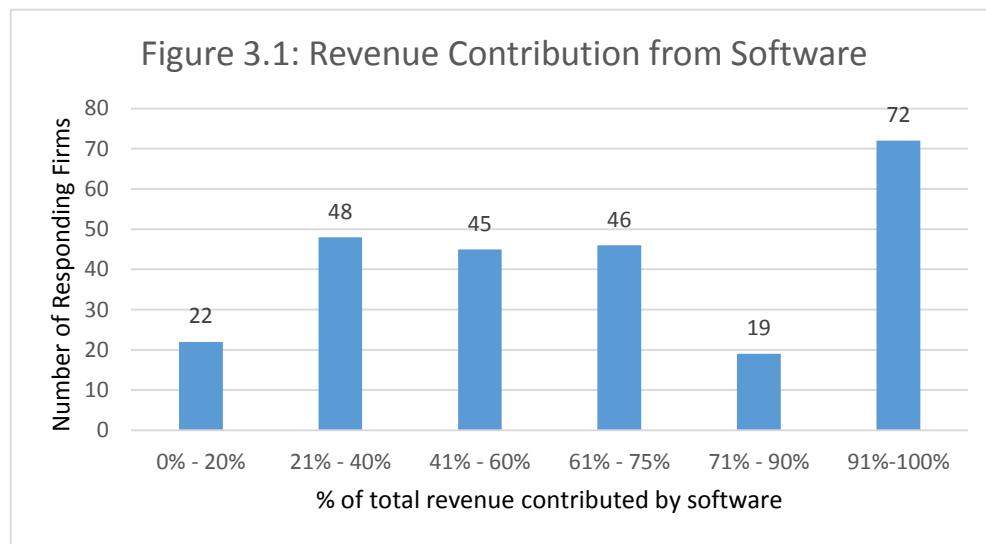
public policy to use outputs of defense R&D programs to develop local technology cluster, which attracted foreign multinational firms to enter the country. Such model does not appear to be applicable for Bangladesh to develop thriving software industry.

Korea: Usually, Korea is not cited as the success story of software. In 2007, the Korean software industry was estimated to have revenues of \$21 billion. The software industry is making important contributions to the Korean economy, especially in the form of embedded software. In 2009, this segment accounted for almost 59 per cent of all software production in the country. In 2010, the Government outlined a new strategy entitled the Software Korea Quantum Jump Strategy. Among the targets set were to increase software exports from about \$6 billion (including embedded software) in 2008 to \$15 billion by 2013 and to more than double software employment from 140,000 to 300,000. Various policies and strategies were identified to achieve these and other targets. In the area of packaged software, there are efforts to support open source software, open innovation and to activate SaaS by leveraging cloud computing. It appears that Bangladesh has lessons to learn from Korean model of Software innovation led growth.

Chapter 3: Basic Characteristics of the Software Development Sector of Bangladesh

3.1 Positioning of the Software Industry

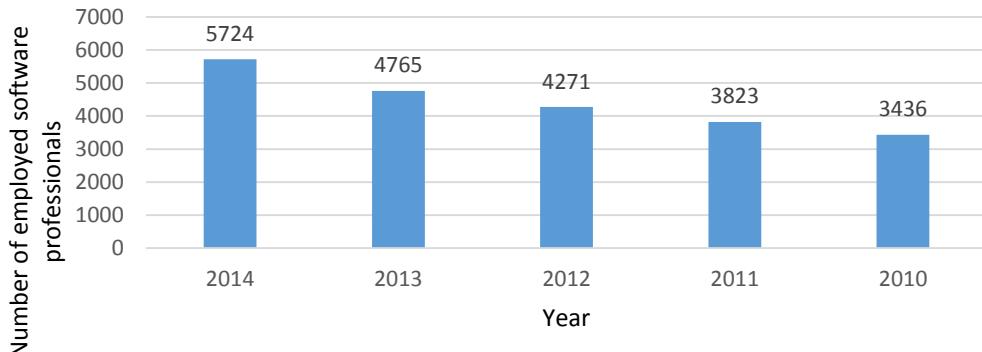
Firm Level Revenue Contribution from Software: This study identified 309 firms, who are in the business of software development and commercialization. Among these firms, 269 responded in the field survey. It should be noted that all of these responding firms did not answer each of the questions. The study finds that software is not the sole source of revenue to most of the responding firms. Most of these firms, as high as 77%, also generate revenue from other sources such as computer hardware trading and networking services. The contribution of revenue generated by software development, software engineering services and COTS implementation services to total revenue among responding software firms is shown in the Fig. 3.1. Software is the sole source of revenue to only a fraction of firms, less than 30%; almost 40% responding firms generate less than 50% revenue from software. Upon consideration of the whole population, such findings indicate that only a small number of firms, as low as less than 100, solely rely on software development and commercialization.



Data source: Field Survey

Employment in the Software Industry: Out of 309 firms that being surveyed, responding 262 firms reported that collective employment of software professionals in these firms stood at 5,724 in 2014, which has steadily increased over last five years from 3,436 in 2010, as shown in Fig. 3.2. As samples were taken randomly, estimated total employment in the sector appears to be: 6750. Employment of female professionals appears to be very small: only 17%.

Figure 3.2: Employed Software Professionals in Responding Firms

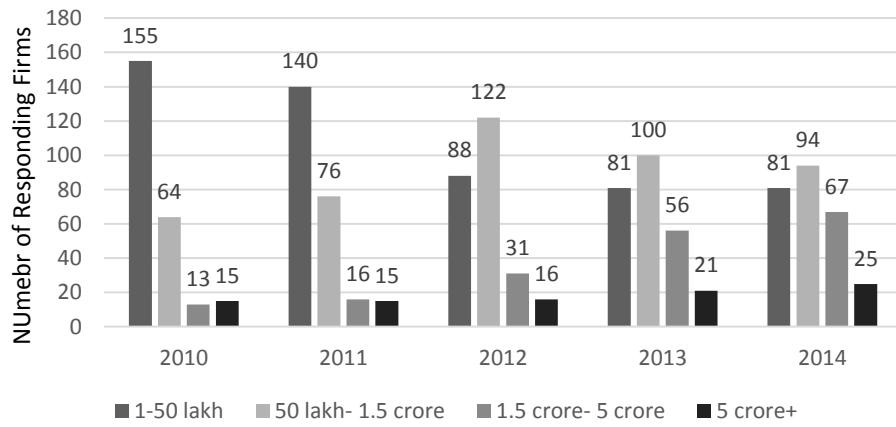


Data source: Field Survey

During this 5 year period, employment in these firms has grown by 66%, with an annual average growth is almost 13%.

Revenue Distribution: Among 267 responding firms, most of the firms have reported their revenue level between BDT 50 lacs to BDT 1.5 crores, as shown in Fig. 3.3.

Figure 3.3: Revenue (in BDT) Distribution Over Last Five Years



Data source: Field Survey

Table 3.1 Export Revenue Distribution

Revenue in BDT	Years (Frequency of Responding Firms)				
	2010	2011	2012	2013	2014
1-25 Lakh	120	107	69	63	63
25-50 lakh	27	38	60	54	42
50 lakh- 1.5 crore	9	14	28	44	51
1.5 crore- 5 crore	10	11	14	16	26
5 crore+	3	3	4	4	3

Data source: Field Survey

Table: 3.1.a Export Revenue Distribution in Percentage

Revenue in BDT	Years				
	2010	2011	2012	2013	2014
1-25 Lakh	5.51%	4.90%	3.16%	2.87%	2.86%
25-50 lakh	1.24%	1.74%	2.74%	2.46%	1.91%
50 lakh- 1.5 crore	0.41%	0.64%	1.28%	2.01%	2.32%
1.5 crore- 5 crore	0.50%	0.55%	0.70%	0.79%	1.29%
5 crore+	0.14%	0.14%	0.18%	0.18%	0.14%

Data source: Field Survey

Export revenues are shown in Table 3.1. It appears that major revenue source for the software industry is the local market. In 2014, as high as 175 firms have reported annual revenue to be less than BDT 1.5 crores. Only, 25 firms have reported their revenue to be more than BDT 5 crores. In the export sector, only three firms have reported revenue of more than BDT 5 crores in 2014.

There appears to be revenue growth trend in responding firms during the period of 2010-2014. It seems that these firms are growing, which is reflected in revenue patterns. It seems that growth of the export revenue at the highest revenue segment is more or less static. The number of firms earning more than BDT5 crores over 2010-2014 has not changed, which stood at 3. Due to significant large volume of the global market and extremely small size of export revenue of local software firms, such growth should have been much higher. It seems that these firms are facing growth limitation at BDT 5 crores band. As explained in Fig 2.4, the export production function of these firms did not improve over these five year periods. Similar situation is also true in the domestic market, almost 74 Software firms migrated the lowest band of revenue during 2010-2014, on the contrary to entry of only 10 firms in the highest band. This is an indication that with given production function, software firms are facing significant growth limit at the highest revenue band. Such reality may be attributed to high degree of reliance to customized service or application delivery, where the scope to benefit from economies of scale and scope are very limited. Due to slow or no growth of production function in terms of reduction of rework and increase of reuse, these firms are reaching to growth saturation—may be at very small size. Such response patterns reflect the presence of diseconomy of scale at very small size, which may be attributed to such high density of micro and small firms in the software development sector of Bangladesh.

Revenue Estimation and GDP Contribution of the Software Industry

This study located 309 firms having business activities in software; out of these firms, only 262 responded to the question of employment of software professionals. Therefore, it could be estimated that software professional employed in the sector stood at **6750** (309(5724/262)) in 2014.

Salary Structure: Based on data gathered in the survey and from key informant interview, estimated salary of different categories of professionals and their density are shown in Table 3.2.

Table 3.2: Salary Variation with Experience

Experience	(Frequency of Responding Firms)										
	BDT 0 -10,000	BDT 10,001- 20,000	BDT 20,001- 30,000	BDT 30,001- 40,000	BDT 40,001- 50,000	BDT 50,001- 60,000	BDT 60,001- 70,000	BDT 70,001- 80,000	BDT 80,001- 90,000	BDT 90,001- 100,000	More than 100,000
Fresh university graduates	12	192	50	14	1	1					
3 years in software industry		12	162	64	19	8	4		1	1	
5 years in software industry			13	131	58	34	15	8	7	3	1
10 years in software industry				12	79	70	30	14	22	10	30

Data source: Field Survey

From the table 3.2, salary estimation of different categories of software development professionals is shown below in Table 3.3:

Table 3.3: Estimated Salary of Software Professionals

Experience Level	Estimated Salary	% of Professionals
Fresh university graduates	18,000	25%
3 years in software industry	32,000	35%
5 years in software industry	45,000	30%
10 years in software industry	65,000	10%

Data source: Field Survey

Therefore, average estimated salary per software development professional is BDT 35,000 per month, according to following relationship:

$$35.7 = (18*0.25 + 32*0.35 + 45*0.30 + 65*0.10)$$

Estimated Revenue: Based on data provided by respondents, it appears that 50% expenditure of the software industry goes for salary. Therefore, estimated expenditure incurred by software companies in Bangladesh is BDT 5783 million in 2014. Based on key informant interview and obtained data, it appears that gross margin is around 15%. Therefore, estimated revenue of the sector is BDT 6,650 million, which is equivalent to value addition of BDT 972,664 (USD 12,632) per annum per software professional.

GDP Contribution: Therefore, it could be estimated that the software industry in Bangladesh is adding BDT 7,700 million (USD100 million) value to the local economy. In comparison to national GDP of BDT 9,240 billion (USD120 billion (approx.)), it's a small fraction: 0.070%. Although GDP contribution is low, but per person value addition seems to be very high: BDT 962,500 (USD 12,500 (approx.)).

3.2 Major Products and Services

The overall responses of revenue contributions from different product categories are shown in Table 3.4. It appears that Mobile Applications have grown as a major source of revenue; they are the source of more than 50% revenue to 27 responding firms. Although, Government has the potential to be large source of revenue, but according to this survey, only a small number of firms are generating significant revenue from work on e-Government applications.

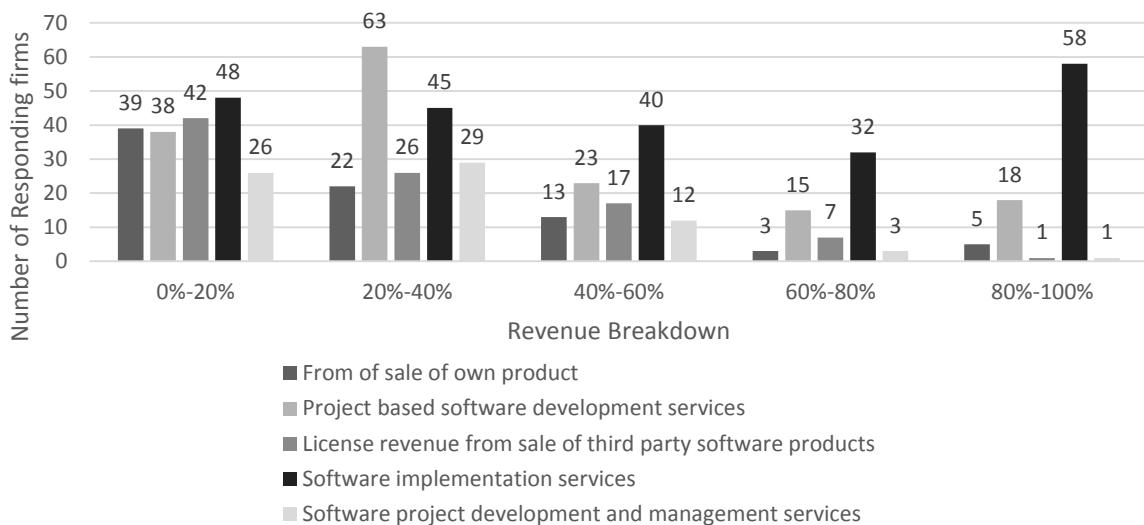
Table 3.4: Revenue from Different Product Categories

Product Categories	Range in % of total revenue earned from software and services (Frequency of Responding Firms)									
	0%-10%	11%-20%	21%-30%	31%-40%	41%-50%	51%-60%	61%-70%	71%-80%	81%-90%	91%-100%
HR Management	43	45	29	19	22	9	2	3	2	2
Accounting	44	44	40	17	7	5	5	2		1
Payroll	30	39	36	15	7	5	1	1	1	
Retail/POS	16	25	25	11	7	3	1	3	1	
e-Commerce	19	32	31	20	9	9	5	1		5
Mobile applications	30	31	33	26	20	10	4	2	2	9
e-Government	18	23	12	5	7	1	3	3		1
Others: Please mention	9	4	4	4	5	3	2	4	5	13

Data source: Field Survey

It seems that a large number of firms are active in the area of HR management, Accounting, Payroll, e-Commerce and POS applications. Presence of large number of firms in the same market segment, such as 160 firms in accounting, indicates there is very low economy of scale benefit, resulting in high cost.

Figre 3.4: Revenue Breakdown Over Different Offerings



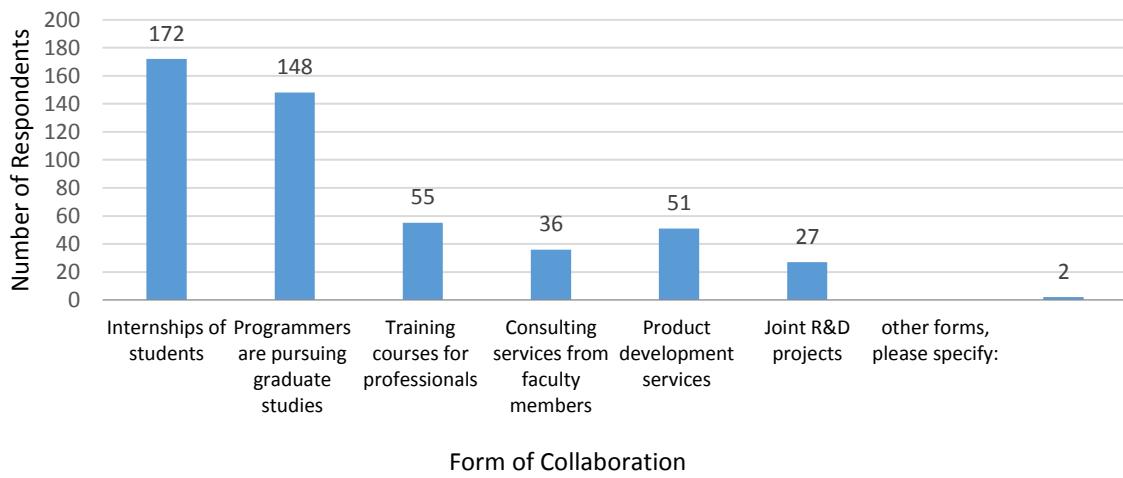
Data source: Field Survey

It appears that software implementation service is the single most important source of revenue; it generates more than 80% revenue for 58 responding companies as shown in Fig.3.4. It has been learned that a large number of software companies have developed business function specific software applications. For customer specific delivery, significant work is required to customize such applications and integrate it with customers' corresponding business functions. Project based software development services, one of its kind, is also important source of revenue. Software project development and management service as an independent source of revenue is yet to grow as an important source of revenue, to only 5 firms is this the sole source of revenue. According to data, project based service delivery is the largest source of revenue for the sector—low economy of scale benefit.

3.3 Key Link Analysis of the Industry

As large as 172 firms have indicated that they receive interns from academic institutions as shown in Figure 3.5. It's also encouraging to note that programmers employed by responding 148 firms are pursuing graduate studies in local universities.

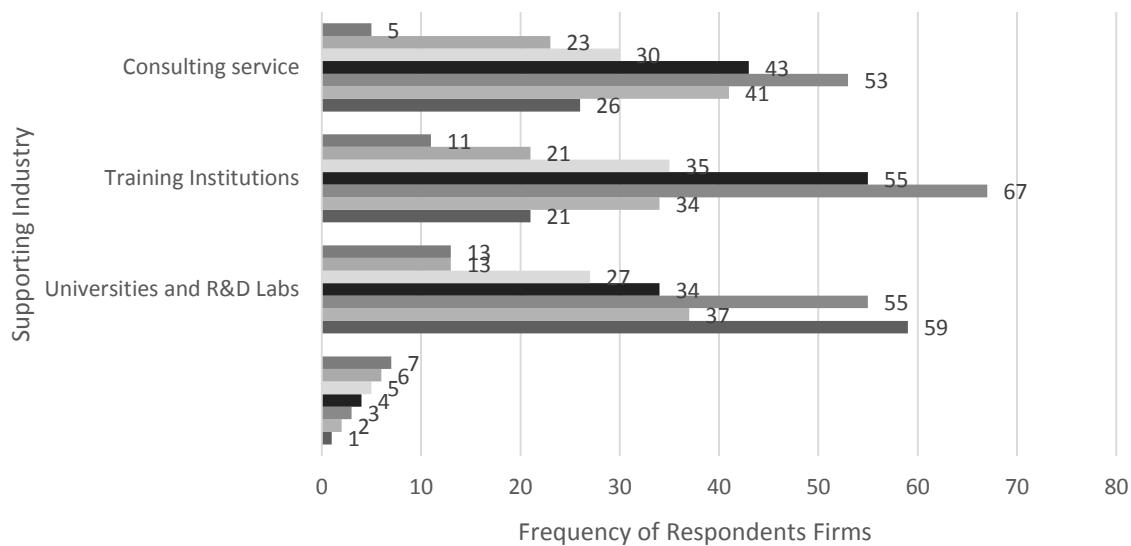
Figure3.5: Linkage with Local Academic Institutions



Data source: Field Survey

There appears to be certain degree of collaborations between universities and software firms in product development and R&D.

Figure 3.6: Availability of Services from key Linkages



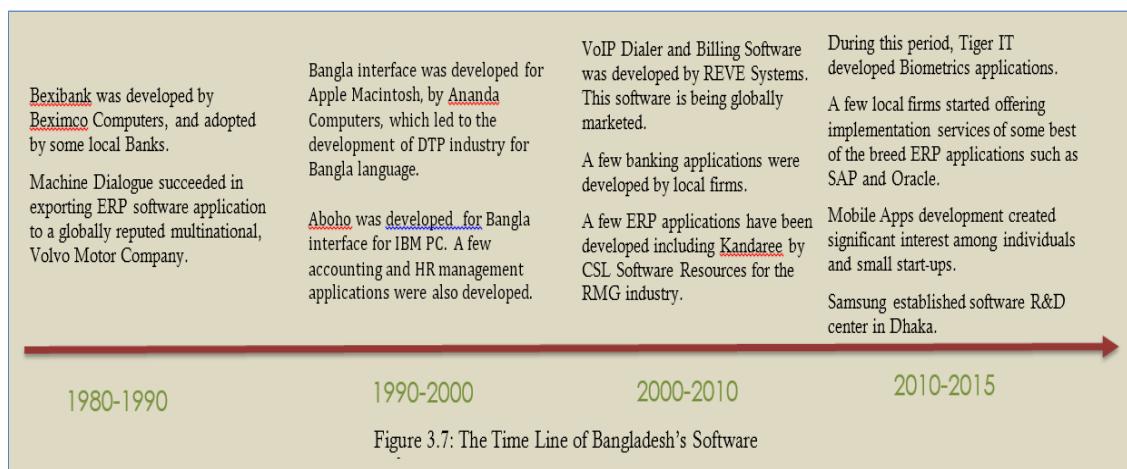
Data source: Field Survey

Despite certain degree of linkages with academic institutions, overall satisfaction about R&D supports received from academic institutions is very low, 59 firms reported to be extremely low as shown in Fig.3.6. Among three major link institutions, training institutions are rated to best performer; 55 firms have expressed average level of satisfaction. On the other hand, more than 50% responding firms have expressed dissatisfaction about services available from consulting houses to support the growth of software industry in Bangladesh. Although role of R&D is critical to the growth of software firms, there appears to be strong dissatisfaction about prevailing support level from this key component of the ecosystem; as high as 59 firms have expressed strong dissatisfaction.

Software firms are also receiving services from Law firms and Insurance companies. More than 100 responding firms have expressed dissatisfaction about services received from insurance and law firms to address their requirement. In general, there appears to be low linkage between software firms and key components of the local ecosystem supporting the growth of software firms.

3.4 Brief History of the Software Industry of Bangladesh

A brief history of software development by local companies, over last more than 3 decades, is briefly summarized in Fig. 3.7. During 80's, Beximco Computer's started developing software applications targeting the automation need of local banking industry. As part of this initiative, this company developed a branch banking software application named BexiBank. A number of branches of local banks adopted this application. As early as 1986, a UK-trained non-resident Bangladeshi computer scientist set up a firm, Machine Dialogue, to develop business applications for export market. Machine Dialogue succeeded in exporting ERP software application to a globally reputed multinational, Volvo Motor Company. Sudden departure of core development team for US led to the folding of the company.



Due to rapid adoption of personal computers in early 1990's, both Apple and IBP PC brands, by growing number of public and private enterprises, the use of Bangla in computers started drawing interest in Bangladesh. The development of Bangla Fonts, keyboard design and user interface by Ananda Computers led to the development of Desktop publishing industry around Apple Macintosh Computer. For IBM PC, Bangla keyboard interface and Fonts were developed and commercialized using Aboho brand. During the period of 1990-2000, a number of enterprise applications were developed, primarily for Accounting, Human resource management and Inventory.

Following the footstep of Machine dialogues, individual Bangladeshis also started leveraging their overseas contacts to begin the export of software development services in western countries. In course of time, export of IT enabled services (ITES) added to this initial software service export trend. Using this strategy, almost 200 indigenous software and ITES companies have organically grown over last three decades with export track records—although sporadic in most of the cases. These companies are also active in the local market. Over the years, these companies suffered from a number of limitations including discontinuous flow of export work orders, high cost of business development,

and rapid employee turnover. Extremely small size of work orders, in the order of US\$5,000 to US\$10,000--offered by also overseas small companies, made it very difficult for these companies to generate growing revenue-- with acceptable profit to revenue ratio—to meet financial obligations. During 2000-2010, notable examples are Tiger IT and REVE Systems. REVE systems has established itself as market leader in VoIP dialer segment for supporting voice calls over IP network. Tiger IT is another example of success story. Biometrics solution of this company has been highly rated by American's National Institute of Standard and Testing. The development of ERP software application named Kandaree has made CSL Software Resources market leader in the RMG industry vertical. Despite limited R&D facility, weak risk capital financing capacity, and virtually non-existence of lead users in Bangladesh, the success stories of these and other indigenous software application companies are testimonies of creative capability of Bangladeshi IT professionals. The struggle of organically growing local companies started to draw the attention of foreign firms and individuals to exploit the latent potential of Bangladeshi youths. Initially to support the software development, investments were made to develop captive facilities, either as joint venture and full ownership, primarily to export coding and testing services to support the software development work of overseas parent companies. Matatitude, captive facility of a Dutch company, was the first European facility in Bangladesh. Sponsors of these captive facilities were mostly small companies, and none of them experienced sustained exponential growth over last 20 years. As a result, these captive facilities did not grow beyond the size of 30 to 40 people.

Upon being impressed with resilience and perspiration of Bangladeshi youths in acquiring software development competence, Samsung opened the software research and development center in Dhaka. Over a span of less than 3 years, Samsung's Dhaka R&D center has grown as strong team of 600 professionals in its global network of R&D facilities.

From the very beginning, prospects of software industry drew attention of the nation. High level task force, headed by the Prime Minister, was formed to address major issues. For increasing the presence in the international market, Government and Donors supported participation in numerous trade shows. Even, a marketing office was opened in Silicon Valley of USA. More than 100 public and private universities started to offer CSE/CSE programs to address HR issues. At one point, extensive industry focused training programs were offered by Indian Institutions; NIIT and Aptech were notable. Soft financing windows, including EEF, were opened by the Banking system to address financing limitations of the industry. Bangladesh Computer Council was also established to support the growth of the software industry. Taxes on computer HW were waived with the objective to reduce the cost of capital expenditure for software firms to grow. A number of software companies were assisted by Donor funds to obtain CMMI and ISO certification. Recently, BDT 5,390 million (USD70 million) loan has been taken for the purpose of stimulating, primarily through training, the growth of software industry in Bangladesh.

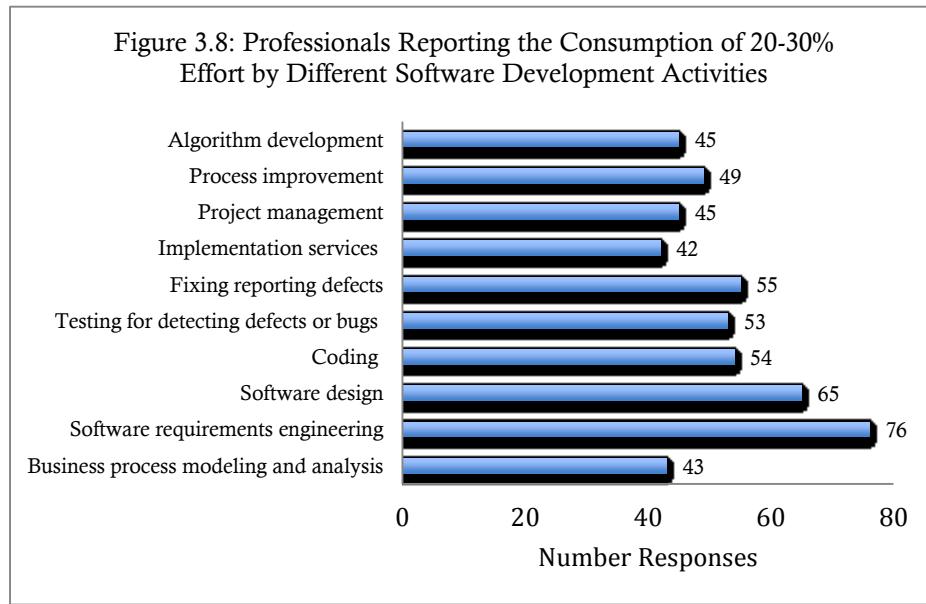
1. Business process modeling and analysis
2. Software requirements engineering
3. Software design
4. Coding
5. Testing for detecting defects or bugs
6. Fixing reported defects

7. Implementation services
8. Project management
9. Process improvement

3.5 Technical Value chain of The Local Software Industry

According to provided data by responding 269 software professionals, it appears that Bangladeshi software companies have activities across all segments of the technical value chain of software development as shown below.

Fixing reported defects also consumes significant resources, 4 respondents have mentioned that entire efforts of companies known to them go for fixing reporting defects. It's also interesting to note that companies are also spending effort on business process modeling, analysis and improvement. Among all these technical activities, testing and bug fixing (both during the development and after delivery) consume lion share of effort of software developers—more than 50% reported by almost 100 software professionals as shown in Fig. 3.8. Coding appears to be the next most effort consuming activity in the industry, followed by software requirements engineering. Almost 50 software professionals reported that almost more than 50% efforts in their known companies is spent for business process modeling and analysis; this is particularly significant in delivering software implementation services. It has been reported before that software implementation service has become important source of revenue for software companies. Basically, customization and integration of generic production solution to customers' business require significant amount of process modeling and analysis effort.



Data source: Field Survey

It appears that algorithm development engagement of local software firms is low. This may be attributed to generic application development focus on automating business processes.

3.6 Volatility Analysis of Life Cycle of Software Firms

It has been gathered that starting software firms is very easy, almost every key informant has mentioned it. It has been gathered from BASIS that on an average, 10 to 15 new membership applications are being filed with BASIS in every month. Such monthly high rate indicates that almost more than 200 new firms are being started in each year. Most of these software firms are started by either fresh graduates or professionals having limited experience with the understanding that technical competence and access to a few customers requiring customized solutions are not good enough to develop software firms.

In most of the cases, entrepreneurs start their journey with generic technology competence and access to a few customers. Initial seed capital primarily supports procurement of computers, furniture, and renting office space. With the necessity of meeting monthly financial requirements, mostly they take the strategy of providing software engineering services such as coding or testing to foreign clients or customized generic small application development—mostly related to web site development or small enterprise application development.

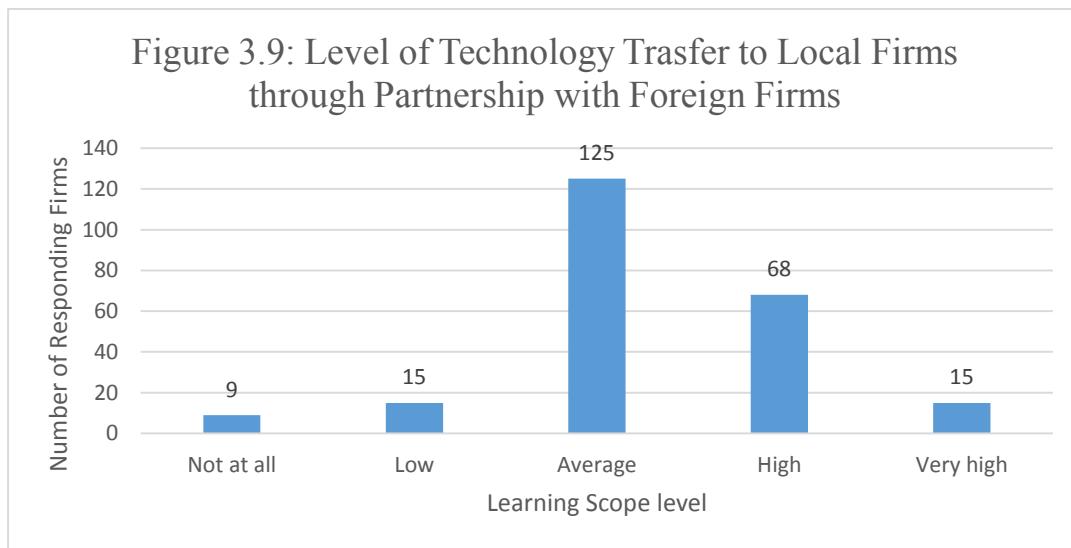
Over the years, these companies suffered from a number of limitations including discontinuous flow of export work orders, high cost of business development, and rapid employee turnover. Extremely small size of work orders, in the order of US\$5,000 to US\$10,000--offered by overseas as well local clients-- make it very difficult for these companies to generate growing revenue-- with acceptable profit to revenue ratio—to meet financial obligations. Moreover, poor response of financial institutions to address cash flow discontinuity, originated from irregular order flow, often time forced these companies to pursue the practice of project based hiring. This HR approach significantly erodes employee loyalty, in a society where job security is very much valued. Such recruitment practice coupled with weak financial situation contributed to loss of experienced people resulting in loss of precious tacit knowledge. As a result, most of these companies fail to generate high volume work orders from high paying mid to large customers to support consistent growth of revenue and profit to revenue ratio.

The starting of the journey with the support of little love money eventually leads to the strategy of profit based financing to develop Software Company. The success in developing Software Company largely depends on reusable asset development to provide performance improvement solutions to target industry. The challenge of dealing with technology complexity, acquiring domain expertise and supporting multiple failed attempts in developing successful applications eventually stresses the financial and intellectual limits of young entrepreneurs- which results in early death within 3-5 years of birth. As a result, despite high start-up rate, Bangladesh has not become successful to have more than dozen reasonable sustainable software companies, over last 30 years of entrepreneurial journey. In addition to limitations to access to finance, it has been reported by some professionals that lack of knowledge in the area of software production economics and product line architecture, very often management fails to develop sustainable growth capacity in these start-ups. As a result, after crossing the infancy period, most of the software firms start expanding business in other areas to address stagnation. In course of time, focus on software business gets further diluted. Weakness in management, investment capability and non-favorable client's procurement practices lead to no growth of software business within 5 to 10 years of operation—for most of the software firms.

3.7 Software Industry Related Policies and their Implications

Overall, there appears to be satisfaction about public policies extended towards software industry. But analysis of some specific policies indicates mixed findings.

Particularly there appears to be strong dissatisfaction about public procurement practices. It has been reported that public procurement practices are not in favor of creating local capacity for delivering globally competitive software solutions. Due to weakness in public policy, partnership with foreign firms is neither facilitating technology transfer to local Firms nor enabling local Firms to penetrate foreign markets. In bidding for public sector projects, as local firms are perceived to be much weaker in comparison to foreign firms, so there should have been very high technology transfer in each engagement. But respondents have reported such partnerships to support public procurement is merely transferring average level technical know-how as shown in Fig.3.9.



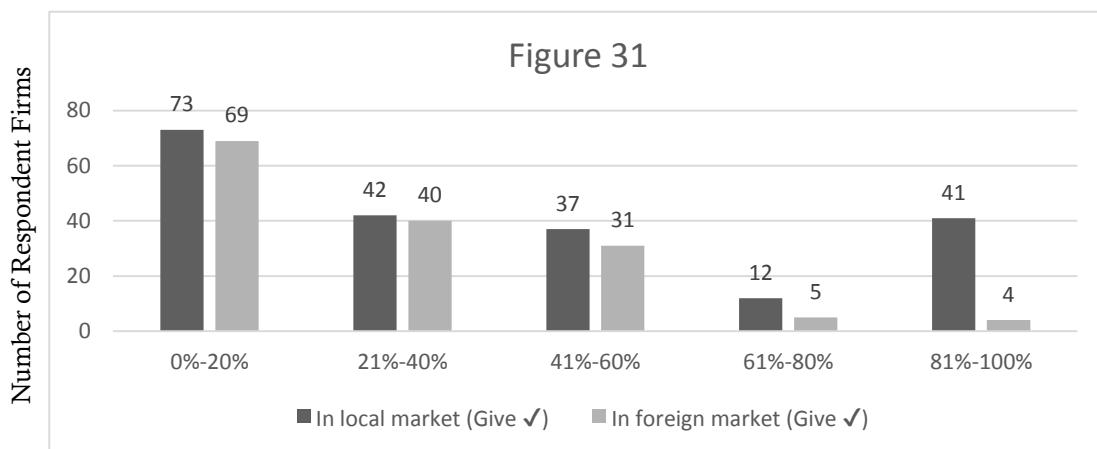
Data source: Field Survey

According to data as shown in the Fig. 3.10, engagement in public procurement is not increasing their capability to support significant business expansion, both in local and foreign markets.

It has been referred that instead of having a long term strategy of public procurement conducive to the growth of capacity of local firms to deliver high end solutions, the policy of purchasing of state-of-the-art finished products is preparing Bangladesh's software market for foreign companies. It has been reported that all public policies, including public procurement policy should be made industry growth friendly.

The policy of private corporations of purchasing readily available finished solutions is also placing local software firms in disadvantageous position. There should have been strong partnership between the software industry and different local industries for consistently improving competitiveness through innovative software. Such partnership could have been facilitated by relevant industry policies. It has been learned that ministry of Industry has not looked into software as strategic tool for improving the competitiveness of different industries such as Tea, Leather, RMG, Textile, etc.

Figure 3.10: New Projects due to Reference to Delivery of Public Sector Projects



Data source: Field Survey

In the industrial policy of 2010¹², role of ICT has been categorized as 1. ICT as a sector to create employment and generate revenue from export, and 2. ICT as a cross cutting issue to support the growth of other sectors. From the review of the policy, it appears that role of ICT has been primarily focused on communication, knowledge management and automating supporting functional arrears such as accounting, payroll, and commerce. It seems that broader role of ICT, particularly software, could be included as a strategic tool for improving productivity, value addition, and quality of outputs of each sector. Clarification of such possibility and role of policy in two example sectors are given below:

Textile Sector: The fabric wastage and presence of undetected defects in finished products are serious concerns---from both quality, productivity and cost perspectives. It appears that almost 10% finished fabric is wasted in the readymade garments industry of Bangladesh. One of the main reasons of presence of undetected defects, at different stages of production such as spinning, weaving, and finishing, is the limitation of human based inspection system. In Bangladesh, human based visual inspection is the primary means of detecting all possible defects, which might originate at different stages of production. For a number of reasons, including speed and fatigue, human inspection system can, at best, detect 70% of defects. Although, certain automated machineries are available for such inspection task, but both cost and varying factory environments limit their usages. The engagement of local software firms in developing solution for this task may lead to significant reduction of fabric wastage in our readymade garments industry. Such reduction of wastage will lead to higher quality, lower rework, higher productivity and lower cost.

Agricultural Sector: The codification of field level tacit knowledge and sharing it within farming community has the potential to reduce Yield gap—which appears to be 30% now. 10% reduction of such yield gap may lead to additional BDT 154 Billion (USD2 billion) worth of output—resulting in more than 1% GDP growth and increased income for 15 million farming families.

The policy of purchasing finished software solutions to automate functional areas such as accounting or payroll fail to unlock such growth potential. The software innovation is at the core of deducing such solutions. The local context is very important—plot level

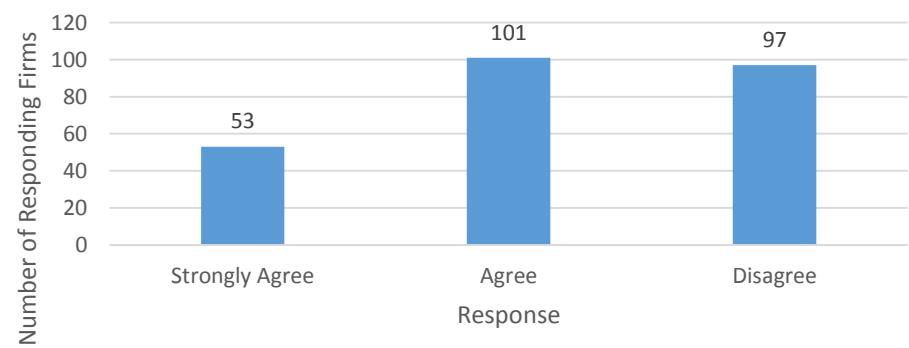
¹² Government of the People's Republic of Bangladesh, National Industrial Policy, 2010

knowledge, which is being generated in every season should be codified and shared. Software solution for such codification will have strong local context. On the other hand, diffusion of incremental automated inspection system as a complement to human capability should be given due consideration to make it a viable better alternative in the RMG sector. The policy of procuring finished solution does not allow such potential to be exploited—to the fullest. Such software innovations requires years of R&D, which local software companies cannot afford to finance. Industrial policy could be amended to address this capacity gap of local software firms to help the nation to create new wealth in different wealth creation sectors of the nation. It may be useful to have policy option to manage and finance such innovations, so that local software firms in partnerships with academic institutions and concerned industry partners can exploit such value addition opportunity with software.

3.8 Major Related Development Projects and their Implications on the Software Industry

Professionals employed in the software industry indicated that employers do not provide adequate training opportunity as shown in the following Fig. 3.11. On the other hand, strong dissatisfaction has been expressed by employers that weakness in supply of skilled labor force is one of the main impediments to the growth of the software industry in Bangladesh. It appears that LICT project, being implemented by BCC, and skill development project being implemented by BASIS with the support of ADB are going to address this knowledge and skill gap. BASIS and BCC are expected to train more than 50,000 IT professionals within next 5 years. It has also been mentioned that most of these programs are offering generic technical training, but industry needs high end professionals, who are specialized in certain areas. There should be development projects to attract, grow and retain such competences for the industry. Moreover, the role of HR should be dealt with by academic and training institutions. Although government has taken projects for High-Tech Park and software technology park development, but there appears to be dissatisfaction about these initiatives. Slow speed of execution and inappropriate locations are among main concerns. It has been reported that within next year or so there should be software Technology Park within Dhaka city, so that foreign investors can start piloting their operations in Bangladesh.

Figure 3.11 Employer does not provide adequate training and learning scope



Data source: Field Survey

Satisfaction has been expressed about Internet connectivity due to rapid fall of wholesale bandwidth price, which is reducing the Internet bill for software companies. The progress

in SE-ME-WE-5 is also welcoming development in this regard. But, high end user level Internet price, particularly mobile, is limiting the proliferation of connectivity based applications. It appears that demand led investment in transmission network is limiting the expansion of affordable data connectivity services across the country. There is a sense of urgency that Government should undertake development projects to stimulate private investment to expand transmission network, so that access network expands rapidly to ease the impediment of end user level data services.

Although public sponsored EEF was developed as the source of risk capital, but it has become source of such finance to only a limited number of firms as shown in the following Table 3.5:

Table 3.5: Source of Finance for Software Firms

Portion of total finance	(Frequency of Responding Firms)					
	Bank Loan	Personal money	Retained income	EEF*	Private Investors	Venture capital fund
5%-15%	68	35	5	1	1	6
16%-25%	29	18				1
26%-40%	23	6	4			
41%-50%	13	9	2		4	1
50% +	5	96	22	5	44	2

Data source: Field Survey

* Information on companies list operating in Bangladesh associated with EEF is attached with in the Appendix-6

3.9 Political Support

From different key informants, it has been learned that political aspiration of the current government to have significant socio-economic gain through ICT is going to play very strong positive role in next five years. Particularly, government's intension of offering most or may be all public service through ICT, within 2030, has the potential to create significant market for the local software industry—provided public procurement practices are made friendly to local firms.

From Digital Bangladesh initiative as outlined in the SPDB, growing expectations are riding due to continued expansion of the digital economy across the globe, particularly in G20 and emerging countries, to meet Bangladesh's GDP growth target of 8 per cent in 2015 and 10 per cent in 2021, as set in the Perspective Plan (2010-2012).

In its 2008 election manifesto, "Vision 2021 Bangladesh: A New Horizon," the incumbent government introduced the concept of "Digital Bangladesh," a mirror reflection of the *Information Society* vision, advocated by the "World Summit on Information Society" (WSIS). A White Paper by KPMG titled, *Bangladesh Beckons*, observed that the "'Digital Bangladesh' initiative of the government is helping setup infrastructure for enhanced connectivity, ICT based citizen service delivery, and ICT based Education and Healthcare service delivery system.

In implementing the political aspiration of Digital Bangladesh Vision, local software industry is considered vital partner. For this reason, Government has extended cooperation towards the industry along with the theme of PPP—co-hosting of Digital World in partnership with BASIS is an example of such approach.

3.10 Investment Profile and FDI

Investment in the sector is primarily driven by small amount of personal money resulting in small investment as shown in Table 3.6. In most of the cases, per firm investment per year is less than 50 lacs, or less than BDT 5,390 Thousand (USD 70,000). More than 100 firms have mentioned Bank loan as main source of finance. In Bangladesh, Banks primarily provide working capital finance. Such low investment capability appears to be one of the causes of slow growth and/or high mortality rate of software firms in Bangladesh. As it has been mentioned, significant upfront investment is required to understand business processes of target industry and/or application area to develop reusable asset base and demonstrate utility of proposed solution.

Moreover, total cost of development should be spread over many customers, who will be adopting the solution over a span of 5 to 10 years. Without the support of needed investment, companies fail to capitalize the strategy of low cost through reusability of common software assets. As a result, price cannot not be reduced to a level to make it affordable to large number of customers.

It has been learned from key informants that FDI in the software sector is very low. One of the largest FDI in the history of Bangladesh's software industry is Samsung's Software R&D center. It has been learned that this R&D center has been shrinking. Another major development is the acquisition of 49% shares of GP IT by Accenture. From insiders, it has been learned that expansion of this facility will likely be in the area of delivering business process management services, instead of focusing on software development.

It has been learned that a limited number of captive software development facilities have been set up with small investment. Although investors from different countries such as Sweden, Japan and Korea are making inquiries about the prospects of setting up software development facility in Bangladesh, but lack of special purpose facility like Software Technology Park is deterring decision making in favor of such facilities.

Ownership Distribution: According to data provided by respondents, it appears that ownership of software firms, located in Bangladesh, is mostly to local entrepreneurs, as shown in Table 3.7. Among responding 253 firms, as high as 186 software firms (73%) are fully owned by Bangladeshis. Only 2 responding firms have mentioned that they are fully owned by foreign shareholders.

Such high density of local ownership distribution indicates that there is strong homegrown entrepreneurial drives. Such entrepreneurial spirits should be scaled up to exploit the growth potential of wealth as well as high paying job creation out of software innovations.

Table 3.6: Investment Made by Responding Companies

Investment	(Frequency of Responding Firms)				
	2010	2011	2012	2013	2014
less than 1 lac-10 lac	155	6	5	3	1
11-25 lac	72	16	17	13	9
26-50 lac	45	14	12	17	8
51-80 lac	11	3	10	4	10
81-90 lac	10	1	2	9	6
90-99 lac	3	2	3		6
1- 5 crore	10	1	1	6	4
6-10 Crore	3			1	
10 crore +	2		1		

Data source: Field Survey

Table 3.6a: Investment Made by Responding Companies

Investment	2010	2011	2012	2013	2014
less than 1 lac-10 lac	6.68%	0.29%	0.24%	0.15%	0.05%
11-25 lac	3.10%	0.78%	0.82%	0.63%	0.44%
26-50 lac	2.24%	0.70%	0.60%	0.84%	0.40%
51-80 lac	0.47%	0.15%	0.48%	0.19%	0.49%
81-90 lac	0.43%	0.05%	0.10%	0.44%	0.29%
90-99 lac	0.13%	0.10%	0.15%	0.00%	0.29%
1- 5 crore	0.43%	0.05%	0.05%	0.29%	0.19%
6-10 Crore	0.13%	0.00%	0.00%	0.05%	0.00%
10 crore +	0.09%	0.00%	0.05%	0.00%	0.00%

Data source: Field Survey

Table 3.7: Ownership Distribution: Between Local and Foreign Partners

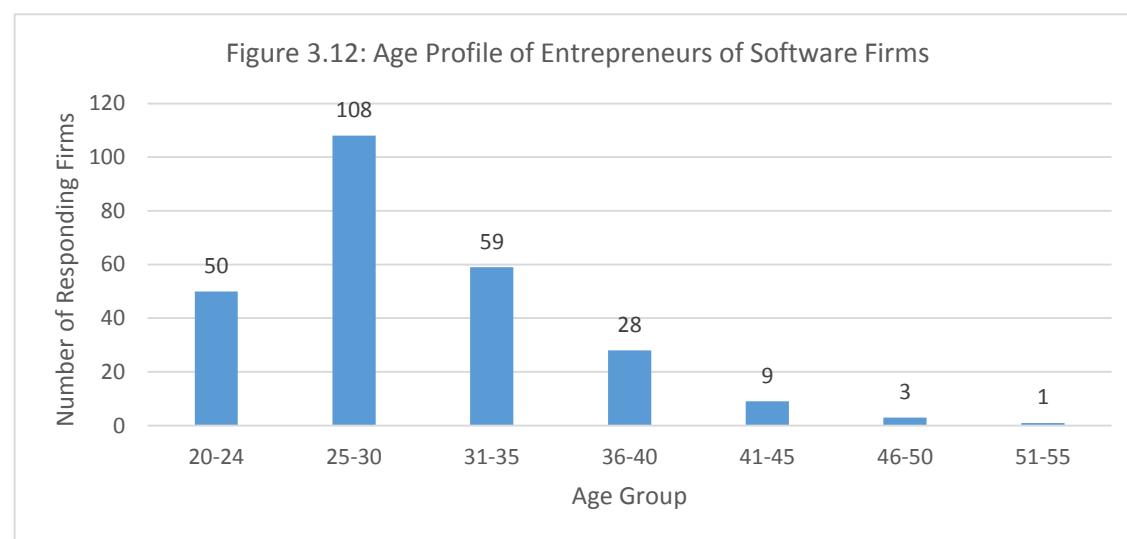
Local in %	Frequency of Response	Foreign in %	Frequency of Response
5	1	10	18
10	1	14	1
30	3	20	16
50	13	25	1
60	4	30	8
65	1	35	1
70	8	40	4
75	1	50	12
80	16	70	2
86	1	95	1
90	18	100	2
100	186		

Data source: Field Survey

On the other hand, foreign equity participation in as high as 66 firms indicates that these local firms are connected to the global value chain of the software industry. The scaling up benefit in operation of these firms will likely lead to rapid expansion in global market. Therefore, such early stage linkage should be scaled up for rapid expansion of the sector.

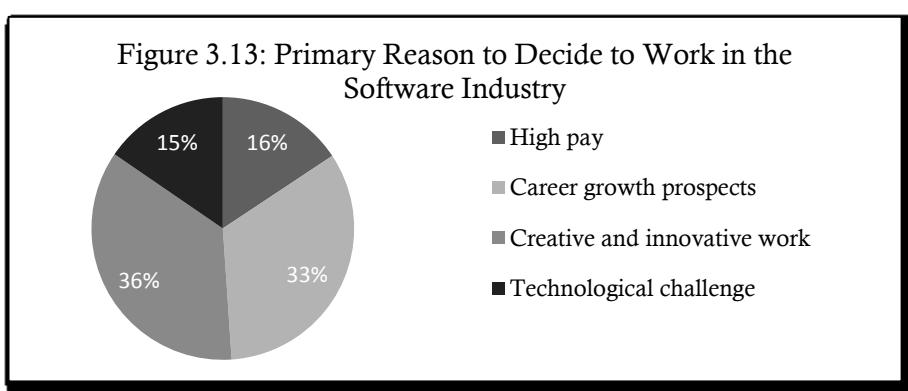
3.11 Demographic Profile of the Software Industry

It has been learned from Key informants that young professionals dominate software industry in Bangladesh. Just after graduation, fresh graduates enter the industry, and upon having few years of experience they leave the industry-may be the country. Among professionals, only 17% are female. Moreover, entrepreneurs in charge of developing software firms also started the journey at very early stage; age of entrepreneurs at the starting of more than 150 firms was less than 30 years as shown in Fig.3.12. Remaining less than 90 firms were started by Entrepreneurs of the age bracket 31-40, and only a dozen or so firms were started by Entrepreneurs in their middle age.



Data source: Field Survey

Most of the professionals have experience of less than 05 years as shown in Table 3.8. It appears that the High pay is the least important reason for job seekers to work in this industry. Career growth prospects, and creative as well as innovative work are most dominant reasons to 36% and 33% respondents respectively as shown in Fig.3.13. Such attitude is very much in line with the youth as well as male population.



Data source: Field Survey

Table 3.8: Age Profile of Professionals Working in the Software Sector

Length of Experience	Percentage of employees (Frequency of Responding Firms)							
	<10	10-15	15-20	20-25	25-30	30-40	40-50	>50
<3 months	33	14	7	1	1	3	1	7
3-6 months	26	18	17	7	7	3	2	1
7 months to 1 year	16	19	18	34	34	27	15	22
1-5 years	18	11	6	10	10	25	25	111
6-10 years	50	21	18	6	6	7	2	7
11-15 years	22	5	3	1	1			1
15-20 years	11	1						1
20+ years	2							1

Data source: Field Survey

As it is expected, the entrepreneurial landscape of the software industry in Bangladesh, as shown in Fig. 3.12, is dominated by youths, as high as 158 entrepreneurs started software ventures before crossing the age limit of 30. Unfortunately, most of these ventures are basically caught at very early saturation point. It is also important to note that the 2nd main reason for professionals to enter the software industry is about pursuing highly prospective career growth paths. It appears that most of the professionals in the sector are very young, average experience is below 5 years. The scope of doing creative and innovative work is the most important reason for these youths to enter in the sector.

It has been found that key intervention in the creative industries such software relates to institutions and organizations. Weak institutional linkage, shown in Fig.3.5, indicates that these entrepreneurs and professionals are working within the software industry of Bangladesh as individuals, but not as members of a larger group, sector or even a network. This leads to isolation and weak economic performance, whereas collaboration, even across genres, could tremendously increase the success rates of these young entrepreneurs and professionals alike. The participation of youth entrepreneurship in the software sector represents a viable but insufficiently explored development policy and programmatic option to deal with the challenges of youth unemployment through employment creation by young people.

The failure of the mainstream economic and financial systems and the exit of the “old guards” coincide with the meritocratic rise of creative minds whose ambition, drive and imagination readily exceed the expectations set for them on their paths by traditional business and institutions—who often participate as angel investors or debt financers to create dragging effect on the growth of the sector. Schumpeter’s idea of “creative destruction” resonates behind the growth of creative entrepreneurship and the major innovations and paradigm changes that we need to nurture around such youth entrepreneurship in the software sector.

Chapter 4: Market Analysis

4.1 Market Segments

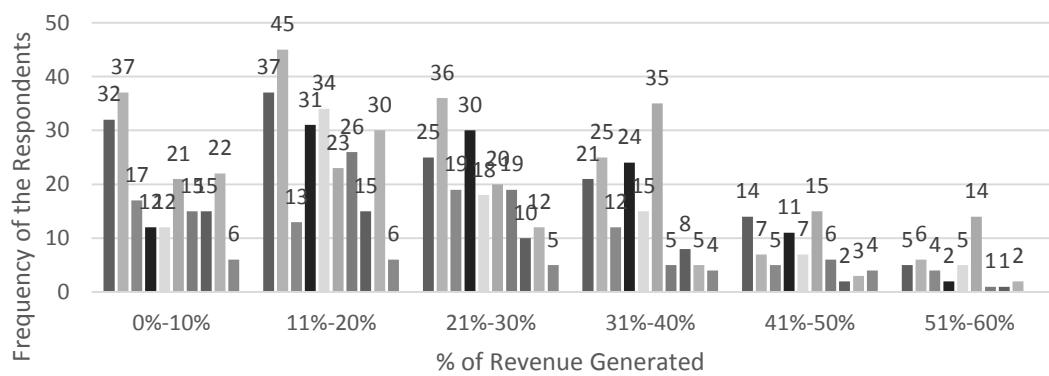
Major economic sectors of the nation are the primary customers of products and services produced by the software industry of Bangladesh, as shown in the Table 4.1. Although Government has very high commitment to the software sector and also has very high potential to be software users, but still to date, e-Government has not become the largest customer for the software industry yet (Table 4.1) The study indicates that revenue generated by the Government as a whole is much smaller than that produced by even a single private sector, such as Garments or Textile.

Table 4.1: Contribution to of Different Sectors to Total Revenue from Software and Services

Market Segments	% of revenue generated from different industry verticals (Frequency of Responding Firms)									
	0%-10%	11%-20%	21%-30%	31%-40%	41%-50%	51%-60%	61%-70%	71%-80%	81%-90%	91%-100%
Garments	32	37	25	21	14	5	1	3	1	1
Textiles	37	45	36	25	7	6	2	1		
Pharmaceuticals	17	13	19	12	5	4				
Banking and Finance	12	31	30	24	11	2	6	2	1	1
Insurance	12	34	18	15	7	5	1	1	2	
Telecom	21	23	20	35	15	14	8	1	3	3
Real states	15	26	19	5	6	1	1	2		1
Hospitals	15	15	10	8	2	1			2	1
e-Government	22	30	12	5	3	2		2	1	
Others: Please mention	6	6	5	4	4		2	3	3	10

Data source: Field Survey

Figure 4.1:Contribution to of Different Sectors to Total Revenue from Software and Services



Data source: Field Survey

In the private sector, Garments and Telecom appear to be very prominent market segments for the outputs of the software industry—Telecom alone generates revenue for more than 140 firms. According to key informants of the industry, although Banking and Finance is the largest consumer for software and services, but local software firms have little market

share. Despite the early success of BexiBank, over the years the software market in the Banking sector has been taken over by foreign companies, who do not have any development activity within Bangladesh. Only one Firm has reported more than 90% revenue generation from the Banking sector. Based on data of software professionals employed by Standard Chartered Bank in its development centers in India, Malaysia, and China—almost 4,000 professionals in these three development centers-- it appears that Banking sector alone could have been the revenue source of almost 50% of total revenue of the software industry of Bangladesh. It has been mentioned by a number of key informants that measures should be taken for empowering local software firms to position in the Banking and Finance sector of Bangladesh.

There appears to be four major market segments for Bangladeshi software firms to operate. The overall market concentration of software Firms in Bangladesh is shown in Fig. 4.2 It seems that most of the firms are in service focus. It's also understood from responses that a single firm earns revenue from multiple market segments such as 1. Software product, 2. Software implementation services, and 3. Project based customized application delivery.

The Inner Most Market Segment: From the knowledge of history of growth of software firms, the likely entry point of domestic software firm is at innermost circle of four concentric market segments: Project based delivery of customized applications to local clients as shown in Fig.4.2. At this market segment, entry barrier is low: as low as requirement of couple computers, a few programmers and contacts to some potential customers. Even a freelancer enters in this market segment. The cost of acquiring customized software through such project based approach is extremely high. In an economy like Bangladesh, only a limited number of private enterprises and Government institutions have adequate budget for such solutions. Moreover, the complexity of managing contract and ensuring quality delivery makes it quite professionally challenging for clients. Due to asymmetric information about delivery competence of competing firms and large variation of quoted price (as high as 1000%), clients prefer to choose the Firm quoting the least cost. In most of the cases, least cost bidder is neither technically competent, nor is able to cover cost of delivery with quoted price. As a result, even after winning the bid, either the winning company ends up in losing money, or generating bad reputation for poor delivery. Such high degree of concentration of firms in this market segment, cost based pricing, price based competition as well as selection strategy, asymmetric information of delivery capability of competing firms, and limited capability of clients to manage acquisition are primary causes of very slow growth of this market segment.

The Software Product Market in the Domestic Market: A relatively small number of firms, 82 responding firms, are generating revenue from the sale of their own products. Moreover, only 22 of them are generating more than 50% revenue from product sale; to only 05 firms as shown in Table 4.2, product appears to be the primary source of revenue. Such responses indicate that software firms in Bangladesh have not had much progress to take the benefit of economy of scale by migrating from project based business model to product. In product based business model, the economy of scale is very high, as the cost of replication of software products virtually zero. Due to very low marginal cost of production of software product, per unit cost of products rapid decreases with the growth of customer base. For a country like Bangladesh, the price appears to be significant barrier to market expansion. Migration of software firms to product based delivery model has the

potential to increase significant economic gain from software consumption as well as production. It's worth to note that the largest market for software in Bangladesh appears to be the software embedded in Smartphones. The software component of many Smartphones cost as much as 30% of the price charged to end-users; 1.6 million units were sold in Bangladesh in July-September period of 2014 alone (Source KII). It seems that software Firms in Bangladesh should look into the opportunity to develop products around Smartphone based access devices and cloud based backend to reach to large number customers to deliver value created by high quality innovative software solutions. The development cost of such software innovations will likely be very high, but due to the scope of high economy of scale resulting from potentially large number of clients, per unit price will be likely very low. It appears that policy changes of the Government to ease the process of compliance of regulation with the support of Software have also the potential of expanding domestic software product market at rapid space. The scope of scale to benefit from virtually zero cost of reuse is the key to succeed in software business. It happens to be the reality that software companies in Bangladesh are failing to benefit from such unique characteristics of the software based wealth creation business.

Global Software Engineering Service Market: There are many reports to suggest that the global offshorable software engineering service market is very high. India's large scale success in this market segment of the global software industry is well cited. Driven by two large clients, GE and City Group, Nasscom predicted software exports (mostly service though) in 2014-15 would rise to as much as \$99 billion, from about \$86 billion for this fiscal year ending March¹³.

In Bangladesh, as high as 185 companies are active in this market segment, but only 3 of them generated more than BDT5 crore revenue from this segment. It appears that these companies are primarily working with small work orders, which are likely generating from small companies of advanced nations. It has been learned that some of these companies are even bidding projects on the on-line market place, commonly known as freelancing market. Usually, both business development and delivery costs are high for small projects. The scope of economy of scale of benefit is very low in such small projects. The generation of large projects of similar nature (such as technology migration) from selected number of clients usually provides the scope to benefit from reuse of both tacit and explicit knowledge. The entry in foreign market with small clients should rapidly progress towards the generation of similar large projects from selected clients to develop scalable growth model. Although Bangladeshi firms have developed track record to more than dozen of countries as shown in Fig. 4.3, but it seems that over the last 30 years, none of Bangladesh software firm has made success in generating consistently large projects from selected global customers.

Global Software Product Market: The success of Microsoft in developing global market for its Office Suite is a popular success model for the software industry. As a matter of fact, developing the product and commercializing all across the globe is highly rewarding as well as challenging. So far, only one company, REVE Systems, has made some progress from Bangladesh to develop and commercialize product for the global market. According

¹³ <http://www.livemint.com/Industry/BrMXBnGtIewsRoN99KqKCM/IT-sector-exports-to-grow-1315-in-FY15-Nasscom.html>

to Garner¹⁴, Worldwide packaged software revenue in the enterprise segment totaled \$407.3 billion in 2013, a 4.8 percent increase from 2012 revenue of \$388.5 billion. The software which is being embedded in numerous products, such as Smartphones, or Medical Equipment, is not valued in such estimate.

Table 4.2: Distribution of Revenue over Products and Services

Breakdown	From sale of own product	Project based software development services	License revenue from sale of third party software products	Software implementation services	Software project development and management services
0%-20%	39	38	42	48	26
20%-40%	22	63	26	45	29
40%-60%	13	23	17	40	12
60%-80%	3	15	7	32	3
80%-100%	5	18	1	58	1

Data source: Field Survey

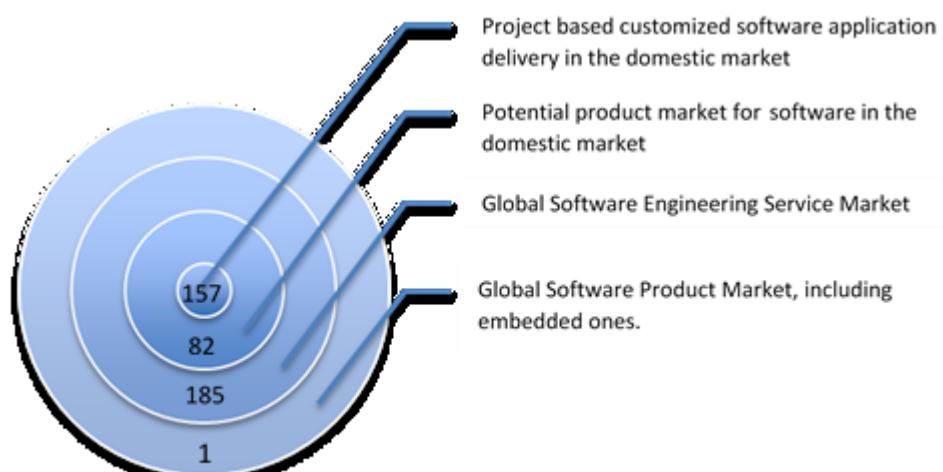


Figure 4.2: Major Market Segments for Software Engineering Services and Products

Data source: Field Survey

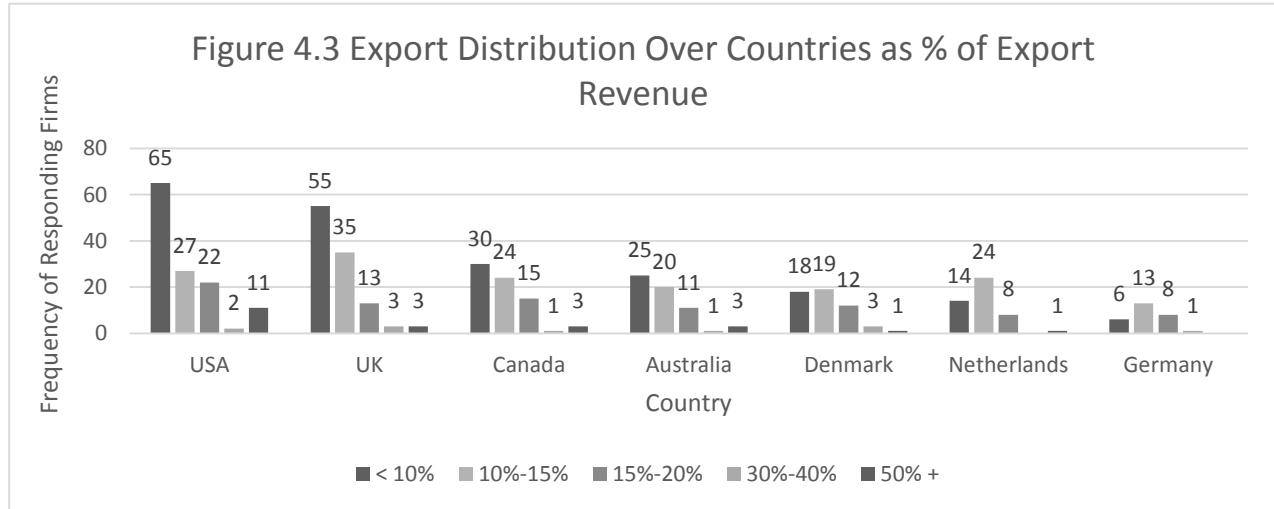
¹⁴ <http://www.gartner.com/newsroom/id/2696317>

Bangladeshi software firms are exporting software applications and software engineering services to more than dozen countries including USA, Canada, Denmark, and the Netherland as shown in Fig.4.3. Among export markets, the USA is the largest market. It has been learned that some companies have become successful in exporting software and services even in some African countries and even in India, which is known as the exporter of software engineering services.

Table 4.3: Revenue Distribution

Total Revenue (Frequency of Responding Firms)					
Revenue	2010	2011	2012	2013	2014
1-50 lakh	155	140	88	81	81
50 lakh- 1.5 crore	64	76	122	100	94
1.5 crore- 5 crore	13	16	31	56	67
5 crore+	15	15	16	21	25
Revenue from Export Market					
Revenue	2010	2011	2012	2013	2014
1-25 Lakh	120	107	69	63	63
25-50 lakh	27	38	60	54	42
50 lakh- 1.5 crore	9	14	28	44	51
1.5 crore- 5 crore	10	11	14	16	26
5 crore+	3	3	4	4	3

Data source: Field Survey



Data source: Field Survey

Analysis of Market Forces

The summary of learning from key informants regarding to factors affecting the demand side of the market is summarized below table. It has been mentioned by key informants that buyers, including the Government of Bangladesh, are not in general willing to pay for software. Prevailing perception that software should be free---lack of IPR enforcement has been partly attributed to such mindset. Despite such impression, it has been learned that if the quality is right, corporate clients are willing to pay high price.

Table 4.4: Analysis of Market Forces

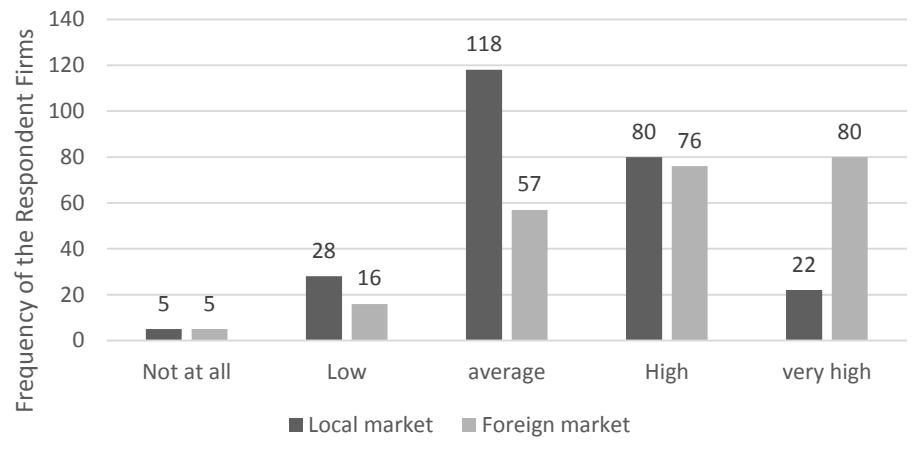
Factors	Low						High
	1	2	3	4	5	6	7
Development cost			x				
Competition among buyers to improve their business performances using better/smarter software		x					
Perceived value by buyers			x				
Prices of complementary goods	x						
Prices of comparable foreign best-of-breed products							x
Taxation level		x					
Access to finance for buyers					x		

Data source: Key Informants

If quality could be ensured, development cost, in terms of salary given to programmers, does not appear to be barrier to demand growth. Except Banking, competition among buyers to use software applications as strategic tool for improving business performance is not strong. Due to weakness in focus on improving process through software, perceived value of software among target buyers appear to be low. As a result, scope of differentiation or innovation for demanding premium price or capturing lucrative market position is low. Due to rapid reduction of price of HW, price of complementary goods and services for integrating software into work processes appears to be very low. It has been learned that prices of foreign applications as a substitute to local ones are much higher than corresponding local offering. But due to the perception of higher quality of foreign applications, certain large customers are acquiring such expensive applications. It has been mentioned that weak support in services of these foreign applications may lead to significant bad experience from software usages, which may dampen the overall market response towards software led performance improvement or growth.

From key informants, it has been learned that competition among local software firms is moderate. Moreover, there is basically no rivalry among local software firms. Such observation is also shared by survey respondents as shown in Fig. 4.4. Due to limited job opportunity and sudden increase of supply, primarily due to rapid growth of private universities, bargaining power of key supplies, HR, is very weak. As a result, software market appears to be suffering from lack of dynamism---all the forces of Porter's Diamond model appear to be weak in Bangladesh's software market.

Figure 4.4: Perceived Competition Expressed by Respondents in the Survey



Data source: Field Survey

Usually healthy competition leads to investment in both product and process innovation. Due to weak competition, companies are not aggressively investing in developing products and improving process for reducing rework and increasing reuse. As a result, both economy of scale and scope benefits are mostly unexploited by these local Software Firms. Due to limited economy of scale and scope benefit, cost of delivery is not falling, which is limiting the expansion of local market. As a result, both consumer and producer surpluses created by local software innovations is at sub-optimal level. Moreover, due to such poor economy of scale and scope benefit, companies are failing to grow to offer growing career path to professionals. Such reality is leading to departure of experienced professionals from the industry, and offering not so appealing signals to bright students to develop career in the local software industry of Bangladesh. There are a number of policy challenges, which need to be dealt with to stimulate competition for increasing the benefit from economy of scale. As a matter of fact, consistent persuasion to benefit from economy of scale is the core strength for the software industry to create the opportunity for Firms to grow and let the customers enjoy higher quality products or services at lower price.

Due to absence of effective strong competition force, software firms are pursuing the least cost bidding strategy to get new projects. As it has been explained, due to asymmetric nature of information, winning firms, very often not based on actual competence level, are not developing competitive advantage through delivery of projects.

4.2 Capacity Utilization

The main resource of software firms is human resource. Due to weak enforcement of labor law and lack of long term strategic vision, software firms in Bangladesh pursue project based recruitment, in most of the cases. As a result, resource utilization factor in most of software firms is very high, as shown in the following Table 4.4. Despite such reality, it has been learned that due to discontinuity of work orders, a portion of billable hours of professionals remains unutilized. Although billed hours produces profitable revenue, but improvement in % of billing hours could have increased the financial position of these companies. According to data shown in Table 4.5, it's encouraging to note that resource utilization factor has increased over the years.

Table 4.5: Resource or Capacity Utilization Level

Percentage of resource Utilization	Year (Frequency of Responding Firms)				
	2010	2011	2012	2013	2014
50%	66	37	24	23	21
60%	17	42	32	17	10
70%	41	47	53	35	29
80%	33	35	37	63	50
90%	33	35	48	49	67
100%	56	61	65	80	90

Data source: Field Survey

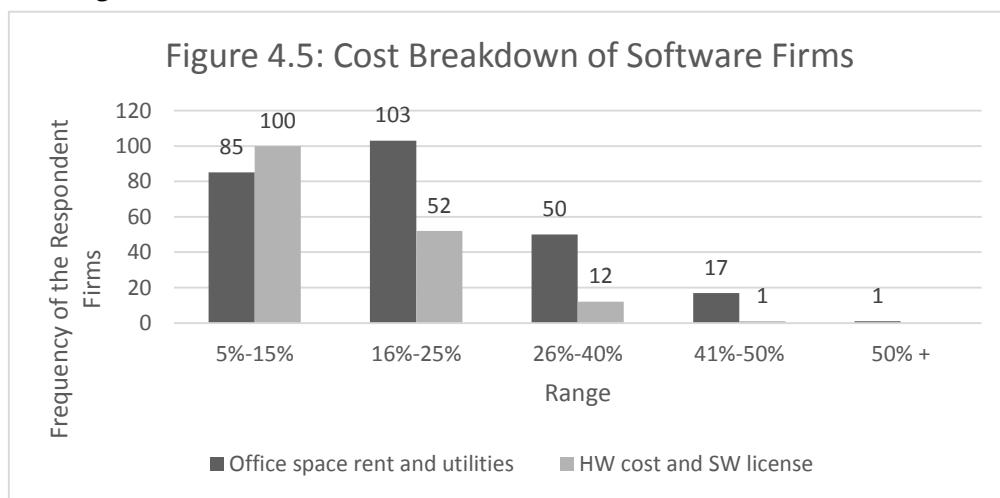
It has been reported that employed Human Resources could have been utilized better, if their skill level is improved further. Responding firms have indicated that their willingness to pay more for this improved skill as shown in Table 4.6.

Table 4.6: Willingness to Pay for Better Skill

Percentage of Current Salary	Give ✓ (Frequency of Responding Firms)
10%	55
20%	71
30%	78
40%	29
More than 50%	33

Data source: Field Survey

The pay increase scope of 30%-40% appears to be quite acceptable to large number of firms. Through such skill improvement, firms will be able to generate additional revenue without incurring costs on other production facilities such as office space, computer, utilities, etc, as shown in Fig. 4.5.



Data source: Field Survey

4.3 Market Forecasting and Volatility

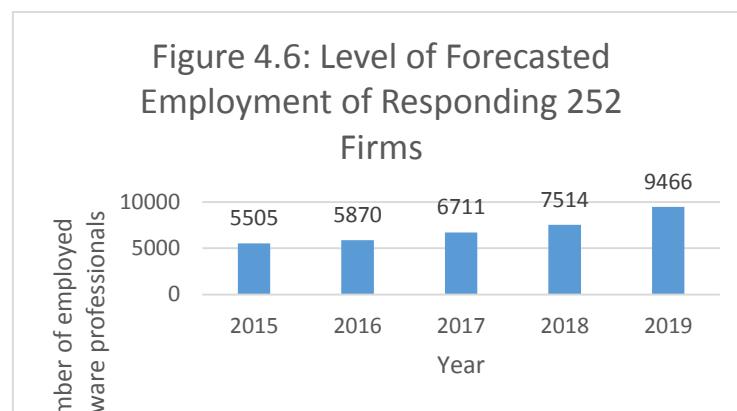
Key informants have indicated that market will expand at a higher rate than the past over next five years. Due to weak competition in the local market, there will be likely no volatility in the local market. As far as foreign market is concerned, demand is expanding and resources of existing providers such as India are being stressed. As a result, there will be likely steady growth of foreign demand of software development services delivered from Bangladesh.

There might be certain volatility in certain firms or establishment. For example, due to global restructuring, which may result from changing market position, Samsung may change strategy with respect to its software R&D center here in Dhaka. But, in general, there appears to be growing attraction among foreign firms to locate software development centers in Bangladesh. Due to China plus 1 strategy, Japanese companies may be more willing than before to invest in the software development facility in Bangladesh. The development of Software Technology Park, either by the government or private initiatives, may accelerate this relocating process.

Due to the growth in Smartphones and mobile broadband services, there could be increasing entrepreneurial activities in the segment of mobile applications. Freelancing experience may accelerate such start up initiatives. Particularly, reduction of wholesale bandwidth price (from BDT28000/Mbps in 2008 to BDT500/Mbps in 2015, source: KII) improvement in power and redundant international connectivity may contribute to this process further. Individual success in the form of freelancers may lead to entrepreneurial initiatives for developing software firms may be more common in future than past. Such trend may gather significant momentum leading to sudden growth, in both number of software firms and revenue from software.

The sudden interest of large corporations, even by the Government, has created surge in sale of license of global best of breed software applications such as Oracle and SAP. It's estimated that license sale alone will reach to BDT 154 million (USD 2 million) by the end of 2015 (Source: KII). Almost three times more revenue than the license sell will generate from implementation services. This market is totally dominated by Foreign Service providers.

Moreover, responding software firms are forecasting steady growth of employment as shown in Fig. 4.6, which is directly related to market expansion or revenue growth.

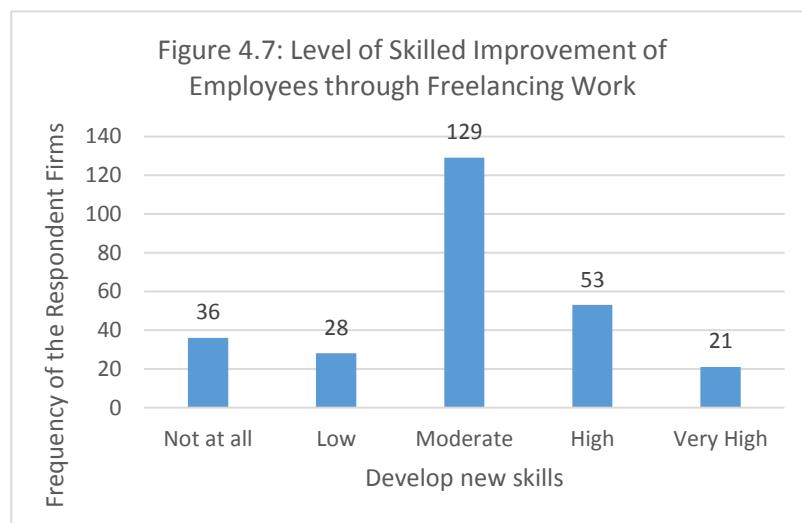


Data source: Field Survey

4.4 Implication of Freelancing

The transformation of global job market has given the opportunity to Bangladeshi youths to demonstrate their strong willingness to learn, undertake challenging assignments, and deliver on-time with hard work. Among more than 400,000 (50% YoY growth) freelancers registered in global on line market places, like Elance-oDesk, 30,000 very active professionals have shown their potentials.

Among these 30,000 active freelancers, most of them are part timers, a significant of them are students and some of them have day time full time jobs. Despite low hourly rate, these Bangladeshi have shown their commitment to learn and deliver from remote place to satisfy their western clients. During 2010 to 2014, 435,249 jobs were awarded to Bangladeshi freelancers from Elance-oDesk market place alone. In this market place, Bangladeshi freelancers contributed almost 5-7% working hours to total working hours contributed by more than 8 million freelancers from 180 countries. This is a testimony of large volume work force what Bangladesh has to offer to global human resource pool. Freelancing has mixed implications on organized Software development Firms. Employees during nighttime work on online job markets, without having adequate sleep resulting weak attention to day time regular work in software Firms. On the other hand, such work improves skill level as mentioned by responding Firms, as shown in Fig. 4.7.



Data source: Field Survey

Freelancing is also addressing some important entrepreneurial hurdles. Online market place has unlocked opportunities to address five pressing entry barriers faced by aspiring entrepreneurs in Bangladesh. These constraints are: 1. Acquiring marketable knowledge and skill, 2. Knowledge about global demands for IT products and services, 3. Access to seed capital, 4. Confidence to deliver, and 5. Reference clients (Source KII). With affordable seed capital for acquiring a computer and broadened connection, and basic skills, thousands of aspiring university graduates or students started exploring bidding opportunities for micro jobs in online market place. After facing surmountable barriers, they started becoming successful in winning bids and acquiring delivery track records. Through a series of deliveries, some of them succeeded in developing enough understanding about customers' requirements, acquiring necessary knowledge-skill, saving required seed capital from earnings, building CanDo confidence, and developing satisfying relationships with customers having capacity to give repeat work orders. Capitalizing these achievements, more than 50 high performing freelancers crossed the barrier to develop enterprise to export product and services to global market; one of them is TechnoBd. Capitalizing freelancing success, the entrepreneur has built this company

with almost 20 professionals without requiring any seed capital from family, friends or anybody else. Despite small size, this success of creating US\$10,000 per person (source: survey data calculation) value addition for global market appears to be replicable growth model to connect millions of Bangladeshi students to global job market.

4.5 Implication of Public Procurement Practices

It has been reported that the implementation of Government vision in e-Service delivery has the potential to create large market for the software industry. But there appears to be serious concerns about government's procurement practices—which are perceived to be weakly supporting the growth of local capacity. Local software firms participate in Government projects in different capacities as mentioned in the Table 4.7. Particularly in large projects, foreign firms become lead bidders to comply with bidding requirements.

Table 4.7: Modality of Participation of the Responding Firms in GoB Projects

Percentage of Projects	(Frequency of Responding Firms)			
	Worked as Lead firm	Worked as subcontractor	Foreigner firm as lead firm	Other Local firm as lead firm
0%-20%	59	58	46	42
21%-40%	41	22	23	14
41%-60%	20	6	19	13
61%-80%	18	1	1	10
81%-100%	51	3	2	11

Data source: Field Survey

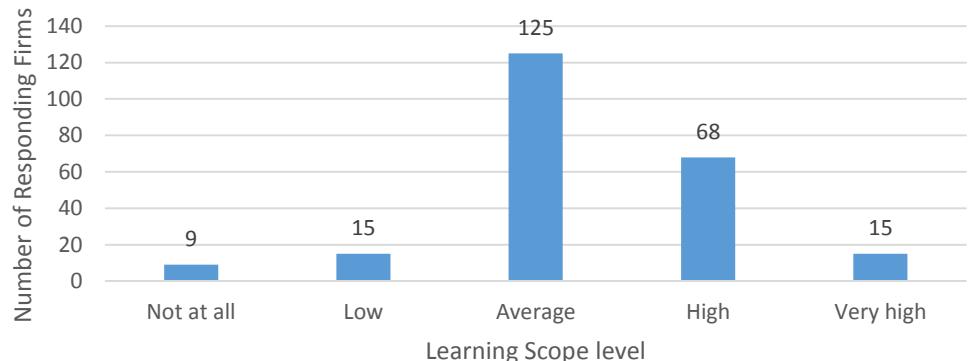
Table 4.8: Percentage of Revenue taken by Foreign Firms

Percentage of Revenue	(Frequency of Responding Firms)	
	As Lead Firm	As Subcontractor
0%-20%	72	78
21%-40%	51	49
41%-60%	25	27
61%-80%	7	9
81%-100%	2	5

Data source: Field Survey

In certain situation, particularly in large projects, foreign firms take away large portion of revenue, as shown in Table 4.8. One of the additional benefits for such partnership could have been technology transfer from foreign firms to local ones; but responses do not give very positive outcome, as shown in Fig.4.8. Moreover, it has been learned that such partnership with foreign companies hardly leads to market expansion for local firms.

Figure 4.8: Learning Scope from Foreign Partners in Joint Projects



Data source: Field Survey

Moreover, scope of learning from Government officials in the area of reengineering of government work processes and capturing smart requirements is also very limited. It has been cited that due to lack of scope of specialization of government officials in reengineering of Government's work processes using ICT is also limiting the scope of capacity development of local firms (source: KII and FGD). There is a strong sense of urgency in the industry to address public procurement practices in such a manner that through public procurement practices local software firms acquires significant new competence, which could be very useful.

In Bangladesh, likely many developing and emerging economies with a nascent software industry, providing services for the local market is often the natural entry point for new enterprises. Entry into international markets requires additional capabilities. In addition, the government could grow as the largest buyer of software innovations to implement its development programs. Many studies suggest that public procurement in the USA not only caused demand for software, but also created capability of software development to meet high value requirement of the society.

SME intensive software development sector of Bangladesh has the potential to grow as the heart of the Bangladesh's economy—through spillover effects to local economy and export earnings. Software firms are not only potential large-scale job generators, but they're also at the heart of the Dream of New Generation Bangladeshis.

One potentially useful policy tool to spur these SMEs growth and thereby increase competitiveness of local economy, create high paying jobs and promoting entrepreneurial opportunity in innovation industry to 30 million students is the proactive use of government procurement. The use of SME procurement preference schemes need to be objective, targeted and with an exit strategy to ensure that they do not become a mechanism to subsidize inefficient and/or corrupt SMEs¹⁵. It's to be noted that in an era of increasing globalization, domestic SME procurement preference schemes that do not promote longer-term comparative advantage at an international level ultimately become mechanisms for local market capture and rent-seeking. This aggravates, rather than reduces, economic inefficiency and competitiveness gap between local and foreign

¹⁵ ADB, SME Development Government Procurement and Inclusive Growth, 2012

software firms. In the context of trade liberalization, constructive and flexible dialogue on ways to promote growth of local software firms, including the use of carefully targeted procurement preferences schemes, is essential. Some of the suggestions provided by an UNCTAD in a recent report on “PROMOTING LOCAL IT SECTOR DEVELOPMENT through public procurement¹⁶” appears to be useful to consider to adapt public procurement practices in Bangladesh to increase value addition capacity of local software firms through participation in public procurement. They are explained below:

1. Ensure that key conditions for success are in place: a shared IT/software and public procurement policy, a critical mass of public ICT/software projects and a good alignment of software acquisition strategy with the capability-uplifting roadmap of the local software firms.

To develop shared understanding to maximize local value addition, it is essential to secure the commitment from key authorities. First, the different ministries and agencies involved should agree on a common vision and objective of software led growth. This requires that public procurement policies of software are effectively integrated in broader ICT policies. Second, the promotion of domestic demand for software innovation should be recognized at supporting export growth of the sector. Third, before launching a major initiative to leverage public procurement, governments should explore their current and future needs for e-government systems, including the development agenda of individual Ministries, which could be addressed with software. For example, role of software for addressing quality and monitoring issues of education should be envisioned to address vision of the Ministry of Education. Finally, an understanding of the capabilities of the local software development sector has to be developed at an early stage to assess the kind of projects that could be undertaken by domestic suppliers. Software acquisition road map should be developed in line with the delivery capability-uplifting plan of the software industry. It should be noted that software innovation led development agenda of individual ministers and agencies should be coupled with the delivery capability of local software firms in a such a manner that Government acquire state-of-the-art solutions at possible least cost, on the other hand, software companies acquire capability through such deliveries to enter in the export market.

2. Adopt Best Practice Software Design to Facilitate Local Firm Participation

The use of modular design of systems and architecture allows for the tendering of smaller projects and greater participation of local firms. The strategy of such incremental delivery model should focus on acquisition of modules, each of which is usable to address particular purpose. This approach, however, requires a certain degree of authority to establish technical standards, advanced technical software development skills among the procurement offices and careful attention to software standards and interoperability frameworks.

3. Increase the Options for SMEs to Submit Bids

It has been learned that Bank guarantee and previous track record to qualify in winning large public software projects has become an insurmountable barrier to local small software firms. In order to reduce the threshold for local SMEs to participate in the bidding process,

¹⁶ UNCTAD, PROMOTING LOCAL IT SECTOR DEVELOPMENT THROUGH PUBLIC PROCUREMENT, 2013
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governments should consider providing concessions on bid and performance guarantee requirements. Another way to increase the options to submit bids for SMEs that have limited experience in public procurement is to use quality control criteria other than a previous track record specifically linked to public procurement. For this reason, significant capacity development is required among procurement offices and outside capacity, to whom Government approaches for technical assistance.

With the given potential of the growth of software industry and the uphill obstacles being faced by local software firms in winning public bids, Government of Bangladesh should (may be must) implement the essential strategies including establishing the basics, promoting good procurement practices, undertaking incremental delivery model, developing capacities of local software firms and providing targeted preferential treatment for local suppliers—which focuses on capability development. Implementation of one or two carefully designed software intensive e-government projects (such as e-Heath) with the involvement of domestic software firms can help showcase their potential and to build trust between the public and private sectors to scale up this model.

Challenge of Reconciling Software Sector Promotion with Value for Money in Public Procurement: The primary aim of public procurement is to obtain value for money. Procurement entities are tasked with procuring systems that fulfill the technical specifications at the lowest total cost of ownership. This is best served by having a reasonably large number of firms-local and international-with experience and relevant products and services competing in the tendering process. Procurement entities are generally not entrusted with ensuring that local SMEs submit bids and are given a chance to deliver. Giving preference to local firms may result in fewer qualified firms, mostly local, competing for the tender. Moreover, reliance on foreign firms with limited or no local support may also negatively affect total cost and value of ownership of delivered software assets. Reducing the competition among bidders by setting up artificial barriers will likely reduce local firms' incentive to innovate and to become competitive, reducing their chances to compete in international markets in the future. On the other hand, without giving the opportunity to small software firms to compete and learn, nation will likely lose an opportunity to create an industry for the purpose of not only to create jobs, but also to create a window of opportunity of high value entrepreneurship, which may lead to path breaking economic growth. It's therefore vital to acknowledge such conflicts of interest to develop strategies and procedures suitable for the specific circumstances faced by Bangladesh. It's recommended that thorough review of past public procurements having significant software components should be reviewed; lessons should be drawn and effective solutions to be derived. Most of the advanced countries, and also emerging as well as developing nations, have been intelligently crafting strategies to use public procurement as a tool to create local capacity for not only import substitute, but also for creating domestic market as springboard to enable local firms to enter in the international market¹⁷.

The European Parliament has recently adopted a resolution in recognition of the European's review of the Public Procurement Directives to address pressing issues including to simplify the rules and allow more flexible procedures to improve access for SMEs¹⁸.

¹⁷ Michel Porter, Theory of Competitiveness, Simon and Schuster, June 2008.

¹⁸ Guidelines for Public Procurement of ICT Goods and Services SMART 2011/0044, European Union, 2012

By their very nature, software firms in Bangladesh like SMEs of many other countries lack the resources and management expertise to plan, draft, and complete tender applications. These SMEs also often have a limited commercial history, which makes them unattractive and appear risky to public tenders. To address such reality, one of the notable major changes of law which took place in Mexico. In April 2009, the Mexican Federal Congress approved the modifications to the law on the *Acquisition of Goods, Leasing's and Rendering of Services for the Public Sector and the Public Works and Related Services* law, which regulate the basic principles of government procurement established in Article 134 of the Mexican constitution¹⁹. These amendments are intended to streamline public procurement procedures to achieve greater participation of SMEs in public procurement. A study conducted by UNCTAD reported the existence of many problems in developing and transition countries that keep local suppliers from taking advantage of the government marketplace²⁰. It has been reported that participation of SMEs in public procurement can lead to greater competitiveness and export readiness. Improved public procurement aligned towards the capability development of SMEs through participation in public procurement may lead to establishing a “launch market” base for small and medium enterprises (SMEs). Such observations appear to be very relevant to the potential scope of enabling local software firms, most of which are SMEs, to participate in public procurement to improve their delivery competitiveness—which will likely led to export growth.

In a recent study conducted by European Commission has identified ‘Public Procurement as a Driver of Innovation in SMEs and Public Services’²¹. It has been reported that purchasing innovative solutions allows public bodies on regional and local level a more efficient delivery of public services, lower energy consumption, lower life-cycle costs, and many other advantages from having solutions that meet exactly their needs. At the same time, procurement of innovation offers opportunities for innovative SMEs that are agile and flexible enough to meet the specific needs of the public procurers. Such observations appear to be very much in line with the opportunities of engaging local software firms to deliver innovative solutions to address development agenda of the Government of Bangladesh. In another study, it has been reported that by ensuring open and fair competition for public sector contracts, while minimizing burdens on potential and successful bidders, government can help SMEs directly but also save money for the taxpayer. SMEs play a vital role in supplying goods and services and the increased competition and innovation they bring helps to ensure that the public sector can deliver world-class public services that are value for money²².

In a study conducted by The Institution of Engineering and Technology²³, a global organization with over 150,000 members representing a vast range of Engineering and Technology fields, the inclusion of SMEs in public procurement has many benefits, including:

¹⁹ Eight Big Ideas From Mexico, Leveraging Public Procurement to Encourage Economic Growth and Access to Finance for Small and Medium- Sized Enterprises (SMEs), International Institute for Sustainable Development, 2015

²⁰ Wayne A. Wittig, Public Procurement and the Development Agenda, UNCTAD

²¹ European Commission, How to support SME Policy from Structural Funds, 2014

²² HM Government, CONSULTATION DOCUMENT: Making public sector procurement more accessible to SMEs, 2014

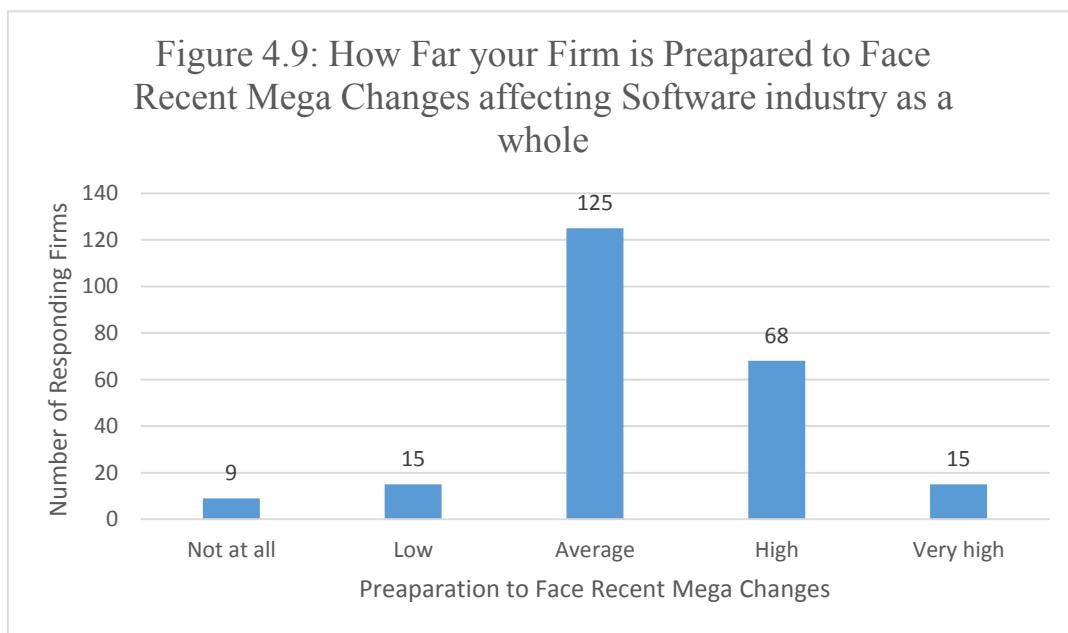
²³ IET, Managing Risk, Driving innovation, and Growing SMEs through public procurement, 2011.

1. Can be an effective mechanism to promote SME growth through the use of public procurement.
2. Can foster the culture of close working relationships reducing transaction costs and helping the public sector to understand the needs and constraints of SMEs.
3. Can help to develop innovative, high tech solution to rebalance the economy.

So inclusion of competence development of local software firms and tuning public procurement practices towards the participation of local firms will serve multiple purposes, including strengthen the sector to create new develop opportunity for the nation.

4.6 Implications of Changes of Technology and Business Model on Local Software Industry

The global technology landscape as well as business model surrounding software industry has been going through significant changes. Emergence of cloud computing, smart hand held devices and consumption of software as a service are some important developments. The aggressive marketing effort of the best of breed enterprise applications offered by Oracle, SAP and others are also causing significant changes in the industry. Preparedness of the local software firms to deal with such changes is shown in Fig. 4.9. It appears that preparedness level is not quite strong, more than 50% responding firms are assessing their preparedness level to be average.



Data source: Field Survey

On the other hand, only small portion of firms have mentioned strong adaptability of work force to reposition resources and capability to take advantage of emerging opportunities such as mobile, slate and cloud computing, as shown in Table 4.10. Revenue growth trend in responding firms from emerging opportunities is shown in Table 4.11.

Table 4.9: The Adaptability of Repositioning to Take Advantage of Emerging Technology and Business Model

Resource and Capability	low adaptability	(Frequency of Responding Firms)						High adaptability
		1	2	3	4	5	6	
Management expertise	5	5	19	65	63	44	47	
Technical expertise	3	2	24	76	76	48	28	
Physical assets	4	8	49	73	49	37	11	

Data source: Field Survey

Table 4.10: Revenue Growth Trend from Emerging Opportunities

Emerging opportunities	(Frequency of Responding Firms)		
	Low	Moderate	High
Mobile	23	105	110
Slate or Tablet based computing	17	121	91
Cloud	70	113	39
Best-of-breed ERP/CRM implementation services	49	82	55

Data source: Field Survey

Table 4.11: Revenue Growth Trend from Emerging Opportunities (Percentage)

Emerging opportunities	Low	Moderate	High
Mobile	14%	25%	37%
Slate or Tablet based computing	11%	29%	31%
Cloud	44%	27%	13%
Best-of-breed ERP/CRM implementation services	31%	19%	19%

Data source: Field Survey

4.7 Preparedness to Deal with the Trend of Adoption of best-of-breed Enterprise Applications

There is a growing trend among large buyers, particularly Government organizations and large private corporations, towards the adoption of best-of-breed enterprise applications from global software companies such as Oracle and SAP. It's estimated that the Oracle alone will be able to sale more than BDT 154 million (USD2 million) license of enterprise applications in Bangladesh in 2015 (Source: KII and FGD). Such license sale will generate almost 3 times more of implementation service revenue. It has been learned that large potential buyers are changing their software acquisition strategy—shifting from in-house development and local sourcing of customized applications to global best-of-breed applications. Such strategy is opening large implementation and maintenance service business. It has been learned that foreign companies dominate such service business. As a result, local software industry is facing the challenge of losing share in domestic market and failing to penetrate the emerging implementation service business. From key informants, it appears that existing mode of engagement of local firms in such projects has very limited local value addition opportunity. As it has been mentioned before, preparedness to deal with such challenge appears to be moderate.

It appears that local software companies have significant deficiency in HR capability and prior experience to qualify in bidding for adding significant value in such best-of-breed

enterprise application projects. Due to poor strategy and non-favorable procurement practices, Bangladeshi software firms already missed the opportunity to position well in the Banking and Financial service industry. If necessary steps are not being taken, there is a risk that Bangladesh software companies may be marginalized in the local enterprise computing market. Loss will not be limited to software companies alone, but also clients will be liable to pay significant annual maintenance fee to meet licensing obligations.

There appears to be need of policy to support the local value addition capacity in best-of-breed enterprise applications and awareness creation among buyers about likely consequence of following such trend. It seems that lack of prior experience of implementations services and high cost in developing HR are working as strong barriers for local software firms to capitalize the emerging opportunity of best-of-breed enterprise applications.

4.8 Research, Development and Innovation Capacity of the Software Industry of Bangladesh

Capacity in the area of research and development is quite important for software firms to innovate software applications for generating new revenue streams. It should be noted that primary means of value creation in the software industry is through innovations. The R&D investment of responding firms appears to be very low as shown in Table 4.12.

Table 4.12: Annual R&D Investment Trend of Responding Firms

Amount in BDT	(Frequency of Responding Firms)				
	2010	2011	2012	2013	2014
10 lacs-20 lacs	195	199	181	177	180
21-50 lacs	23	16	38	42	39
51-80 lacs	7	12	9	14	19
81-99 lacs		1	3	3	2
1 Crore +	1	1	1	2	2

Data source: Field Survey

Table 4.12a: Annual R&D Investment Trend of Responding Firms

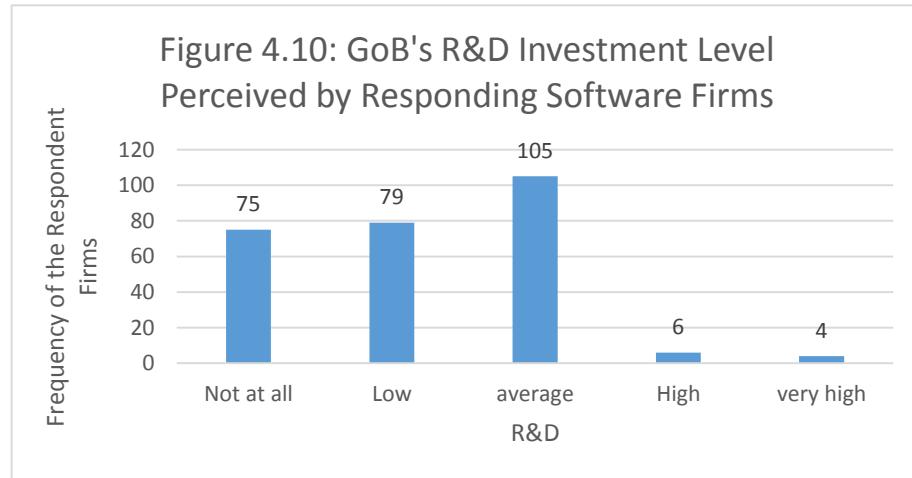
Amount in BDT	2010	2011	2012	2013	2014
10 lacs-20 lacs	86.28%	86.90%	78.02%	74.37%	74.38%
21-50 lacs	10.18%	6.99%	16.38%	17.65%	16.12%
51-80 lacs	3.10%	5.24%	3.88%	5.88%	7.85%
81-99 lacs	0.00%	0.44%	1.29%	1.26%	0.83%
1 Crore +	0.44%	0.44%	0.43%	0.84%	0.83%

Data source: Field Survey

Among 222 responding firms, 180 of them invested only less than BDT20 lacs in 2014; only two of them invested more than BDT1 crore. As a matter of fact, it takes several years of team work to develop a product for generating new revenue stream. Continuous

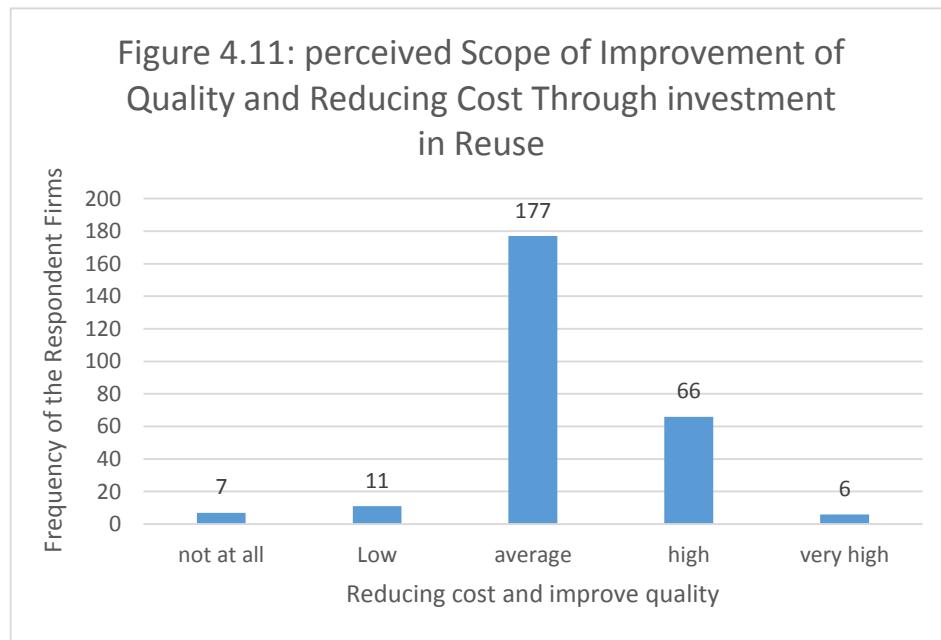
research is also needed for sustaining the innovation edge of existing applications and reducing the cost through efficiency innovations.

On the other hand, Government's R&D investment supporting the innovations needed by software firms is also perceived to be low as shown in the Fig. 4.10.



Data source: Field Survey

There is a strong sense among responding companies that quality of software applications could be improved and cost could be reduced by increasing reuse as shown in Fig. 4.11. There is a need of significant investment in R&D to address this growth opportunity.



Data source: Field Survey

Innovation is a major driver of economic transformation and development. In the software development sector, the primary, may be only, means of value addition is through innovation. Enabling and fostering innovation has long been considered a core strategic goal of economic policy in more advanced economies, and is receiving increasing attention in most developing countries. Finance, particularly long term risk capital, plays a fundamental role in absorbing technological change and understanding target work processes to be improved for innovating software solutions. The availability of financial capital and the organization of financial markets strongly influence the way software

innovations are pursued and new techno-economic paradigms emerge for wealth creation. Development and commercialization of new software innovation often involves significant capital investments to cover expenses of employing a large number of professionals over several years and is an uncertain, risky undertaking, which makes it more difficult to mobilize resources.

For software enterprises, lack of finance is often a major obstacle to innovation in Bangladesh. This is a common finding of the Science, Technology and Innovation Policy Reviews that UNCTAD carried out in developing countries as well²⁴.

Although innovation materializes most often as an entrepreneurial activity, the public sector plays a critical role in it²⁵. The existence of market failures affecting the production and diffusion of knowledge and technology is a broadly recognized justification for public funding for innovation. It has been stated, “we expect a free enterprise system to underinvest in invention and research (as compared with an ideal) because it is risky, because the product can be appropriated only to a limited extent, and because of increasing returns in use.”²⁶

Different studies have shown that the social rate of return of public investments in research and development (R&D) can be several times larger than private investments. Due to high spillover effect caused by domestic usages of software applications, which are developed and maintained to address need of local market, perceived social benefit from software R&D investment appears to be much higher than direct revenue contribution to software companies. However it must be underlined that R&D investments should be linked with, and supportive of, policies addressing a broad range of other obstacles that may impede the emergence of innovation systems. In other words, innovation policy cannot be limited to the funding of R&D alone.

Public R&D spending and business–academic–Government R&D partnerships: Most countries undertake publicly funded R&D at research institutes and universities. Public R&D is particularly important for Bangladesh’s software development sector, as the private sector has very low levels of R&D investment capacity. This funding should not be a direct source of financing for enterprises, but the R&D investment should focus on providing knowledge, particularly ideas and prediction of global trend, that helps firms to innovate applications, develop service capacity or adapt emerging technologies for efficient local use by firms. Such R&D also provides new knowledge and technologies that can be transferred to firms as the basis for innovative activity. It may be useful to encourage R&D alliances between enterprises, universities and public research institutes—although such institutions are weak in Bangladesh. This is a classic tool for strengthening key linkages in national or sectoral innovation systems that is going support innovation in the software development sector of Bangladesh.

In Higher Education Quality Enhancement Project (HEQEP), with the support of World Bank funding amounting to US\$125.0 million, UGC has been supporting the implementation of two activities: (i) establishment of quality assurance mechanism; and

²⁴ [http://unctad.org/en/pages/publications/Science,-Technology-and-Innovation-Policy-Reviews-\(STIP-Reviews\).aspx](http://unctad.org/en/pages/publications/Science,-Technology-and-Innovation-Policy-Reviews-(STIP-Reviews).aspx)

²⁵ United States National Academies of Science (2007). In the information technology sector alone, a 2012 report by the United States of America’s National Research Council calculated that \$500 billion per year of private sector revenue could be traced back to research by public sector agencies. See National Research Council (2012).

²⁶ Hall B and Learner J (2010).

(ii) university-industry research collaboration. This funding appears to be the largest source of fund for university based R&D to generate ideas for industry to pursue commercial innovation. This university-industry research collaboration is titled as Innovation Fund subprojects and is operational under the Academic Innovation Fund (AIF) component of the project through a new Window 4 (Source: University Grant Commission). The stated objective of the Innovation Fund is to build an innovation ecosystem in the country. Information and Communication Technology (ICT) is one of the five areas to qualify for this fund.

Table 4.13: R&D Contributions of Different Countries²⁷

Countries	R&D Investment as % of GDP				
	2006	2007	2008	2009	2010
Bangladesh					
India	0.76	0.77			
Pakistan		0.67		0.46	
Sri Lanka	0.17		0.11		
Singapore	2.16	2.37	2.84	2.43	
Korea	3.01	3.21	3.36	3.56	3.74
Finland	3.48	3.47	3.70	3.93	3.88

Data source: Footnote reference 27.

Functioning of this program in developing technologies and ideas, which lead to the development of commercial software applications should be monitored. Additional complementary support elements, including different types of financing, should be developed to strengthen the overall innovation ecosystem.

Governments often provide other support measures that are non-financial in nature but encourage enterprise innovation by providing infrastructure, knowledge or a guaranteed market for their products. These measures can include public investment in clusters such as software technology parks and business incubators; science and technology, and information, communication and technology infrastructure; and public procurement contracts—which develops local capacity to add value through software innovations. In some cases, incubators and science and technology parks may also provide financing as well as infrastructure and other indirect support (for example, the Hsinchu Science-based Industrial Park in Taiwan Province of China and the Technological Incubators Program in Israel). The survey conducted by Deloitte and Ernst&Young indicate that recently countries such as Brazil, China, Hong Kong (China), Taiwan Province of China, India, Indonesia, Malaysia, the Philippines, the Republic of Korea, South Africa, Singapore, Thailand and Viet Nam implemented various R&D incentives for innovation.

Trends in R&D Investment for Innovation led Growth in Developing Countries: Expenditure on innovation in most developing countries is clearly at a much lower scale than in developed countries. There are also a small number of developing countries that

²⁷ Deloitte (2011). Global Survey of R&D Tax Incentives. Updated July 2011.

are investing a significant and rising share of their national income in R&D, including Brazil and Tunisia. Most developing countries invest less than 1 per cent of GDP in R&D, and many of them invest less than 0.4 per cent of their national income in innovative activity, as shown in Table 4.13²⁸.

Challenges in Designing and Administering R&D Funding for the Software Industry in Bangladesh: Some of the challenges are:

1. Based on learning from past experiences such as EEF, it appears that public finance for R&D support will likely to attract rent-seeking behavior, which could result in inefficient funding allocations if the institutional design cannot immunize the funding allocation from interference by political actors and other interest groups. The design of instruments is crucially dependent on the capacity of public servants to administer them and insulate their decision making promises from capture and rent seeking. It's likely that weak public service institutions might result in a lack of capacity to make informed and economically beneficial decisions.

Table 4.14: Areas of Improvement for Enhancing Financial Performance

Areas to be Improved for Having Positive Implications on Financial Performance of Firms	Degree of Implications (Frequency of Responding Firms)		
	Low	Medium	High
Technical skill	13	68	185
English language and communication ability	32	141	80
Reuse improvement	36	127	80
Defect prevention	29	128	91
Software production process improvement	19	122	105
Project management skill	23	112	109
Business process reengineering capability	21	129	85
Establishing linkage with university	59	117	68
Focus on product innovation	30	89	123
Documentation	75	94	56

Data source: Field Survey

Table 4.15: Percentage of working hours in different areas of works

Areas of work	0%-10%	11%-20%	21%-30%	31%-40%	41%-50%	51%-60%	61%-70%	71%-80%	81%-90%	91%-100%
Learning new technologies, programming languages	34	65	42	46	22	18	12	16	3	4
Learning work done by coworkers	22	39	65	48	34	14	10	8	3	1
Developing documents	22	53	59	39	35	13	6	7	4	1
Fixing work done by himself/herself in previous days or months	20	51	48	53	29	15	14	6	3	
Meeting and client site visits	31	43	52	44	24	22	13	5	6	1
Waiting for preconditions to be met to start assigned work	31	40	50	33	37	23	13	8	2	

²⁸ Trade and Development Board Investment, Enterprise and Development Commission, Fifth session Geneva, 29 April–3 May 2013 , Item 5 of the provisional agenda Investment, innovation and technology for development

Areas of work	0%-10%	11%-20%	21%-30%	31%-40%	41%-50%	51%-60%	61%-70%	71%-80%	81%-90%	91%-100%
Identifying and modifying software assets to be used in current projects	21	49	45	51	29	11	11	10	5	
Updating work of past projects for improving core reusable assets	27	44	51	45	30	16	11	9	2	

Data source: Field Survey

2. It's suggested that the administration and funding decisions are located in an independent institution with a clear mandate and control mechanism, separating it from other, may be conflicting, public policy goals. An independent investment committee, having proper representations from Industry, Academia, Government and Financing Institutions, makes the R&D funding decision.
3. Agreement on key indicators indicating progress in programs to fund collaborative R&D is needed. Developing simple but meaningful indicators that can demonstrate the linkage between R&D outcomes and the goals of funding programs to facilitate commercial software innovations, having high spillover effects on local economy, require an understanding of firms and institutional dynamics in the national innovation system.

4.9 Mainstream Technology Usages and Mobile App Development Competence

Investment in learning emerging technologies, such as application development technology for smart hand held devices, is a precursor to remain at the edge of software business. Although software firms' investment in R&D is low, but there appears to be on going investment of time of professionals in learning new technologies, as shown in Table 4.15. There is also strong feeling among professionals that by improving technical skill, software firms will be able to enhance financial performance. Among 266 respondents, 185 feel that such scope of improvement is high as shown in Table. 4.14.

It has been learned that there are almost 30 firms (they participate in BASIS's mobile Monday meetings), who are involved in mobile Apps development. Although most of these firms are small and young, but there appears to be very promising potential in this sub-segment of the industry. BASIS has been providing training in Mobile Apps development, primarily focusing on technologies such as Android and iOS. From key informant interview, it appears that there is significant deficiency in User Interface design. Apps development competitions, sponsored by global companies such as Microsoft, Mobile operators, IT companies and the Government, are also creating awareness, providing incentives and increasing competence level of Mobile Apps development.

Chapter 5: Competitiveness of the Software Industry of Bangladesh

5.1 Enterprise Size and Growth Pattern

Employment based Distribution of Firms: It has been noticed that most of the firms are small, only 3 firms have reported to have more than 100 employees in 2014, as shown in Table 5.1. Distribution of employee size shows a bell shaped pattern (as shown in Fig. 5.1) between employee size 0 to 35, having axis around 16-20. This bell shaped curves indicate that most of these software firms limits the growth capability to firm size of 20 to 25.

Table 5.1: Employment based Distribution of Firms

Year	2014	2013	2012	2011	2010
No. of Employee	Frequency of No. of Firm				
0-5	20	22	20	27	44
6-10	38	41	60	61	67
11-15	57	58	53	66	49
16-20	61	65	50	32	31
21-25	37	29	28	21	11
26-30	25	11	11	9	9
31-35	5	5	5	2	1
36-40	4	1	5	4	3
41-45	4	1	2	3	-
46-50	2	2	2	1	2
51-55	2	1	2	-	1
56-60	2	2	-	1	-
61-65	1	1	-	-	-
66-70	1	1	1	1	-
71-75	1	-	-	-	-
76-80	1	1	-	-	-
81-85	1	-	-	-	1
86-90	1	-	1	1	3
91-95	-	-	-	-	-
96-100	1	1	2	2	-
100+	3	3	1	1	1

Data source: Field Survey

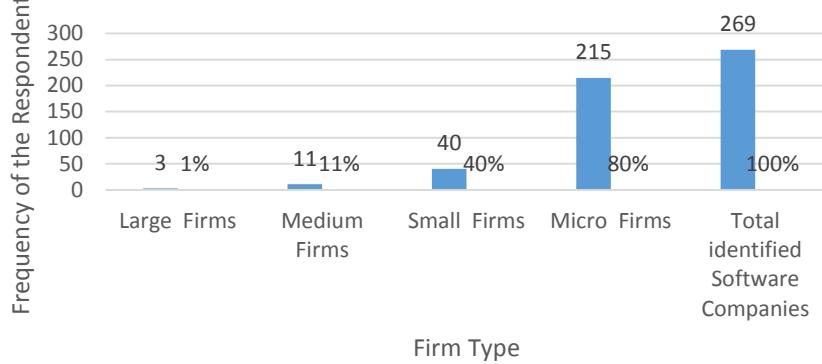
Table 5.1.1 Stratification of Responded Software Firm during Survey

Stratification of Software Companies	Large Firms	Medium Firms	Small Firms	Micro Firms	Total identified Software Companies
Number of Companies	3	11	40	215	269
% of companies	1%	11%	40%	80%	100%

Data source: Field Survey

As it has been explained before, software firms at very early stage enjoys natural economy of scale. At the early stage, due to complementary role of new recruit, marginal income grows. But such growth saturates very quickly; a number of factors contribute to diseconomy of scale.

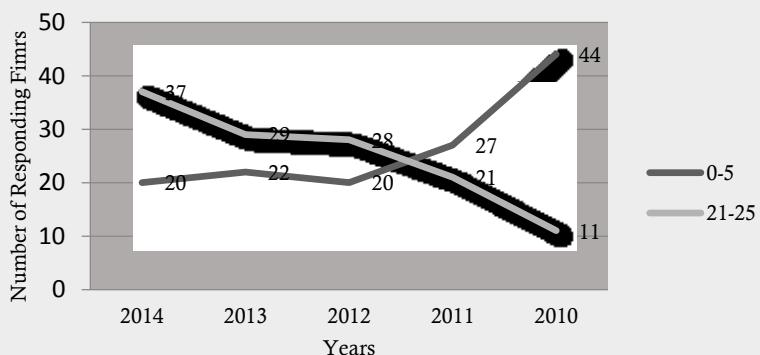
Figure 5.1: Stratification of Responded Software Firm during Survey



Data source: Field Survey

High rework caused by poor delegations, non-transparent supervision capability, long waiting due to poor job division and high communication & coordination cost are such major factors contributing to diseconomy of scale. To address this critical growth constraint, companies have two basic strategic tools: 1. Increasing reuse from development of projects from same market segments, and 2. improving the process to increase scalability ad reduction of rework. It should be noted that there is cost associated with the implementation of these strategies. Quick fix approach such as SW-CMMI or ISO certification is not solution to the problem. Based on economics fundamental, production function should be kept improving to increase the scope of economy of scale. The economy of scope should also be taken into consideration. This appears to be critical growth constraint faced by the software industry of Bangladesh. Such constraint should be addressed as early as possible so that with increasing economy of scale and scope, cost decreases and quality improves. So that software firms increasingly offer higher quality solution at less price to make more profit. Progress along this line will address local market expansion and growth issues faced by both software Firms and professionals alike. More than 90% software firms in Bangladesh appear to have less than 35 employees. It's also interesting to note that firm size has been increasing over the years, as shown in Fig.5.2.

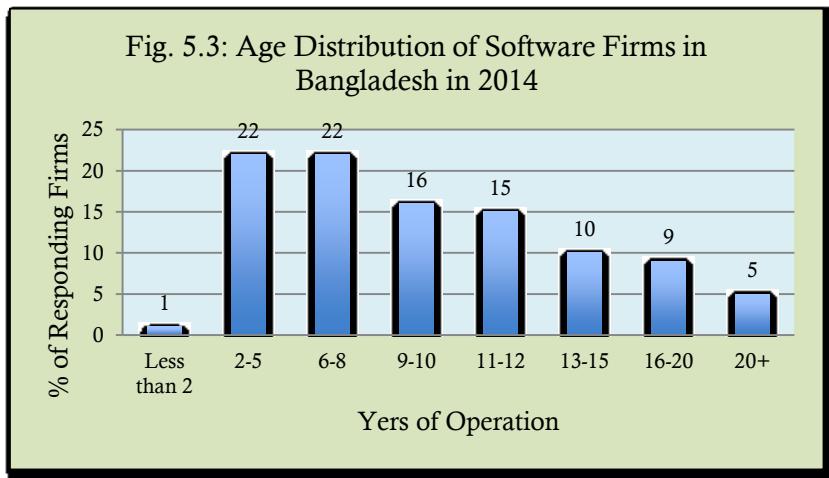
Figure 5.2: Software Firm Size Growth Pattern



Data source: Field Survey

Age Distribution of Software Firms:

It appears that most of software firms are young. Among 246 responding firms in the corresponding question, only 5 firms have claimed to have age more than 20 years. In presentence, more than 60% firms have less than 10 years; only 2% firms have age more than 20 years, as shown in Fig. 5.3.



Data source: Field Survey

It's interesting to note that although size of firms has been increasing as shown in Fig. 5.2, but growth show tendency of saturation reaching to firm size 30 or so. According to these data, it appears that existing production function, affected by many variables, limit the growth size of local firms at very early stage. Limited economy of scale and scope is the underlying cause. As a result, both consumer and producer surplus from software innovation is quite limited in Bangladesh.

5.2 Cost Components and Profit

Typical cost components of software firms in Bangladesh are shown in the Table 5.2. It appears that salary given to software development professionals consumes the largest cost, which is as high as more than 50% for many companies, which is followed by salary for management and rent for office space.

Table 5.2: Cost Components and their Breakdown in Software Firms of Bangladesh

Range	Frequency of Responding Firms							
	Salary for software professionals	Salary for management and staff	Office space rent and utilities	HW cost and SW license	Training	Tax/VAT	Informal cost	Others
5%-15%	29	57	85	100	105	111	31	29
16%-25%	46	98	103	52	40	34	10	5
26%-40%	98	58	50	12	12	21	5	
41%-50%	33	29	17	1	3	1		
50% +	48	7	1		1			

Data source: Field Survey

Cost for HW and SW license is very low. According to give data, Tax and VAT payment obligation is quite low, less than 20% for many companies. Although software firms are

exempted from Taxes, but due to malicious practice, software firms are required to deal with tax officials to get clean Tax/VAT certificate.

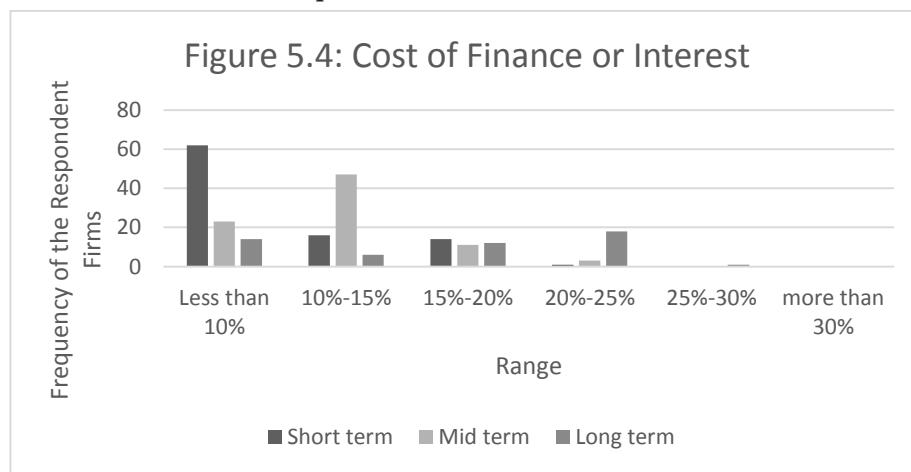
Net profit as percentage of revenue of responding firms over last five years is shown in Table 5.3. For most of these firms such ratio is less than 30%--in presentence point it does not sound bad. But due to small volume of revenue, total profit per firm appears to be not encouraging. It's interesting to note that one of these responding firms has indicated of more than 40% net profit, which appears to be very encouraging. Scaling up such business could be very attractive to investors.

Table 5.3: Net profit profile as presentence of revenue

Net Profit	Frequency of Responding Firms				
	2010	2011	2012	2013	2014
less than 10%	155	6	4	6	6
10%-20%	76	37	26	16	6
20%-30%	14	2	19	16	11
30%-40%	11	2	6	1	7
40%-50%		1	2		1
50+					

Data source: Field Survey

For software companies, cost of finance appears to be high, as shown in Fig.5.4, which is around 15% for most of the companies.



Data source: Field Survey

5.3 Salary Structure of Software Professionals

Based on available data it's estimated that 40% of revenue earned by software firms goes for the salary for software professionals. Therefore, from salary structure, we can estimate revenue earned per software professionals. According to data provided by responding firms, salary structure of software professionals, depending on experience is shown in the Table 5.4.

Table 5.4: Salary Structure of Software Professionals

Salary Range (Tk)	Frequency of Responding Firms								
	Programmers	System analyst	Analyst programmers	Project managers	Database Administrator	Help Desk	Software Engineers	Web Developer	Testing
7000-15000	12	17	24	3	28	153	24	38	13
16000-30000	69	52	78	25	97	40	94	109	69
31000-50000	130	111	53	98	66	1	92	83	26
51000-80000	44	48	63	90	20	1	34	5	29
80000-11lakh	3	5	2	14	1	1	1	2	3
1 lakh +	2	1		2			1		

Data source: Field Survey

Table 5.5: Salary Structure of Software Professionals

Salary Range (Tk)	Programmers	System analyst	Analyst programmers	Project managers	Database Administrator	Help Desk	Software Engineers	Web Developer	Testing
7000-15000	4.62%	7.26%	10.91%	1.29%	13.21%	78.06%	9.76%	16.03%	9.29%
16000-30000	26.54%	22.22%	35.45%	10.78%	45.75%	20.41%	38.21%	45.99%	49.29%
31000-50000	50.00%	47.44%	24.09%	42.24%	31.13%	0.51%	37.40%	35.02%	18.57%
51000-80000	16.92%	20.51%	28.64%	38.79%	9.43%	0.51%	13.82%	2.11%	20.71%
80000-11lakh	1.15%	2.14%	0.91%	6.03%	0.47%	0.51%	0.41%	0.84%	2.14%
1 lakh +	0.77%	0.43%	0.00%	0.86%	0.00%	0.00%	0.41%	0.00%	0.00%

Data source: Field Survey

Usually, fresh graduates start their career as either tester, programmer or web developer. Average salary of fresh graduates in the software industry appears to be around BDT 15,000 per month. Within 3 to 5 years they promote to position of software engineers, or analyst programmer resulting salary growth to around BDT 30,000. Usually, project managers require more than 8 to 10 years of experience, by this time salary increases to around BDT70,000/month. From such basic data, growth of salary and revenue per employee over years of experience could be summarized in the Table 5.5.

Table 5.6: Estimated Salary Variations

Experience in Years	Average salary in BDT	Average yearly growth (approx.)
0	15,000	0
3	30,000	33%
8	70,000	25%
10	80,000	10%

Data source: Field Survey

It has been learned that at the beginning of the career, annual salary growth rate is high. But it saturates with experience, as career growth path is limited, resulting in dissatisfaction among senior professionals as shown through the Table 5.6.

Table 5.7: Level of Satisfaction about Salary

Satisfaction area	Frequency of Responding Firms		
	Low	Medium	High
Monthly salary amount	17	137	112
Regularity in payment of salary	32	125	99
Career growth path	90	101	52
Salary increase rate	20	134	102
Provident fund, gratuity, and pension	37	105	86
Work environment	27	114	93
Scope of gathering know/how to build your own software firm	16	108	85
Scope of higher education	9	141	106
Social status	18	74	162

Data source: Field Survey

5.4 Revenue Distribution and Growth Prospects

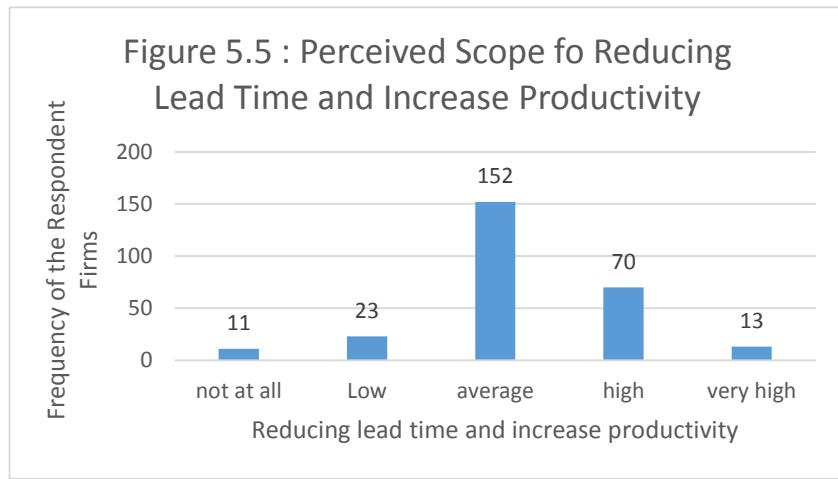
It appears that most of the software companies generate revenue from development and implementation of own products. Only a limited number of firms generate a small fraction of revenue from sale of 3rd applications as shown in Table 5.8. In addition to products, project based delivery of customized software is also a major source revenue to large number of firms; it generates more than 40% revenue for 56 responding firms. For 18 responding firms, project based delivery appears to be the sole source of revenue.

Table 5.8: Revenue Distribution Over Different Products

Contribution as % of total revenue	Frequency of the Responding Firms				
	From sale of own product	Project based software development services	License revenue from sale of third party software products	Software implementation services	Software project management services
0%-20%	39	38	42	48	26
20%-40%	22	63	26	45	29
40%-60%	13	23	17	40	12
60%-80%	3	15	7	32	3
80%-100%	5	18	1	58	1

Data source: Field Survey

As most of the firms are primarily involved in engineering solutions, therefore significant improvement could be made by focusing on development aspects of software and services. As shown in the Fig. 5.5, most of the firms believe that through improvement of process, productivity and lead time could be improved. As high as 83 respondents perceive that high improvement scope is prevailing.



Data source: Field Survey

One of the options of making improvement in productivity and reducing lead time is through reduction of rework. As shown in the Table 5.9, as high as 73 firms believe that rework is an area where scope of improvement prevails.

Table 5.9: Scope of Reduction of Rework

Reduce rework through process	Frequency of the Responding Firms
	Give ✓
not at all	10
low	23
average	161
high	65
very high	8

Data source: Field Survey

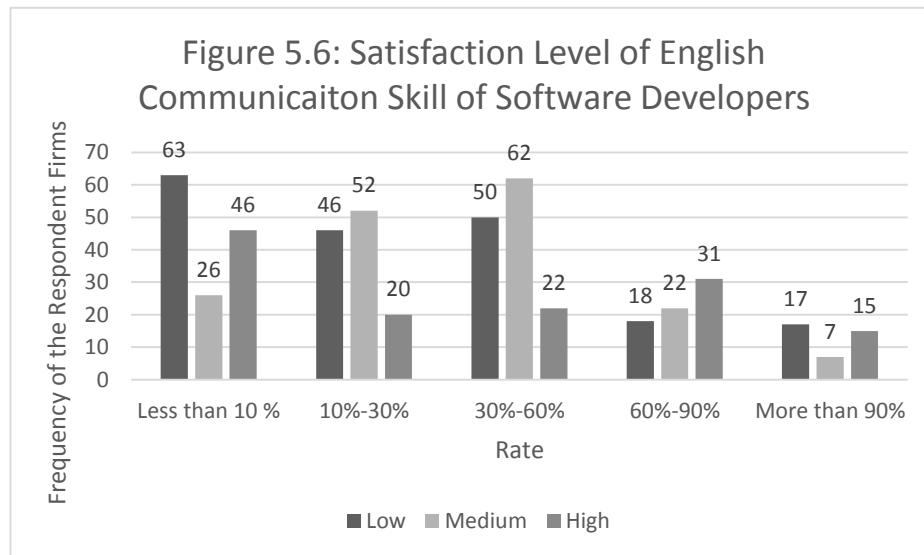
5.5 Current State of HR and Steps being taken to Improve

It has been learned that quantity of CSC/CSE graduates is longer a question. It's the quality or employability, where industry insiders have serious concerns. From the Table 5.10, it can be inferred that across all areas there appears to be urgency of making improvement. Discussion with key informants indicates that software professionals are not mentally used to professional work culture. In certain situation, although they are good in technology, but due to their weakness in disciplined work culture, their productivity is quite unsatisfactory.

Table 5.10: Problem Areas of Human Resource in the Software Industry

Problem Areas	Level						
	Low	Frequency of Responding Firms					High
	1	2	3	4	5	6	7
Absenteeism	72	38	31	20	30	41	13
Frequent job switching	17	29	30	39	55	47	34
Lack of technological skills	35	37	43	34	38	36	20
Low motivation	67	27	11	26	54	39	22
Weak learning capability	52	30	29	30	44	35	11
Poor writing capability	51	24	13	30	51	36	13
Indiscipline work culture	54	18	24	28	45	36	17
Weak R&D exposure	41	15	28	42	41	42	16
Poor management capability	48	26	23	37	39	34	14
Weak in Math and Science	79	25	12	21	37	34	10
Weak in algorithms	84	18	12	16	41	23	11

Data source: Field Survey

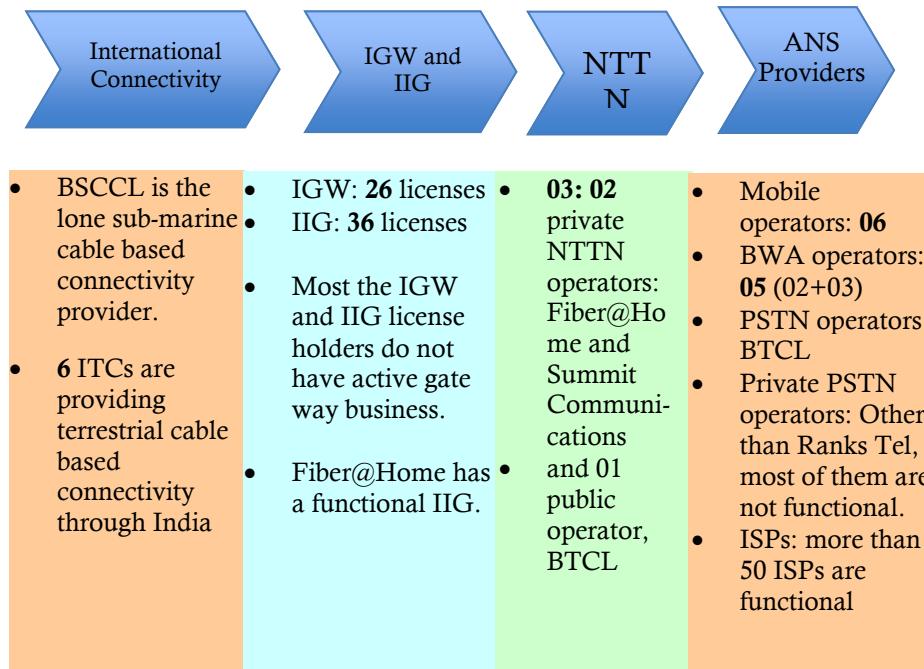


Data source: Field Survey

Here is concern about English communication skill as well, as shown in Fig. 5.6. Most of the responding firms have expressed dissatisfaction about such an important skill level of software professionals.

5.6 Current State and Improvement in Infrastructure

Broadband: The summary of operators in major segments of the broadband value chain of Bangladesh is shown in the following Fig. 5.7:



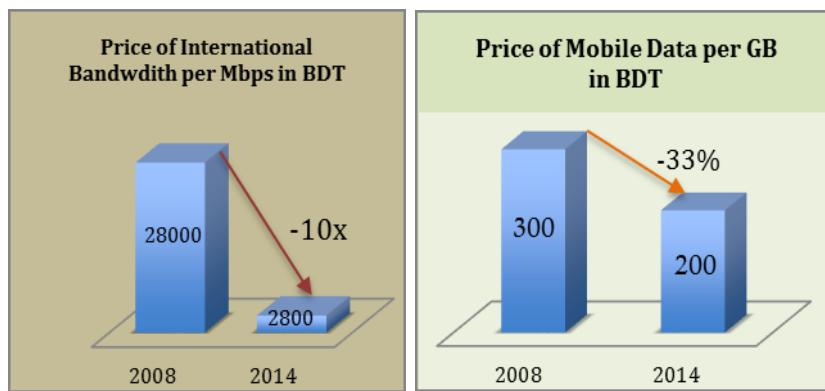
Moreover, ICX provides interconnection services to ANS operators, there are **25** ICX licensees. Like IGW and IIG licensees, most of ICX licensees do not have functional interconnection exchanges. NIX (BDIX) providers local peering of ISPs,

Figure 5.7: Major Vertical Segments of Telecommunication Value Chain of Bangladesh

Connectivity is important infrastructural component required for the growth of software industry. The advent of ITCs have intensified competition in the wholesale segment of the international or Internet connectivity. Over the years, wholesale bandwidth price has fallen from BDT 28,000/Mbps in 2008 to around BDT500/Mbps in 2015 (Source: KII). But such sharp price reduction is not reflected at the end user level, as shown in Fig. 5.8.

From location perspective, data consumption behavior can be summarized in three broad categories: 1. Fixed, 2. Nomadic, and 3. Mobile. There are three broad technology platforms to meet these requirements as shown in the following Table I. In terms of cost and quality, wireline is the preferred technology platform to meet consumption requirement from fixed locations--for delivering high volume data at a fraction of per unit cost of mobile platform. Due to growing comparative weakness of WiMax and accelerated growth of data consumption per unit coverage area, WiFi is the preferred technology platform for delivering data for nomadic usages. But due to weak investment in fixed and WiFi networks, 3G service offered by mobile operators is growing as the only choice to meet all these three categories of data consumption requirements—a discouraging development, as shown in Table 5.11.

Figure 5.8: Comparison of price fall of international bandwidth with that of mobile data services



Data source: Field Survey

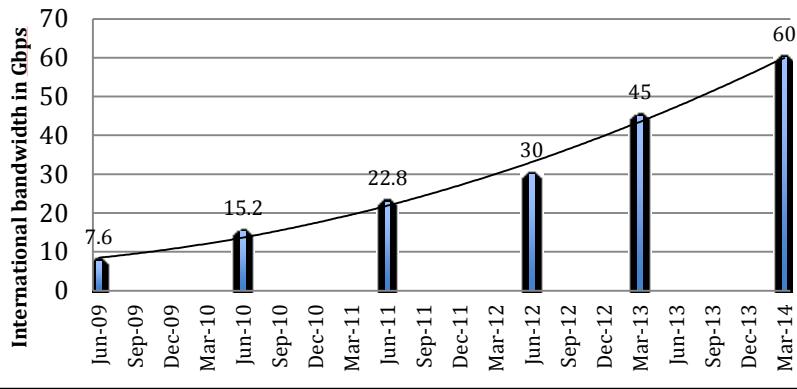
As a result, consumers are deprived from the potential of much lower cost service to meet their lion share of data consumption needs, which are primarily consumed at fixed and nomadic locations.

Reliance on cellular service to meet all kinds of data requirements is not only limiting the mobile Apps based business expansion, but also throttling the Freelance potential. Proliferation of freelancing across the country appears to be precursor for country-wide entrepreneurial activities in software.

Due to limited reach of wire line services, particularly outside Dhaka and divisional cities, unaffordable price of wireless broadband services is limiting socio-economic growth; even realization of some critical e-Governance services such as Digital Land Record management is facing affordability constraint due to high price of mobile data services.

Broadband Adoption Pattern in Bangladesh: According to BTRC, there are almost 40 million internet users in Bangladesh. Among them, 1.2 million are wire line users. Users for WiMax service have decreased to less than 300,000. Among these 40 million, majority access Inter using cellular 2G services—3G service has just started to take off. If a well-designed high performing WiFi network is developed to deliver broadband services at lower cost than 3G service, which is very much feasible, a large portion of these almost 40 million 2G users will be using this service using WiFi enabled smart phones. Despite the suffering of millions of users from slow speed of 2G services, Internet bandwidth consumption is exponentially growing in Bangladesh as shown in Fig.5.9. From different sources, it appears that such consumption has reached to almost 100 Gbps by the end of March 2015.

Figure 5.9: International Bandwidth Consumption in Bangladesh, in Gbps



Data source: Field Survey

Table 5.11: Data Consumption Behavior over Different Technology Platforms

Consumption behavior	Preferred technology platforms to provide connectivity	Primary access devices	Growing alternate preferences due to non-availability of preferred supply alternatives to meet accelerated nomadic and fixed demand	
			Delivery technology	Access devices
Fixed	Ethernet LAN, CAT4/CAT6	<ul style="list-style-type: none"> • Desktop PCs • Laptop computers • Smart TV 	3G(HSPA+) LTE	Smartphones Tablet PCs Laptops
	ADSL/VDSL			
	Cable modem			
	FTTH			
Nomadic	WiMax	<ul style="list-style-type: none"> • Laptops • Smartphones • Tablet PCs 	3G (HSPA+) LTE	Smartphones Tablet PCs Laptops
	WiFi			
Mobile	2G (Edge), 3G, 4G and WiMax	<ul style="list-style-type: none"> • Feature phones • Smartphones • Tablet PCs 	Note: A portion of Fixed line subscribers moved to WiMax to meet nomadic requirement. Due to better coverage and comparable price, WiMax users are migrating to 3G.	

Data source: Field Survey

Distribution of existing 40 million (approx.) subscribers over technology is shown in the following Table 5.12 (As of August 2014):

Table 5.12: Subscription Distribution Over Technology Platforms

	Frequency of Responding Firms						
	Ethernet LAN i/ADSL	4G WiMax	3G Mobile in	2G Mobile	FTTH	Cable Modem	Paid WiFi
Subscribers	1,23,1940	271,831	4,845,000	34,483,613	20,000	10,000	Negligible

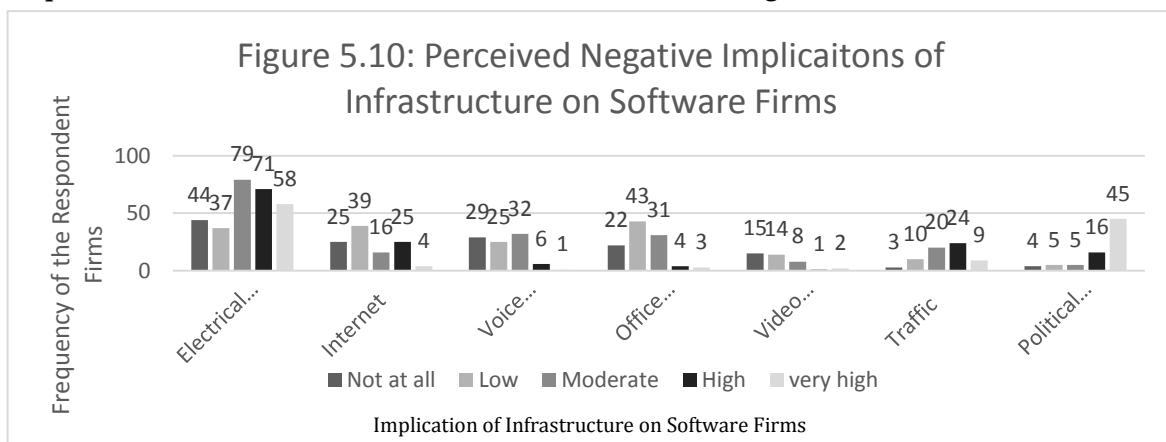
Data source: Field Survey

To clarify the constraint of broadband connectivity to the growth of enterprises through freelancing window of opportunity, let us consider an example to clarify the situation. A university graduate or drop out lives in a district town. The only option of getting data connectivity for him is cellular: whether 2G or 3G. Through this option he can

communicate over e-mail and socialize through Facebook. But, in order to deliver service over the Internet to online job market to generate income, the amount of money to be paid to cellular operators for connectivity does not offer profitable business proposition. A freelancer usually requires to visually communicate with the client and others for getting the job done. It's to be noted that text chatting and just voice significantly limits productivity and customer confidence in getting the job done remotely. Visual communication of 2 hours/day consumes 56 Gb/month. Moreover, he needs to access seamlessly web pages to develop necessary skill and bid for work resulting in additional bandwidth consumption; each page downloading consumes 1MB. It may not be unfair comment that a typical freelancer will require 60 GB per month to earn BDT 10,000 (average earning per freelancer is BDT 115,500 (USD1500)/year in Bangladesh). The market price for 60 G data delivered by 3G service is BDT 12,000 (60x200). As a result, this potential freelancer is derived from generation of BDT 10,000 income. But, conventional work pattern of the freelancer could have been supported with nomadic data services, delivered by WiFi at a fraction of cost. Such option of having data service has the potential of creating job of millions of Bangladeshi students. To unlock this growth potential, we must find alternative to 3G services, and WiFi could be that alternative. To make it clear, 1 million job creation at a rate of BDT 115,500 (USD1500)/year has the potential of earning USD1.5 billion net revenue for Bangladesh. Moreover, high value services such as health, and education require video based interfaces. To support these applications, we need to consume 1 GB bandwidth per hour costing BDT200 taka, if connectivity is provided by 3G services. Such cost of data certainly limits the consumption of tele health and educational services. But, these applications are mostly consumed in nomadic situation. Therefore, strong public incentive should be provided to expand WiFi based nomadic wireless services at a cost much lower than that offered by cellular.

Physical Infrastructure: Despite promises made the Government and persuasion of BASIS, progress has not been made in setting up Software Technology Park (STP) in appropriate locations. Such locations are preferred to be in Dhaka. The long delay in development of Kaliakoir High-Tech park and Government's project of developing Software Technology Parks outside Dhaka have basically very little contributions to make to address infrastructure issues, faced by the Software industry.

Power: It seems that there has been progress in the Electrical sector. With the given growth and planned projects, it appears that Electrical power will not be a constraining factor to the growth of the software industry in Bangladesh. The overall negative impression of infrastructure on Software firms is shown in Fig. 5.10.



Data source: Field Survey

5.7 Current State and Improvement of Access to Finance

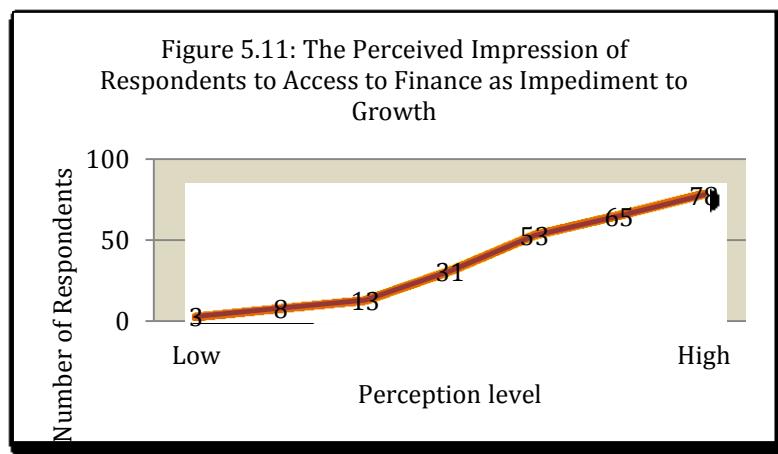
Although such issues have been raised many times, but it appears that no significant improvement has taken place. It has been learned that activities of foreign venture capital fund have been increasing in the IT sector of Bangladesh, particularly in the e-Commerce or ITES sector. The overall impression to fiscal issues faced by responding firms is shown in the Table 5.13.

Table 5.13: Impression about impediments caused by fiscal related issues to the growth of the Software Sector

Impediments	Low	Frequency of Responding Firms						High
	1	2	3	4	5	6	7	
High rate of Duties & Taxes on Software	7	7	11	32	35	72	73	
Limited supply of working capital	1	3	9	32	61	102	30	
Absence of export incentive	1	1	6	26	61	78	56	
Complicated banking procedures	1		4	25	63	80	54	
Bank borrowing rate is high		3	5	30	76	83	37	
Difficulties in customs clearance	4	5	6	30	66	70	33	
Fund constraints for purchasing software license	2	2	8	41	65	75	30	
Absence of funding sources for long term financing	2		4	34	73	87	40	
Absence of funds for market promotion	2	5	9	28	73	84	40	
Absence of funds for R&D		3	3	29	70	79	61	
Lack of availability of risk capital to provide training to employees	1	3	4	19	76	83	31	

Data source: Field Survey

The overall impression to access to finance causing impediment to the growth of Software industry is shown in Fig. 5.11. Among these respondents, 78 firms find access to finance as very high impediment. Only a small fraction, less than 30 firms, finds it less than average impediment.



Data source: Field Survey

5.8 Current State and Improvement of Market Access

It seems that conventional enterprise software application market is saturating. The demand of customized software and customized version of generic applications specific to different business functions are facing hurdles to grow. Impression about market access is shown in Table 5.14.

Table 5.14: Perceived Impediment of Market Access to the Growth of Software Industry of Bangladesh

Perceived Impediment	Low	Frequency of Responding Firms						High
	1	2	3	4	5	6	7	
Capability of Bangladesh's software sector is not known internationally	9	4	11	36	47	71	80	
Tendency to use pirated software deters foreign firms to develop R&D center in Dhaka for contracting out work to local software firms	9	7	13	29	77	78	33	
Domestic market is very small.	7	5	21	36	80	60	32	
Efforts to market Bangladeshi ability/products is lacking	2	3	14	32	72	77	27	
No organized publicity of capabilities of firms involved in software development.		4	13	40	66	77	25	
Difficulties in obtaining direct access to foreign market.		6	11	38	61	80	25	
Low participation in international fairs, which provide opportunities for marketing		2	10	33	87	66	26	
Low opportunity for exhibiting local software capabilities.	1	3	14	37	74	77	21	
Marketing efforts in large software markets is non-existent.		4	12	39	78	65	19	
Quality of Bangladeshi software developers is unknown.	3	2	16	39	72	73	25	
Opportunities for software manpower is not exploited	2	4	8	27	77	56	21	

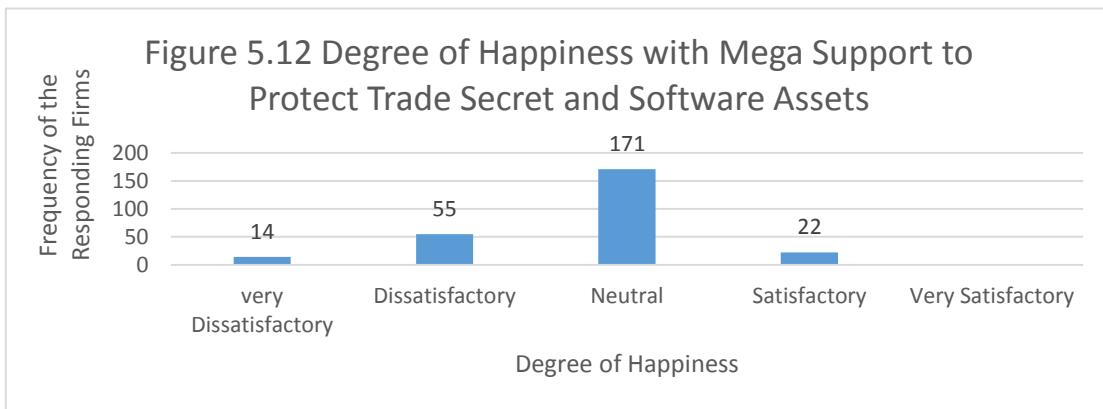
Data source: Field Survey

Particularly, large corporate clients are showing interest for best-of-breed enterprise applications delivered by globally reputed companies such as Oracle and SAP. As a result, software companies are increasingly facing difficulty in developing software projects with large corporate clients. On the other hand, due to proliferation of broadband infrastructure, best-of-breed application providers may choose cloud based delivery of enterprise applications, causing further hurdle to conventional approach of doing software business. Such changes are also creating new business opportunity—software implementation service delivery. Due to weak HR capability and lack of track record in doing similar jobs, such new opportunities are being taken over by foreign providers. The migration from on premise customized software applications to either on premise best-of-breed enterprise applications or cloud based service consumption is also a global trend. As a result, conventional software business is facing saturation, or may be the risk of being extinct (Source: KII), but new opportunities are being created in the same market segment.

Development of smart hand held devices and proliferation of broadband services are creating new opportunities of delivering innovations solutions to key markets such as education, health and agriculture. But due to weak R&D capacity, non-supportive public procurement practices and weak strategic capability, among many other factors, Bangladeshi software companies are in a bit difficult position. On the other hand, on-line job market has the potential to overcome conventional barriers faced by software entrepreneurs.

5.9 Protection of Software Assets and Intellectual Property Rights

It has been learned from multiple sources that departing employees took away software assets from the company and started offering the same, or slightly modified solution, in the market. In some cases, departing employee damaged software assets during the process of leaving the company. It has been mentioned that existing legal framework does not provide remedy to such problems faced by software companies in Bangladesh. Overall satisfaction level of responding companies to protect the loss of trade secret and software assets likely to be lost due to departing employees is shown in Fig. 5.12.



Data source: Field Survey

It has been reported by several key informants that intellectual property right is a very important issue for software firms. But awareness and practice of this important matter is very weak among local software firms. One of the reasons of such situation is that software companies are not becoming serious about the development, protection and management of intellectual property. It has been reported that there is a need of improving the legal framework for making it suitable to address issues related to protection of software assets faced by local software companies. Overall impression of key informants about IPR within the context of software industry is shown in the Fig. 5.15.

Table 5.15: Impression of KIIs about IPR for Software Industry of Bangladesh

Level	Relevance for Software Industry	Current Level of Practice	Recent Improvement
Not at all			x
Low		x	
Moderate			
High	x		

Data source: Field Survey

It has been suggested that steps should be taken to improve the existing framework to address issues related to protection of software assets in different circumstances, and to create awareness as well as capacity within software firms. Weakness in IPRs has been cited as one of barriers to FDI in software industry of Bangladesh.

Software IPRs from the Perspective of Investment and Economic Development: Risk capital investment to produce intangible assets appears to be at the core of creating wealth through software. In the software industry, Intellectual Property Rights primarily takes two forms of ownerships: 1. Copyrights, and 2. Patents. The protection of trade secrets is part of IPRs systems—which appears to be a useful instrument to protect the knowledge which is being generated in software firms as part of experience. Such trade secret could be domain knowledge forming the core insights for innovating software solutions targeting particular market segments. Although IPRs are supposed to be part of the institutional infrastructure of software industry that encourages private investments in formal research and development (R&D) to gather insights, generate ideas and innovate software solutions for commercial benefits, but like many other developing countries, have not relied on IPRs protection as a major mechanism to foster innovation for the growth of software industry²⁹. It is known from the IPR-literature that patents signal niche and expertise on a technological front level and it signals the intangible sources of competition within the firm—which gives attracts VCFs that there may scope of investment and assessment of intangible assets may be pursued in less costly, and more precise manner³⁰. Patents may be efficient signals to institutional investors because they are accessible and distributed sources of information. It is therefore likely that in many cases the value of signals exceed the costs of information disclosure—particularly to attract foreign Funds. Without the presence of strong IPRs culture, software firms stay away from making investment in product development. Rather, they prefer project based software development—which has very limited economic benefits for the society. It appears that this has been the reality in the software industry of Bangladesh. Most of the Software Firms in Bangladesh are SMEs, barriers faced by SMEs, indicated by many studies³¹, should also be taken into consideration to improve the IPRs culture. Despite the presence of many debates³², it appears that IPRs regime suitable for the growth of risk capital investment to support innovations appears to be critically important for the software sector of Bangladesh.

It should be noted that the Open Source movement challenges the traditional IPR regimes by providing alternative incentive mechanisms for software developers that are based on reputation rather than on exclusive rights. It appears that quality and the innovative value of software patents of other countries should evaluated to reveal links between software patenting and the emergence of Open Source projects³³ to reach to IPRs framework suitable for Bangladesh. Some of the works done on Open innovation system could be useful in this regard³⁴. Adopted IPRs framework, establishing links between technologies, markets and legislature, should take into consideration of encouraging private investment for R&D for software innovations to maximize both consumer and producer surplus.

Global Software Piracy and Bangladesh: In Software Piracy Impact Study³⁵, IDC and

²⁹ World Bank, Intellectual Property Rights and Economic Development, 2000

³⁰ Jesper Lindgaard Christensen, The IPR System, Venture Capital and Capital Markets – Contributions and Distortions of Small Firm Innovation?, DRUID working paper No. 08-03.

³¹ WIPO, Intellectual Property (Ip) Rights And Innovation In Small And Medium-Sized Enterprises.

³² Raymond J. Keating, Unleashing Small Business Through IP, Small Business & Entrepreneurship Council, 2013.

³³ Elad Harison, Software Intellectual Property Rights: Economic and policy Analysis, ISBN 90 5278 494 9.

³⁴ European Union, A Practical Guide To Managing Intellectual Property Rights In An Open Innovation Context, 2012.

³⁵ IDC and BSA, Piracy Impact Study: the economic Benefits of reducing software piracy, 2010

Business Software Appliance estimated implication of software piracy on economic growth. In this study, IDC estimated economic implications of piracy of PC software on 42 countries, excluding Bangladesh. IDC's adopted analytical model factors in the relationship between spending on software and spending on related IT services and distribution using current, country-level market data and forecasts for the number of high-tech companies and employees; the taxes they pay; and the rate of PC software piracy and its commercial value. According to this study, Economic impacts of reducing PC software piracy by 10 percentage points in selected countries are shown in the following Table 5.16.

Table 5.16: Estimated Economic Benefits from Reduction of Piracy

Countries	PC software Piracy rate in 2009	10-pt reduction	10 pts Spread Over 4 yrs (\$M)	
		New Jobs	Added GDP	Extra Taxes
India	65%	59,728	\$4,662	\$512
Indonesia	86%	1,884	\$2,433	\$124
Thailand	75%	2,175	\$1,297	\$73
Vietnam	85%	2,100	\$1,173	\$60
USA	20%	25,431	\$37,810	\$6,094

Data source: Field Survey

Different estimates indicates that Bangladesh's software piracy rate is extremely high: as high as 90%³⁶. According to IDC, on average, for every dollar paid to software publishers another \$1.30 is spent on related services and \$2.50 is spent on distribution. In analysis of the PC software markets in many countries with different piracy rates, IDC has found that countries with lower piracy rates have proportionally larger domestic software markets. It appears that steps taken towards the reduction of software piracy will increase willingness to pay for software, which will largely benefit local firms to progress towards market expansion. Moreover, creating the awareness that software procurement costs money will encourage the investment appetite among potential local angel investors.

Strong copyright laws are essential — but meaningless without effective enforcement. The reduction of software piracy can require a fundamental shift in public attitudes toward software and IP. Public education is critical, therefore, to increase awareness of the importance of managing software assets and respecting creative works through compliance with software licensing. Moreover, support for industry-led initiatives to promote the business practice of managing and optimizing software purchases, utilization and maintenance — a process known as software asset management (SAM³⁷) — can reduce piracy while helping governments, businesses and other organizations derive greater value from software assets. Governments being the largest users of software may lead the process through creating example. Governments can set example to follow by implementing SAM policies, requiring the use of legal software by all government agencies, and promoting the use of legal software by state-owned enterprises, contractors and suppliers.

Supportive Role of IPRs Culture to Link to Global Value Chain of Software Industry:

³⁶ 2011 BSA global software piracy study Ninth edition, MAY 2012.

³⁷ (www.bsa.org/samadvantage)

There are many dimensions of this important sub-topic: 1. Being trust worthy software R&D services providers to global clients, and 2. Developing and positioning software products in the global market. In recent past, globalization of software industry has encouraged companies of advanced economies to distribute software engineering services and R&D value chain among companies of other countries, including India. Bangladesh, with large student population, has the aspiration to connect local software firms to this global value chain. So far, success appears to be far below than potential or the success of neighboring country. According to different studies³⁸, risks to privacy, data security, or intellectual property are among strong reasons for consideration of clients' companies to contract out works to companies of other countries. Although the trend of globalization of value chain is growing³⁹, Bangladesh with perceived piracy rate of 90% appears to be in disadvantageous position to promote local software firms as preferable partners for software development to global clients—primarily from USA, Europe and Japan. Among many other factors, due to competition, availability of high bandwidth connection and cost advantage, it happens that many SMEs of advanced economies are willing to set up their own software development facilities or contract out works to local firms of Bangladesh or other developing countries. For SMEs in advanced economies, the link between innovation, intellectual property rights and funding is crucial. These SMEs not only need to protect their cutting-edge innovations from being copied, but also are dependent on IPRs to attract investment and commercialize their innovation⁴⁰. According to recent study⁴¹, to overcome disadvantages linked to lack of resources and scale, as well as gaps in business expertise, innovative SMEs of advanced economies often engage with entities with complementary assets. IPRs, such as patents, have two advantages that are of particular interest to innovative SMEs. First, they can assume an important signaling function, to the market in general and to potential investors and partners in particular. Second, registered IP rights can be used to manage collaboration with other companies, which is a necessity for many SMEs in part due to their limited internal capacities. It should be noted that most of SMEs pursuing innovations centered around software secure risk capital financing from outside investors such as VCs. Due to weak IPRs culture, these SMEs from advanced economies will less likely be willing to contract out work to Bangladesh. Despite the presence of technical competence, multiple firms simply cannot cooperate to develop and commercialize software innovations without the support of awareness, education and culture to comply with IPRs practices required for software asset management. Therefore, it may be fair to comment that significant improvement to be made in the area of IPRs protection for IP set development and management⁴² to tap the potential gain from software innovations.

5.10 Entrepreneurs and Drivers for Entrepreneurships in the Software Sector

³⁸ Globalization and Offshoring of Software, A Report of the ACM Job Migration Task Force, 2006

³⁹ Integrating Developing Countries' SMEs into Global Value Chains, UNITED NATIONS
New York and Geneva, 2010

⁴⁰ Jensen A and Pugatch M, eds. (2005). "IPR and SMEs", in Intellectual Property Frontiers: Expanding the Borders of Discussion. Stockholm Network Publication

⁴¹ International Chamber of Commerce, Enhancing Intellectual Property Management And Appropriation By Innovative Smes, 2013

⁴² WIPO, IP Asset Development and Management: A Key Strategy for Economic Growth.

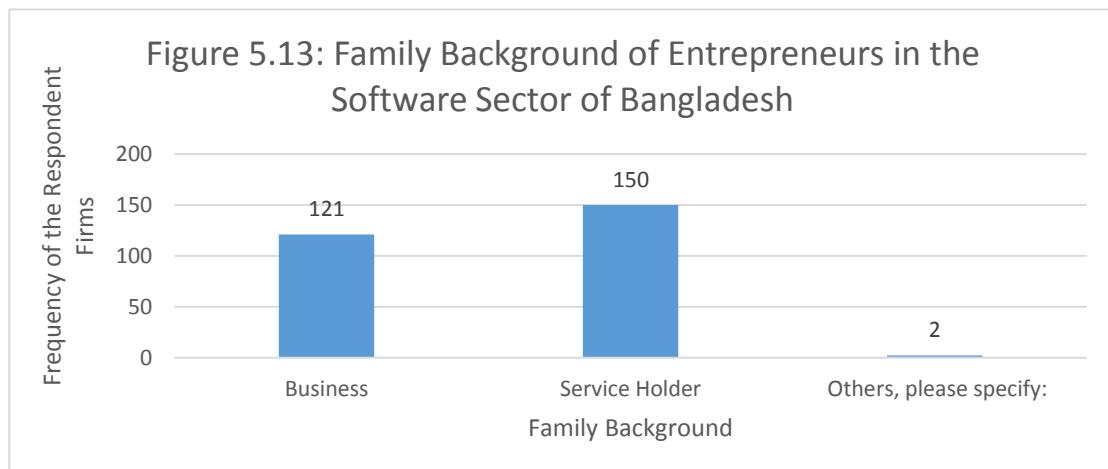
As it has been mentioned before that average age of entrepreneurs starting software firms has been less than 35 years. Academic backgrounds of entrepreneurs in the software industry of Bangladesh are shown in the Table 5.17. Academic backgrounds in Computer Science, Engineering and Business are very much common among entrepreneurs in this sector. A number of entrepreneurs have also academic background in foreign universities.

Table 5.17: Academic Backgrounds of Entrepreneurs

Education level	Subject areas (Frequency of Responding)				
	Computer Science	Engineering	Physical Science	Business	Others
HSC	2	2	4	2	7
Vocational	5	4	2	7	3
Honor's	37	36	10	26	1
Masters+	72	38	7	61	16
Foreign university education	5	5		3	2

Data source: Field Survey

In terms of family background, the largest number of entrepreneurs are from families with professional service background as shown in Fig.5.13. It seems that Freedom is the main driver behind entrepreneurial journey in software, as shown in Table 5.18.



Data source: Field Survey

Table 5.18: Drivers behind Entrepreneurial Journey in Software

Factors	Low	Frequency of Responding Firms						High
	1	2	3	4	5	6	7	
Freedom			5	14	35	81	109	
Technological knowledge		2	4	20	76	72	67	
Product idea and prototype as part of university education	12	3	9	19	58	71	28	
R&D exposure	13	6	9	37	51	56	33	
Participation in business idea competition	27	3	6	35	57	45	22	
Potentiality of the sector		1	9	28	63	72	57	
Have experiences in this field	1	5	6	28	75	55	27	
Have passion for software business		1	9	32	57	55	48	
Contribute to the country	3	1	9	26	64	60	50	
Required low capital	3	10	12	39	59	48	32	
Love to take challenges	1	1	8	27	62	62	42	
Personal Growth and fulfillment			8	31	74	52	28	
Money	7	9	8	44	62	49	34	

Data source: Field Survey

In the software sector, there appears to be five major categories of outputs, which shape entrepreneurial models:

1. To deliver project based customized software application services to local clients
2. To develop and deliver products, and services around them to local clients
3. To offer software development services to foreign clients through on-line market place such as oDesk.
4. To offer software development services to foreign clients as captive development center
5. To offer software development services to a number of small foreign clients through direct contacts.

It seems that multi-year large contract to deliver software development services to large foreign clients, which is common in India, is not present in Bangladesh. Entrepreneurs may start software firms to deliver one or a mixed of these services. Delivery side could also be segmented along these five dimensions. Opportunities and constraints faced by each of these service delivery models significantly vary.

Entrepreneurial Dynamics in the Software Sector of Bangladesh: Such dynamics could be categorized in five broad groups. In the **First** group, a group of senior students, or experienced employees of software firms having exposure to technology and some sort of link with local clients, take the initiative of developing software firms. They usually take the approach of offering customized application development services. In course of time, they try to give product shapes to some of these applications—primarily delivered as project assignments. Along the way, they expand equity partnership to Angel investors and resourceful professionals. Upon gaining certain experience in the local market, they also attempt to deliver software developments services to foreign clients. Due to high cost of delivery and discontinuous work flow, these companies face growth limit of 20-30

employee size within 3 to 5 years of their formation. Some of them have grown to bit of larger size, but usually, not more than 100 professionals.

In the **Second** group, primarily NRBs having exposure to foreign markets, take the initiative to develop software firms in Bangladesh. Usually, these entrepreneurs do not aggressively invest to develop large delivery centers to attract large customers to win large projects, say 10's of millions. Discontinuity of workflow generated from small work orders lead to poor financial health. These firms also reached to saturation at a level of 20-30 employees within 3 to 5 years of operation.

The **3rd** category belongs to captive development centers. Certain foreign firms, usually SMEs, develop back office technology centers in Bangladesh to provide software development services to their parent companies. 20-20 technologies, a 100% Canadian captive facility, having 18 HR is an example of this category. It happens to be the reality that none of the parent companies having captive development center in Bangladesh experienced exponential growth resulting in significant expansion in Bangladesh. As a result, the sizes of these captive development centers also reach to saturation to 25 to 30 people within few years. One of the exceptions was Samsung R&D center established in Dhaka in 2011. The center grew to 600 professionals by 2013 with a plan of expansion by additional 400 by the end of 2014⁴³. But unfortunately, the center started shrinking from the middle of 2014 reaching to 300 professionals by March of 2015.

The **Forth** is the emerging category; primarily they are originating from free lancing work on the online market place. Primarily students, also employed software professionals, start working on the on-line market place as an individual to deliver software development services to foreign clients. Upon developing good reputation and client base, some of these high performing freelancers start forming companies to offer software development services to some of those clients, with whom they develop a good trust worthy relationships. There is a potential of formation of large number of such companies, all across the country, within reasonably short period of time. Due to small work orders, discontinuity of workflow, and also having limited scope to benefit from reuse, the scope of developing large enterprise out of this model does not appear to be attractive either. But, if some of their foreign clients experience exponential growth that may result in scaling up of some of these local start-ups. The **Fifth** category, relatively rare in Bangladesh, represents those companies who develop software products, and of course becomes successful, targeting the local as well as global market. REVE systems is an example of this category. Under the leadership of Mr. Rezaul Hassan, REVE Systems started in 2003 with a focused approach to serve the IP based communication industry. Currently, REVE systems serve 2600+ VoIP and telecommunication service providers across 78 countries. Growth challenges faced by each model of entrepreneurship in the software sector of Bangladesh are summarized in the following Table 5.19.

⁴³ The Financial Express, Samsung R&D centre in city recruits 600 software engineers
To recruit 400 more by 2014, Published : Tuesday, 23 July 2013

Table 5.19: Growth Constraints Facing Different Groups

Types of Entrepreneurial Journeys	Growth Constraints
First Group	Lack of ability of generating delivery assignments to the same market segment to meet similar application requirements using the same technology base makes cost of delivery high. Due to high diversity, learning curve benefit is negligible resulting in low value of experience. In such companies, the scope of financial reward for experienced employee keeps decreasing with the growth of experience resulting in high employee turnover.
Second Group	Due to high diversity of customers and large variations of customer requirements (both functional and technological), scope of reuse is low, customer specific learning requirements is high, and rework level is also high. As a result, cost of delivery is high. Moreover, due to discontinuity of work orders, average ratio of billable hours to available hours is also low. Within short period of time, employees start losing hope of building career in these companions, resulting in loss of valuable tacit knowledge.
Third Group	It happens to be parent companies of all the captive development centers, but one, in Bangladesh are also SMEs. They basically use these development centers to meet their own needs. As a result, these development centers are small; they also grow at very slow space.
Fourth Group	Small work orders and risk of losing clients to employees limit the scope of firm level growth. Moreover, the need of rapid technology upgrading creates significant demand on technology learning resulting in low income level.
Fifth Group	This group requires significant managerial insights, domain expertise and financial capability to remain focus on same set of requirements required by a group of customers, both local and foreign. At the moment of discontinuity, whether technology, or business model, policy regulatory, such opportunities of creating disruptions with new products or service delivery models are created. Smart entrepreneurs should carefully look for entry opportunities created by discontinuities to create success stories. For example, smartphones and wireless broadband connectivity are creating such discontinuities in conceivable every industry.

The software company development model, which has created the success stories in India, is largely absent in Bangladesh: software engineering shops to meet software development and maintenance requirement of large overseas clients. Foreign clients have largely developed such shops in India by ensuring work orders and on site production or project management professionals. The core technology development and commercialization model, largely financed by defense contracts, of Israel is also absent in Bangladesh. The presence of multinationals' R&D lab, to benefit from EU policies, have created the success story in Ireland. It seems that any of these 03 models are close to impossible to replicate for Bangladesh. Bangladesh should rather investigate already experimented five models to figure out most appropriate models to replicate to scale up the success.

Software Sector as an Opportunity for Creative Entrepreneurship for the Youth: RanaPlaza disaster in Bangladesh and valuation of 55 people company at BDT 1,463 billion (USD19 billion) (WhatsApp) in the USA show gulf of difference of wealth creation through labor and creativity. Irrespective of nation or race, creativity spurs many individuals, including young men and women, to undertake new industrial ventures with a vision of the future transformation of their societies. The economic benefits from creativity gift is largely determined by how creative talents are better organized through business and supported by institutions, and where competition encourages and, most importantly, rewards creativity and entrepreneurship. The study done by UNIDO⁴⁴ points to the institutionalization of creativity to explain, why certain societies are able to productively organize creativity to solve their most pressing problems and achieve progress, while others lag behind in spite of abundant creativity and a rich civilization. Not so encouraging performance of so many entrepreneurial initiatives to develop thriving software development industry in Bangladesh largely lies in institutional weakness to nurture creativity to produce wealth through software innovations.

Availability of low cost computing power, broadband connectivity, smartphones, sensors and globalization of economy are opening the software innovation based entrepreneurial opportunities to millions of Bangladeshi youth to create path breaking growth opportunity through creativity. Creating the institutional capacity to support the exploitation of such unfolding opportunity is very much required for Bangladesh not only as one of many development options, rather may be the only option we have to avoid the middle income growth trap⁴⁵. Countries, such as Thailand and Malaysia⁴⁶, moving from low-to-middle-income level by leveraging cheap labor and competing on costs become unable to compete against advanced economies while facing increased competition from less developed economies. Institutional weaknesses—and there are many different types of relevant institutions—could deter innovation, hamper the efficiency of resource allocation, and reduce the returns to entrepreneurship. Institutional capacity should be strengthened in key areas for intervention in creative entrepreneurship: 1. Access to Market, 2. Finance and Investment, 3. IPRs, 4. Education and Training, 5. R&D, 6. Networks and Cluster, and 7. Innovation and Governance. Effective steps should be taken to address each of these issues in an efficient manner. For example, participating in Trade shows helps get in touch with potential clients, but addressing IPRs issue is a pressing need to address to build trust to get work orders from those contacts.

How young entrepreneurs can develop competitive software firms to foster innovation led wealth creation in both domestic and global economies should be the focus of job creation and poverty reduction strategy for the nation. How governments can assist young entrepreneurs in shaping their future work in the creative industry sector such as software and what are the required development institutions and policy changes should be the priority of our time.

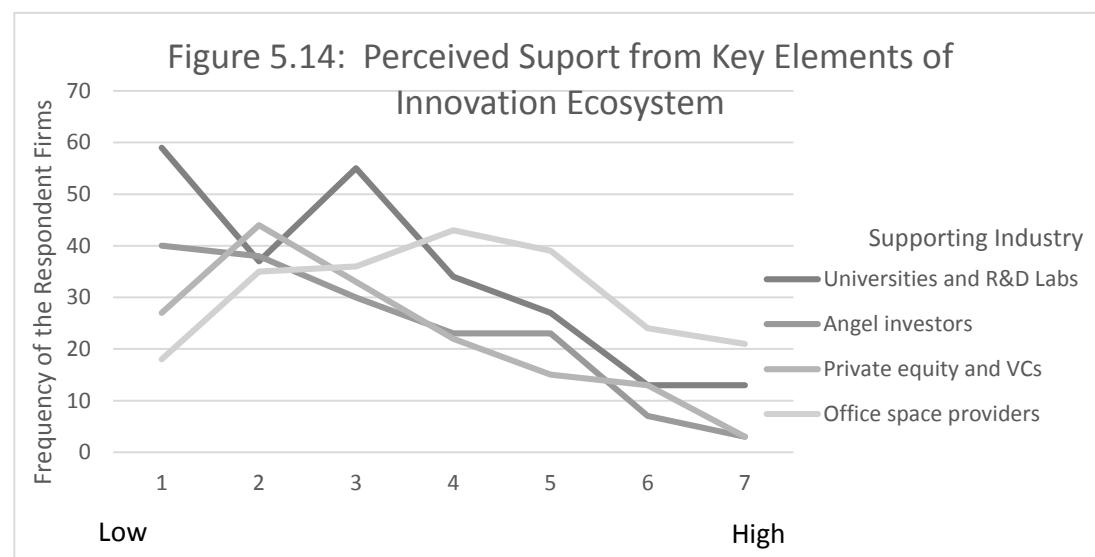
⁴⁴ UNDO, Creative industries for youth: unleashing potential and growth, 2013

⁴⁵ IMF, Growth Slowdowns and the Middle-Income Trap, 2013

⁴⁶ The Asia Foundation, Middle-Income Trap: Economic Myth, Political Reality.

5.11 Innovation Ecosystem and Integration of Software Firms

There is strong sense of urgency about the importance of R&D for the software industry. National innovation ecosystem plays an important role to enable software companies to address this essential factor of success. In innovation ecosystem, Universities, R&D facility, Angel Investors, VCs and Purpose built office space play an important role. Overall impression about such important components among responding firms is shown in Fig. 5.14.



Data source: Field Survey

As it has been shown, satisfaction level about the innovation ecosystem supporting the software industry is low. To address such weakness, responding companies have provided suggestions in the design of software Technology Park, as shown in Table 5.20.

Table 5.20: Facilities to be Included in the Software Technology Park to Strengthen the Innovation Ecosystem

Facilities	Very low importance		Frequency of Responding Firms					Very high importance	
	1	2	3	4	5	6	7		
Training institute			3	7	36	55	150		
University with focus on software technology and innovation	2	1	2	9	53	86	101		
Conference center	2	1	9	19	49	64	88		
Library	4	1	7	17	58	51	89		
Consulting services for business and market development			7	17	49	75	81		
Venture capital funds	1		4	20	57	65	79		
Consulting services for productivity and process improvement		3	5	13	51	74	88		
Foreign companies with the capacity to contract out work to local software firms	1		6	21	43	72	82		
R&D laboratory	1	1	3	8	45	57	103		

Data source: Field Survey

It has been learned from key informants that local software companies are hardly connected to the global ecosystem. Government's support for joint R&D projects in partnership with foreign instructions could have been useful step to address this limitation.

Emerging Opportunities of Software Innovations: Historically, the role of software in managing business processes such as Accounting, Transactions, etc. was the primary factor behind demand creation for the software industry in Bangladesh. In Bangladesh, most of the software companies focus in this segment of the industry. The entry of Global Market players and cloud based offering of software as a service are placing local software firms in a bit of disadvantageous position. But, a number of recent developments have been creating new opportunities for the software development sector. For example, the proliferation of Smartphones, wireless connectivity (whether cellular or WiFi) and cloud based back end computing are opening new opportunities of delivering software based innovations in critical sector of the society— such as Agriculture, Health, and Education.

Due to rapid reduction of price, accelerated miniaturization, low power consumption need and high reliability of computing hardware devices, products and services of almost any industry increasingly depend on software for differentiation and performance. According to recent study done by Mckinsey⁴⁷, the core competition competency of any industry of the world is about to take transition from hardware to software-enabled value creation. In a recent letter to shareholders, General Electric CEO Jeffrey R. Immelt offered a view of where things are headed: "We believe that every industrial company will become a software company". Value of products and services is shifting rapidly as hardware features are increasingly commoditized and software differentiates high- from low-end products. And ever more miniaturized computing power means that the value of embedded software in products is expected to go on growing. As software-enabled customer interactions become the rule, revenues from digitized products and channels are expected to exceed 40 percent in industries such as insurance, retailing, and logistics. According to this study, CEOs and their top teams of any industry are about to get up to speed on how software could be differentiating or disrupting their current businesses and industries. In order to add value to this game changing transition of competition strategy of the industrial economy, software innovation capability is critically important.

Software Innovation Process: Software innovation may be broadly defined as the successful commercial introduction of a new product, service or process. Software innovation can be seen as a process leading to:

1. development of a novel aspect, feature or application of an existing software product or process; or
2. introduction of a new software product, service or process or an improvement in the previous generation of the software product or process; and
3. entry to an existing market or the creation of a new market.

Software innovation adds value to all three types of innovations in any industry, such as:

1. Efficiency innovation, which primarily focuses on automation for improving productivity.
2. Sustaining innovation, which adds new features or improve existing features of

⁴⁷ McKinsey Quarterly, The perils of ignoring software development, 2015

- products and services.
3. Disruptive innovation; in this kind of innovation, software becomes the technology core of offering new value creating new industry by causing disruptions to existing way of doing things.

Software innovation process follows typical S-curve, starting from idea generation, and progressing through concept demonstration, market testing and commercial roll out.

Software Innovation Ecosystem:

The intensity of software-related innovation activities is influenced by a variety of factors that determine its success and that these conditions vary from one place to another. Some of these factors, forming the software innovation ecosystem, are as follows:

1. Investment in R&D
2. Human Resource Supply
3. IPR Regimes
4. Financing, including risk capital
5. Linkage with Value Chain Partners, including global
6. Infrastructure, including office space
7. Training and Professional Services
8. Policy of Software Innovation Led Growth
9. Software Innovation led Growth Management

Role of Public Support for Software Innovations: As it has been explained in this report that there is strong urgency in the industry to strengthen the software innovation ecosystem to address growth constraints faced by the industry. Justification of investing public money in strengthening the innovation ecosystem could be a matter question to policy makers.

According to different thought leaders of free market economy, including Joseph Stiglitz⁴⁸, there are some goods that the market on its own will undersupply—innovations are among them. That is why, in innovation intensive software industry, the Government should take key role in supporting innovations, which could be done by strengthening the innovation ecosystem of the software industry.

According to the Intelligence Unit of The Economist⁴⁹, the rise of ‘micro-multinationals’ – start-ups, which operate across high- and low-cost locations, delivering to an international customer base – exemplifies the opportunities brought by globalization, digital communications and the Internet. Many of existing software companies in Bangladesh and new start-ups may grow as significant value creation agents in both the local and global value chains. The challenges for business leaders and policymakers are to empower such opportunities for entrepreneurs and to foster domestic and international innovation ecosystems, while mitigating limitations of an increasingly dysfunctional

⁴⁸ Joseph Stigliz, Freefall: Free Markets and The Sinking of the Global Economy, 2008.

⁴⁹ The Intelligence Unit, The Economics, Innovation Ecosystems Empowering Entrepreneurs and Powering Economies.

global labor market. Aside from the economic gains of supporting the growth of Enterprises in the software development sector, the soft power benefits of a thriving domestic innovation ecosystem can buoy ‘cultural self-confidence’ and become a virtuous cycle of innovation to meet the current and future needs to support Bangladesh to enjoy growth in diverse sectors to be rich country in the foreseeable feature. Despite the presence of a key hypothesis in the literature on Local Knowledge Spillovers, which states that local knowledge spillovers are the main reason for the increased innovative and economic performance of the firms in clusters and/or regions in the advanced economies⁵⁰, local knowledge spillovers in developing countries have so far received less attention⁵¹. As it has been found in this study that most of the software firms are contributing to performance improvement of all major economic sectors of Bangladesh, also the Government, by innovating and delivering software innovations, customized to local need. Therefore, it could be argued that investment of public resources in strengthening the software industry innovation ecosystems has the potential to have multidimensional effects.

Issues for Policy Makers and Industry to Consider to Strengthen the Software Innovation Ecosystem: Despite high potential and numerous steps taken to date, Bangladesh’s software industry failed to meet expectation. On the other hand, neighboring country India has shown tremendous success, in any scale. Such high contrast presents an unusual set of problems for policy makers to support the growth of software industry in Bangladesh. Software is a relatively low- investment, environmentally friendly, high-growth global industry – a good target growth industry for Bangladesh, with 30 million students in the education system.

With so many ICT-related concerns, including connectivity, pressing government planners, it may not be completely obvious why software requires special attention and consideration. The reason is that software has now become a core competency and general-purpose technology that is critical to the global competitiveness of most industries in every country, regardless of its level of economic development. Moreover, software innovations by taking into local context is going to be the single determining factor of value maximization from investment made in other ICT sectors, such as 3G/4G networks, and national wide high bandwidth connectivity. A single model of development of software industry, which has worked so well for a particular country, does not fit to other country. Every software-exporting country has evolved a unique industry, shaped by its own resources and situation and by the particular global opportunities presented at the time. For example, Japan exports mostly software games, India exports primarily software services to large software development shops, Ireland exports software products (created by MNCs located in-country as well as by a growing number of indigenous companies)⁵², and Israel mostly exports software technology which is subsequently productized by firms in the US and Europe. Software is a dynamic industry; suitable entry point appropriate for a country is continuously evolving. The imitation of success path, which led to the successful creation of such an

⁵⁰ Saxenian, A. (1994) *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge, MA.

⁵¹ Effie Kesidou & Adam Szirmai, Local Knowledge Spillovers, Innovation and Economic Performance in Developing Countries Empirical Evidence from the Uruguay Software Cluster, 2007.

⁵² Shirley Tessler and Nagy Hanna, National Software Industry Development: Considerations for Government Planners.

industry in particular country, such as India, is highly likely going to fail to produce desirable result for Bangladesh. The prudent approach could be to study the dynamics of the industry, both from local and global perspective, to detect entry and expansion opportunities for Bangladesh. Accordingly, the underlying software innovation ecosystem should be strengthened to support the growth of local software industry. With the given unfolding opportunities and prevailing capacity of the nation, options to be considered in supporting the software innovation ecosystem are as follows:

1. **R&D Investment:** Capacity in innovating software solutions for local wealth creation sectors should be given priority. R&D should be supported to absorb emerging technologies and development practices to support the creation of software engineering services for emerging applications such as Internet of Things and Machine/Embedded Intelligence of Computing.
2. **Human Resource Supply:** Human resource development should not only focus on knowing ICT, but also usages of ICT innovations in improving wealth creation activities. There should be strong focus on innovation and enterprise development around that technology competence. The focus should also be on absorption of best-of-breed software applications and their integration with locally developed solutions or capacities to maximize benefit for the economy.
3. **IPRs Regimes:** Focus should be given not only on the legal aspect of IPRs, but also on creating the awareness and capability of developing legally protectable intellectual/software assets and their commercial exploitation. Such capacity of the ecosystem is critically important to support the investment for the creation of software assets for commercial benefits. Until and unless we create legally enforceable demand for a commodity, investment for creation of enterprise or industry for development and commercialization of such commodity cannot be realized.
4. **Financing:** There is a need of risk capital financing for developing both software product and delivering software development services, irrespective of the market focus—whether domestic or export. Due to potential of high spillover effect, it's recommended that financing issues faced by the software industry should be adequately addressed.
5. **Linking with Value Chain Partners:** There are a number of policy and regulatory options what government has to facilitate linking local software industry with value chain partners, both local and global. Different Ministries, including the Ministry of Industry, can take strong policy options to support local software innovations and its integration to improve wealth creation or service delivery capacity of concerned ministries. For example, Ministry of Agriculture may adopt the policy of improving the field level knowledge management with software innovations to reduce yield gap of agricultural production. Similarly, Government may take regulatory measures to encourage foreign firms to increase local value addition to sell their software intensive applications, products and services in Bangladesh. For example, Government may require Smartphone or telecom equipment makers or global ERP software application developers to establish R&D center in Bangladesh to enjoy favorable taxations.
6. **Infrastructure:** It seems that office space has become the critical factor to consider. As

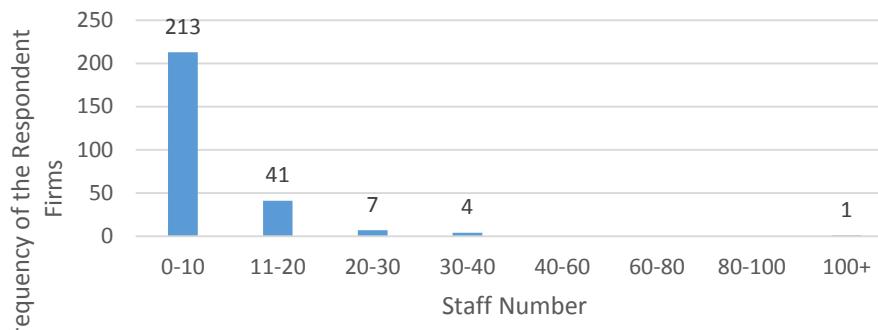
software has strong spillover effect, Government may justify to develop suitable office space which could be rented in favorable terms to both local and software firms as public good.

7. **Training and Professional Services:** Diverse high-end professional services will be or already required by the industry. The potential source appears to be Universities. A number of private and public universities already employ a growing pool of faculty members having higher educational as well as work experiences from USA, Canada, UK, Germany, Japan, and Australia. Steps to be taken to link these faculty members with local software firms. Moreover, local universities should be given assignment of providing needed training to the industry. Instead of making make shift arrangement, such as LICT project, strong software industry development centers of excellence, comprising of leading Public and Private universities, should be developed and consistently funded. Ministry of Education, UGC and BASIS should work together to address this matter.
8. **Policy of Software Innovation led growth:** It seems that there should be significant policy changes among the Government and the private sector alike to address pressing issues such as regulation or competitiveness improvement. Policy of placing software innovation, through local providers, to be placed at the core of available options.
9. **Software Innovation led Growth Management:** Significant capacity should be developed among Government Institutions and private sector clients to manage acquisitions of quality delivery by local software firms, who have not delivered same output before. Instead of relying on delivery track record, acquisition management should be focus to empower local firms to deliver needed solutions at possible least cost.

5.12 Perceived Scope of Improvement of Productivity, Quality and Time of Delivery

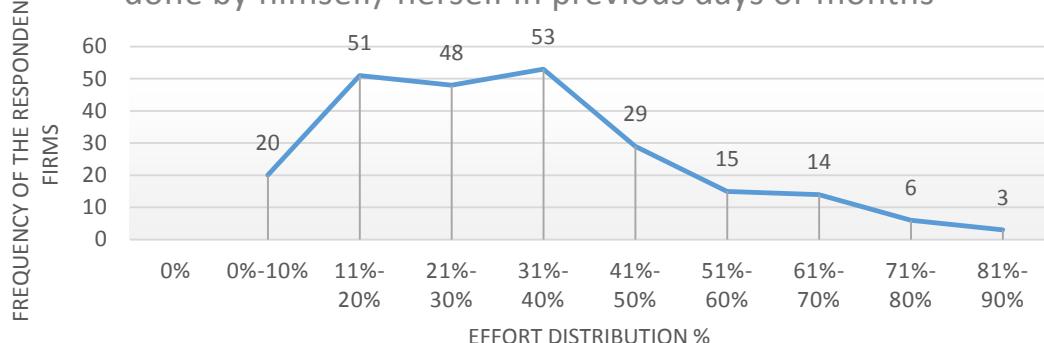
Employee turnover is a serious productivity related problem being faced by software companies in Bangladesh—significant tacit knowledge is lost. The primary knowledge base of software companies remains in tacit form, which is lost due to employee departure. Overall loss of staff appears to be high in software companies as shown in Fig. 5.15. Major attributes such as business process model, software requirements, architectural design, and coding conventions affecting the quality of software assets largely remains in tacit form. The loss of such important assets with the departing employee's significantly affects reworks and reuse level. Key informant interviews indicate that rework contribute to as much as 30% of effort spent. Rework not only increases the cost and time of delivery, but also increases unpredictability, which causes significant dissatisfaction in customers' minds; existing rework level is shown in Fig.5.16. Reuse is a powerful resource for reducing cost and time of delivery.

Figure 5.15: Loss of Experienced staff Per Year



Data source: Field Survey

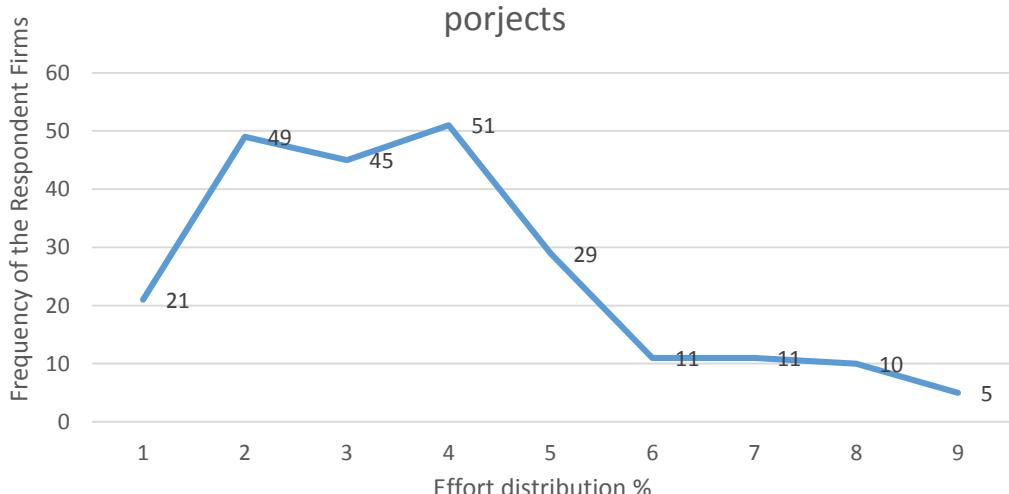
Figure 5.16: % of working hours spent in fixing work done by himself/ herself in previous days or months



Data source: Field Survey

Effort spent in reusing software assets as shown in Fig.5.17, developed in previous projects, to current project appears to be very high as well. Therefore, there appears to be significant scope of improvement of productivity through process, which focuses on reuse and rework.

Figure 5.17: % of effort spent in identifying and modifying software assets to be used in current projects



Data source: Field Survey

Chapter 6: Growth Prospects of the Software Industry of Bangladesh

6.1 Prospects of having Improvement in Infrastructure, HR, Access to Finance and Market Access

Infrastructure: IT infrastructure to support the integration of software in business processes is being improved. The advent of ITCs has intensified completion in international connectivity resulting in sharp fall in price of whole sale bandwidth. Moreover, the installation of SEA-ME-WE5 is progressing to provide 2nd submarine cable connectivity to Bangladesh. To address the secured backend, GoB is partnering with China. The Bangladesh Ministry of Information is planning to build the fifth largest data center in the world at Kaliakair, in the Gazipur district of Dhaka, according to reports in the Dhaka Tribune⁵³. Upon completion, this could be among the first Tier IV data centers in Asia, although there is a Tier IV (design) facility in Hyderabad and GPX has a Tier IV design certified center in Mumbai. It has been learned that Government is also working on to strengthen the nationwide transmission network, which is expected to address end user level broadband connectivity issue at an affordable cost. Moreover, private companies, including Mobile Operators, are also making aggressive investment in Transmission and access networks. Such development in IT infrastructure is expected to contribute to expansion of local market, both in public and private sector, and open the online job market opportunities to millions of youths. The industry is waiting to see tangible progress in office space, particularly the Software Technology Parks in suitable locations.

Human Resource: Training programs being conducted by BASIS and LICT project will increase the supply of more than 50,000 trained professionals by 2018. Such additional supply is expected to increase entrepreneurial activities and employment in the software industry. Moreover, UGC with the financial assistance from World Bank is sponsoring Industry-Academic joint R&D projects to develop technology and product concept having commercial potentials. Such collaborative activities are expected to address innovation capacity of the software industry. Different Apps development competitions, with focus on commercially attractive innovations, are expected to attract talents and stimulate innovation in the sector as well. The Ministry of Education, with the assistance of the World Bank, has undertaken a Higher Education Quality Enhancement Project (HEQEP). The project aims at improving the quality of teaching-learning and research capabilities of the tertiary education institutions through encouraging both innovation and accountability and by enhancing the technical and institutional capacity of the higher education sector⁵⁴. Competition among private universities are expected to take greater role to produce higher quality graduates in near future—provided UGC plays due role.

Access to Finance: There has been growing interest among international VCs to enter the tech sector of Bangladesh. Recently, Fenox Venture Capital, a Silicon Valley-based global venture capital, has announced its plan to invest in the country's IT sector⁵⁵. As part of its investment, the organization is looking to put together a \$200m fund – with the help of local and global entities – to invest in startups emerging out of Bangladesh. There are currently several venture capital firms such as BD Venture Limited, Venture Investment Partners Bangladesh Limited (VIPB) which provide seed capital to entrepreneurs. Grameen Fund is the pioneer of venture capital in the country. It launched its operation

⁵³ <http://www.datacenterdynamics.com/critical-environment/bangladesh-plans-tier-4-data-center-in-quake-zone/89723.article>

⁵⁴ <http://www.heqep-ugc.gov.bd/>

⁵⁵ <http://www.dhakatribune.com/bangladesh/2014/nov/25/fenox-venture-capital-invests-200m-fund-bangladesh>

in mid-1990s although the organization is no more funding the private companies as venture capital. According to The Financial Express, Venture capital companies have been running their businesses over the past few years in the country despite the fact that there are no rules and regulations for handling such types of risky investment⁵⁶. It's expected that VCs will grow as preferred source of access to finance solution for the software industry of Bangladesh.

Founded in 2008 by Shafqat Islam, Iraj Islam and Asif Rahman, NewsCred has offices in New York and Bangladesh. The company is backed by investors including FirstMark Capital, Mayfield Fund, Greycroft Partners, IA Ventures, Floodgate Fund, Lerer Ventures, AOL Ventures, Advancit Capital and Naval Ravikant.

Market Access: With the proliferation of broadband network, establishment of backend infrastructure, and emergence of smartphones, the scope of disruptive innovation has been created in a number of critical areas of the society. Strong non-consumption among large population at the bottom of the pyramid and ICT core are key drivers to follow the path of disruptive innovations. It appears that visionary entrepreneurial initiative, backed by VCs, will be able to bring high value software innovations to create disruptions in certain key segments of the society, namely 1. Government's service delivery, 2. Agriculture, 3. Health, 4. Education, 5. Commerce, and 6. Financial Services.

The evolution of the global society towards densely connected Internet of Things with the support of remotely operated Semiautonomous Machines is going to demand significant amount of software innovations. Recent acquisitions made by Google and Facebook are indicators that serious investment are going to take place in software R&D to create a world of interconnected intelligent machines-starting from smoke detector to autonomous vehicle⁵⁷. Capacities of existing preferred destinations, such as India, are being overstressed to address R&D need to pursue this human race. It's expected that global investments will be looking Bangladesh as their development destinations. As a result, scope of software development work for Bangladesh will expand, not only in size, but also in many emerging areas. Moreover, online job market is likely to spur Entrepreneurial initiatives.

A San Francisco-based startup called Augmedix, which aims to "rehumanize" health care through Google Glass, has development center in Bangladesh. Augmedix, now has a valuation close to \$100 million, according to CEO Ian Shakil, has recently raised \$16 million in Series A funding.

⁵⁶ <http://www.thefinancialexpress-bd.com/old/more.php?newsid=143958&date=2012-09-19>

⁵⁷ <http://en.wikipedia.org/wiki/ListofmergersandacquisitionsbyGoogle> & <http://en.wikipedia.org/wiki/ListofmergersandacquisitionsbyFacebook>

6.2 Growth Prospects of Local Market: Education Sector as an Example

It appears that the usage of software in both public and private sectors is very negligible (Source: KII). For example, among more than 150,000 educational institutions (sample population is shown in Table 6.1), only a small fraction of them has been using software, in limited scope. Software has potential role to make significant improvement in diverse areas including Contents, Management and Governance of the education system of Bangladesh. Despite allocation of highest sectorial allocation (Tk 25,114 crore allocated in 2013-2014), the ministry of education has been struggling to figure ways to make effective and efficient usages of the resource to offer quality education to possible largest number of students. The usage of software has the potential to improve management, administration and governance of this large number of institutions. With the help of software, both individual institutions, educational offices located at different levels of the Government and Ministry of Education will have access, in real time, to diverse data including number of students, attendance, faculty presence in class rooms, expenses, performance of students in different exams, and usages of stipends. Such real time access will lead to development of database opening the door of analysis and insights gathering for creating opportunity of making improvement.

In order to estimate engagement of software firms to empower this large pool of institutions to benefit from software, it appears that on an average each institution will require two man-months equivalent service from software professionals for configuration and change management. It should be noted that in addition to offer software, significant effort should be given in change management in each academic and administrative institutions to create the culture of software centric management of educational service delivery. Based on such assumption, 150,000 institutions will require 300,000 man-months equivalent service, which is equivalent to service of 6,250 software professionals over 4 years.

The transformation plan of management of educational institutions alone to software centric is going to double the capacity of the whole software industry. It's likely that such demand will generate almost additional BDT 19,250 million (USD250 million) revenue over a period of 4 years (estimated based on BDT 65,000/month revenue per software professionals) for the software industry. Upon initial deployment, each institutional will service for continuous improvement generating likely revenue of BDT 15,000/year. Such

Table 6.1: Sample Population Educational

Sl	Type of Educational Institutions	Number
1	Primary School	104,017
2	Secondary School	15,581
3	College	3,547
4	University	86
5	Madrasah	9,441
6	Technical education	3,327
Sub-total		1,35,999

Source: Web site of ministry of education

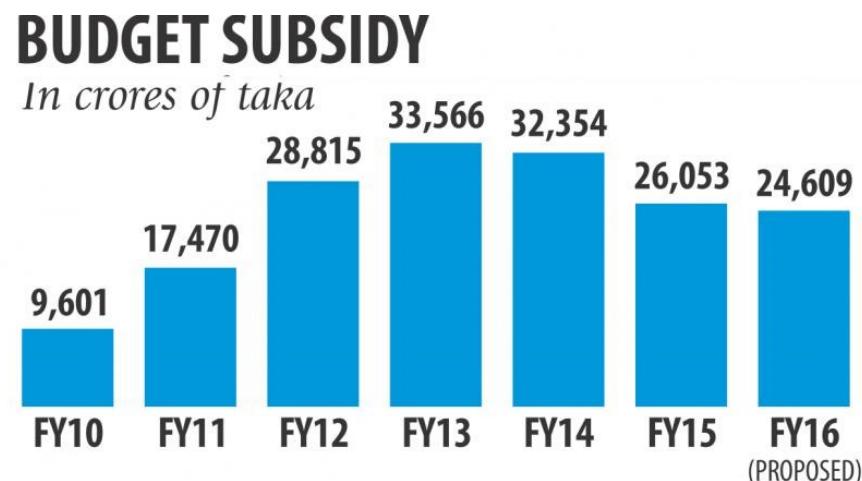
Education sector alone has the potential to generate USD250 million revenue over next 04 years for adopting software based management system. Maintenance of such system has the potential to generate yearly USD 30 million revenue for the software sector.

recurrent service will generate additional almost BDT USD 30 million yearly revenue for the industry. Similar estimation could be made for other sectors such as Healthcare, Readymade Garments, SMEs, Agriculture, etc. As a result, it may not be unlikely to set a target to create USD 1 billion local market for software and service within next 5 years.

Public Policy and Strategy Support:

1. Each ministry should come up with detailed strategy and plan for improving performances of concerned sectors through software.
2. Government should allocate fund to ministries to support software centric growth agenda of each ministry.
3. Government should have strong policy and regulation to ensure compliance by each stakeholder to software centric operation.

Source of Fund for the Government: A portion of development budget should be allocated for using software for improving Governance, Productivity and Quality of respective mandate of each ministry. It should be noted that in each budget, Government shows allocation of large fund for giving subsidy, as shown below. A portion of this subsidy could be allocated for making investment to exploit software centric growth in each economic and social area of the nation.



SOURCE: **FINANCE MINISTRY**

Chapter 7: Constraints Faced by Software Development Sector of Bangladesh

7.1 Policy Constraints

Some of the public policy constraints, which are hindering the growth of the software industry, are as follows:

1. Public Procurement: Policy of purchasing finished software solutions, without having the strategy of maximizing local value addition, through international competitive bidding appears to be a concern. The history indicates that policy of public procurement to support the growth of capacity of private software enterprises, in delivering solutions to the Government in an incremental manner, played an important role in the success of software industry of USA. Pursuing the incremental delivery strategy, the public procurement policy could have been supportive to the capacity growth and track record development of successful delivery for local software firms. Such policy could have been enabling factor for local software firms to play more value additive role, than before, to Government's program. Moreover, track record of success delivery in local market could have made it easier for local firms to enter the export market. According to the theory of strategic management, local market should be spring broad for domestic firms to enter the international market. Instead of taking the role of simple buyer of software, Government should take the strategy of developing capacity of local software firms through smart public procurement policy. Particularly, there is a concern of public procurement policy of buying best-of-breed enterprise applications and implementation services, primarily from foreign firms, without paying attention to local value addition and capacity development.

2. Public Private Partnership: There is a concern, among Government agencies and local corporate buyers, that local software firms are not capable enough to supply high value software solutions, such as core banking solutions. In 1970's, there was a concern that US companies were not capable to deliver software solutions required by US Government's strategic programs for Defense and Space. Weakness in Software Engineering was considered to be the limitation to develop large as well as algorithmically complex software solutions for mission critical applications. To address this limitation of Department of Defense (DoD) contractors (private enterprises), US government established Software Engineering Institute (SEI) at the Carnegie Mellon University. Since late 19070, the US government has been supporting SEI's R&D program and transfer of knowledge & skill to the industry. Such public private partnership is critically needed for nurturing local software industry in Bangladesh-- for unlocking domestic growth opportunity through software and developing the capacity for global market. It should be noted that software engineering solutions are highly context dependent. For example, adoption of SEI's SW-CMMI, developed to deal with software engineering capacity limitations of DoD contractors, did fail to improve profit to revenue ratio in local software firms. For this reason, a number of early initiatives in SW-CMMI certification failed to encourage others. There could be need of PPP for doing research for developing technology for lowering cost of delivery and improving profit to revenue ratio. There could be further need of PPP for ensuring healthy competition among private firms for increasing competence to offer increasingly higher value added software solutions. There should PPP for developing large software solutions for strategic applications, such as banking and integrated work processes of GoB and corporates.

A strong dissatisfaction among industry informants has been perceived about Government's weak patronization to capitalize early success of Bangladesh's Banking software solution resulting in loss of lucrative banking software market to foreign companies. It has been mentioned that along with the encouragement of export, Government should build partnership

with private sector to improve software solution development capacity supporting better positioning of the industry in local market.

3. Investment in R&D Capacity: It has been mentioned by large number of software Firms that R&D is critical for software firms to innovate products. Due to virtual absence of VCs and weak financial base of Entrepreneurs, local start-ups are not in a position to fund product innovations over a span of 3 to 5 years, without generating any revenue. Moreover, only a small fraction of innovations ends up in generating profitable revenue. Due to high risk, long lead time and low financial capability, local software firms take the strategy of project based delivery; as a result, they fail to benefit from reuse. Moreover, due to mental model centric, Coding & Testing approach and frequent loss of experienced professionals, rework level is very high in local software firms. High rework and low reuse limit the capability of local software firms to lower lost of delivery, resulting in weak market expansion.

4. Cadre Service Pool for IT Professionals and Poor Planning for Software led Growth: There is a quite difference between running administrative affairs and executing software innovation led performance improvement programs. Historically, Government officials are trained to perform administrative affairs. Due to weak performance of Government officials in running enterprises, state owned enterprises are being privatized. They very same government officials are now being assigned to improve Governments work process through software innovations, in the name of e-Government or e-Service. The competence in making such program successful through software innovations, with significant local value additions, is quite challenging in-deed. Due to weak exposure to such capability, assigned government officials are preferring to follow more familiar approach: procurement of finished solutions through competitive bidding. Such approach is neither beneficial for the program, nor enabling to the growth of local value addition capacity. For this reason, there appears to be strong recommendations that there should be high caliber pool of government official having appropriate capacity of managing software innovations led performance improvement programs-- for improving functioning of the Government through software innovations.

5. Specialized Infrastructure and Services (Tightly Weaved Innovation Ecosystem): Specialized infrastructure and services, commonly known as Software Technology Park as a tightly weaved innovation ecosystem, appears to be very much essential for the growth of Bangladesh's software industry---examples services could be legal, finance, consulting and training. The cost, quality and location of office space, along with shared common services, appear to be a significant hurdle for entrepreneurial activities in software. Such facility is also needed for interested foreign companies for piloting, without facing the need of large cost, long time and significant management overhead, to test the water. For a number of reasons, such facility should be in a strategic location, easily accessible for Airport and in secured neighborhood. Instead of looking such fundamental need, Government's civil engineering projects at Kaliakoir or District town to develop Software or High-tech park draw significant criticism—they are perceived to serving purposes of certain quarters, other than contributing to the growth of the software industry.

6. Weak Focus on Disruptive Innovations: There are three kinds of innovations, which could be pursued through software to make the Government, in particular and the society as a whole, functioning better. Namely, they are 1. Sustaining, 2. Efficiency & Control and 3. Disruptive Innovations⁵⁸. So far, e-Government or e-Service projects are primarily focusing on Efficiency & Control innovations. Such approach usually does not create jobs and has limited value

⁵⁸ Clayton Christensen, Innovator's Solutions, Harvard Business School Press, 2003.

addition capacity. It's disruptive innovation, which appears to be most encouraging for a resource starved, labor surplus nation like Bangladesh. There is a strong sense of urgency that Government should take appropriate policy for supporting the supply side capacity growth and expansion of demand side for pursuing the disruptive innovations, through software, Key strategic areas such are 1. Agriculture, 2. Health, and 3. Education. For example, disruptive innovations in Farming knowledge management could improve the productivity of USD20 billion agricultural production system by a factor of X. The adoption of Agricultural Extension Services for facilitating knowledge sharing and Technology transfer has played key role for improving agricultural yield over last 50 years—almost 5 folds since 1960. At present, knowledge sharing—primarily in tacit form-- of Farmers are limited to 5/7 people, comprising of family members, neighbors, lad farmers and Agricultural Extension officers, within a small geography. Integration of software innovations trough smartphones and wireless connectivity has the potential to codify such tacit knowledge and increase the knowledge sharing network of farmers, both in space and time, could increase the farming productivity significantly over next decade-10% increase may lead to USD2 billion additional crop every year. Such improvement in knowledge codification, archiving and sharing will also lower cost of inputs and preserve soil fertility.

7. Lack of Academic Focus on Creating Value through Software/ICT: The review of ICT education, including at the School and College levels, reveals that primary focus of ICT education is on knowing only technology. Technology knowledge alone limits the scope of exploitation of potential value creation through software innovations. There should have been focus on role of ICT in diverse work processes for performance improvement. Such awareness at the early stage could have been very useful to nurture the thinking of performance centric economic growth through software innovation. This line of thinking appears to be critically important to make these students future smart adopters of software innovations or drivers of software innovations.

The education of computer science or engineering, even software engineering, at the university level also lacks the focus on wealth creation through software. Without the focus of work process and role of software or ICT in such work process for improving the performance, make graduates quite incapable to innovate software solutions. In software engineering education, economics of software production and management is not being, largely, taught. The lack awareness of implication of software requirements, design decisions, development practices, rework and reuse on cost, time, and quality of delivery make it very difficult to develop a workforce for creating wealth or value for the producer and consumer. As a result, both consumer and producer surplus in software production suffers.

7.2 Information Security, and Threat of Loss of Process Competence and Software Asset

Programmers working in software companies acquire and contribute to valuable assets, including: 1. Business process knowledge or domain knowledge of target sectors, 2. Ideas of software features for which clients of target sectors have willingness to pay, 3. Knowledge about readiness of clients for progressing to business deals, 4. Sound software development practices, which are appropriate within the local context for increasing reuse and reducing rework and 5. Software assets such as requirements documents, design, code, test results, etc. Knowledge of first three categories primarily resides in tacit form. Along with the departure of experienced employees, such very valuable asset is lost. This is one of the key reasons of weak growth of software companies in Bangladesh. There appears to be weakness in existing legal framework of Trade Secrets and Copyright, and also in Firms

capability to codify such tacit knowledge, which could be protected through legal framework of information security, or copyright. A number of key informants have shared such concern.

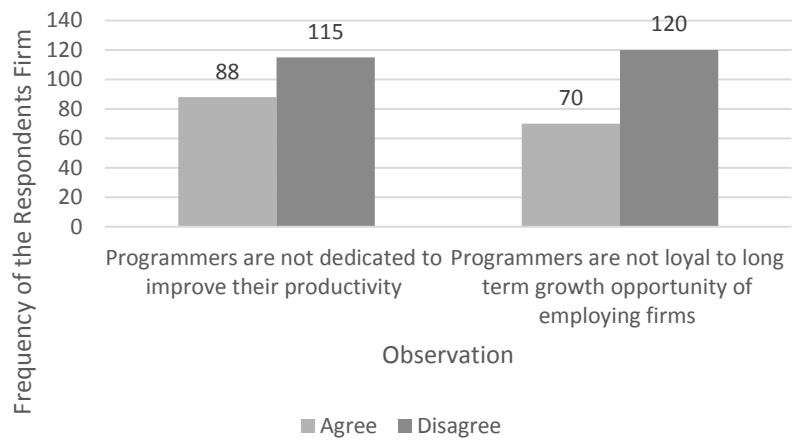
Development of software engineering process capability in the form of policies, procedures, standards, tools, measurements, and control—for which benefit in terms of savings from rework reduction, increase of reuse and reduction communication-coordination overhead outweigh the cost of following the process—is a critical competence requirement to compete in the software industry. Basically, part of the experience of programmers is monetized through this means to accommodate financial pressure, primarily caused by the yearly increment. It has been learned that such valuable competence of most of the firms remains in tacit form, which is lost with the departure of experienced employee. The cost of adoption and practice of ISO or SW-CMMI did not make financially rewarding improvement in this area.

It has been reported that for a number of software firms, departing rogue employee took away software assets such requirements, design, and code. In certain situations, those employees also did not keep any copy of stolen assets in companies. As a result, companies suffered significant financial loss. In a particular case, a company faced bankruptcy and the entrepreneur had to start the whole exercise again. It appears that articulating individual software assets as copyrightable or patentable products is not a common practice among software firms. Moreover, associated cost and time, as well as complexity, in pursuing the process with concerned Government Office are also quite unbearable. Some compliance requirements, such as submitting full code for 3rd party review, are also intolerable. As a result, firms feel it quite risky to invest in developing high value software assets, which is limiting the growth prospects of software firms. Addressing such constraints will likely require taking steps in multiple dimensions—such as improving legal framework, creating awareness, developing in Firm level competence ad simplifying the regulatory process to follow.

7.3 Ethics, Values and Loyalty of Professionals

In key informant interviews, some of the CEOs' have expressed concern about loyalty and ethics of programmers. Although, some of the programmers differ, but a large number of programmers have acknowledged such limitations, as shown in Fig. 7.1.

Figure 7.1 Programmers Perception about Loyalty and Dedication



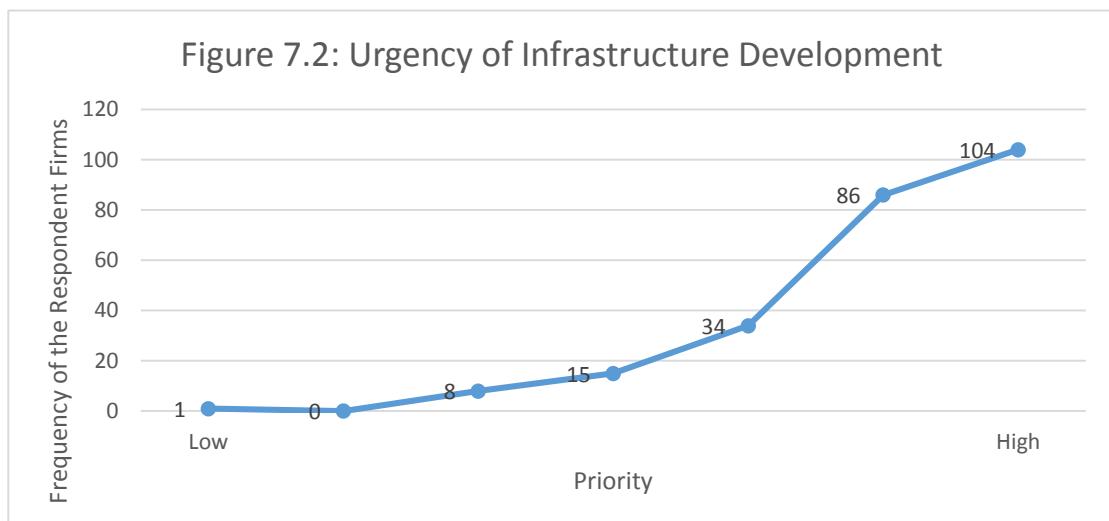
Data source: Field Survey

As it has been explained that significant amount of assets of software companies reside in tacit form, long term loyalty of programmers is an important factor to monetize such assets. It has been shared that due to weak loyalty, management of software companies are reluctant to invest in core competence, high value skill and knowledge of professionals. For this limitation, software companies pursue short term strategy to maximize revenue around existing competence level. Instead of developing high value products, companies rather prefer project based delivery—which basically generates low profit revenue and does not also create new market or revenue stream. For this limitation, major local software companies, even having partnership with best-of-breed applications providers, such as SAP and Oracle, are not willing to take the risk of training their professionals to be competent implementation service providers. As a result, local value addition capacity in best-of-breed application implementation is not growing to an acceptable level. Due to HR weakness, this growing market is basically under the control of Foreign Service providers.

Ethics, Values and Loyalty are at the core of organizational capability for taking initiatives of reducing rework and increasing reuse for improving the productivity and quality of outputs. Due to weakness in such critical area, companies are suffering from organizational capability improvement. With the age, companies are not increasing knowledge base by taking the benefit of learning resulting in lower cost and increased profit. Usually, strong ethical values of both employers and employees contribute to codification of experience into organization knowledge assets, which will likely contribute to income growth, for both company and professionals. As a result, although companies are getting older, but their intuitional capabilities are not growing. One of the prominent buyers identified such weakness at the core of slow growth of software firms in Bangladesh. It has been articulated that institutional practices should be developed to address this matter. On the other hand, academic institutions should also take necessary measures to improve the awareness about this important issues and its implications on performances of companies and long term career of individual programmers.

7.4 Infrastructure Limitations

The degree at which power, internet, voice, office space and traffic are affecting output and cost of software companies is a matter of concern to stakeholders. The distribution of responses on urgency of improving the infrastructure is shown in Fig. 7.2.



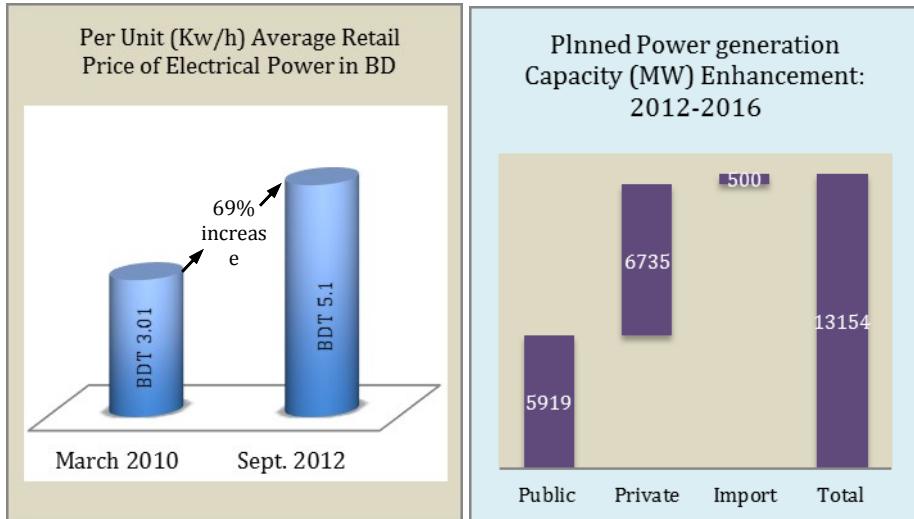
Data source: Field Survey

Internet: As it has been mentioned before, there has been rapid reduction of price of wholesale bandwidth price for Internet connectivity. As result, the perception about Internet as constraint to growth of software firm has greatly been reduced.

Office Space: Affordable quality office space has become a growing concern. Recent rent hike in key areas such as Gulshan and Banani has been creating significant stress. More than 120 firms have expressed urgency if setting up Software technology Park to address this constraint.

Power: It seems that sudden power tariff hike, as shown in Fig.7.3, is causing financial pressure on software companies, as power bill, primarily for running air conditioning system, is a major utility bill. But government's progress of producing 10,000 MW with the plan of producing more than 13,000 MW by 2016 appears to be significant development to address power supply limitation. Almost 100 entrepreneurs have put high priority on the need of reducing power bill, on the contrary to 120 for ensuring uninterrupted power supply. Loss of electrical power is perceived to be the most damaging to productivity, even it is rated over political unrest.

Figure 7.3: Power tariff increase during 2010-2012

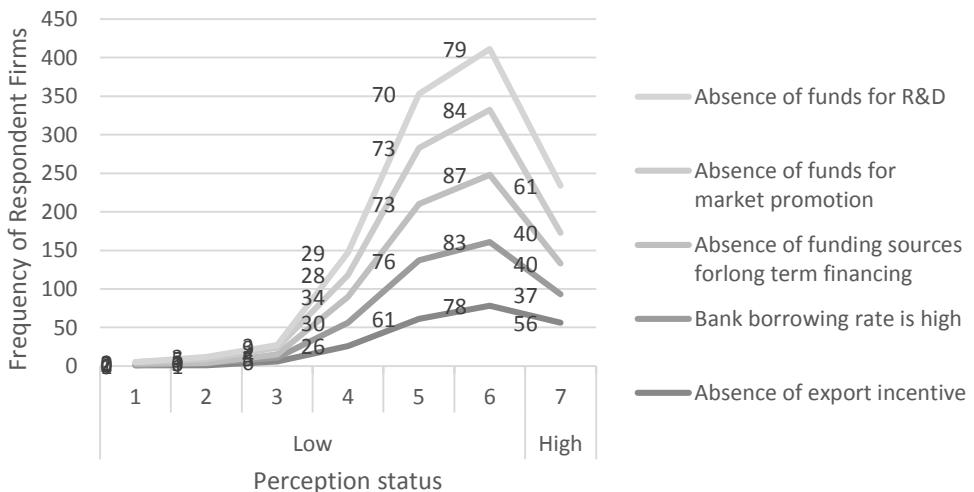


Source: Power Division, Ministry of Power, Energy and Mineral Resources

7.5 Access to Finance

There appears to be strong dissatisfaction about the access to finance to support the growth of software firms as shown in Fig. 7.4. Particularly, risk capital finance is barely available in the market. Moreover, the cost of borrowing from banking system to address working capital need is very high, as high as 15%. The dearth of long term finance limits the scope of business strategy. Instead of looking for high value product based long term growth, most of the firms are trying to meet immediate financial obligations with short term project based engagement of customized solution delivery. Even strong dissatisfaction has been expressed about lack of availability of fund to provide training to professionals.

Figure 7.4: Perception about Access to Finance



Data source: Field Survey

Financing need for software companies are shown in the following diagram:



Usually, it takes almost 2 to 3 years to develop an idea and transferring that idea in the market as software solution to generate revenue. Money spent across this chain is termed as risk capital, because there is high degree of uncertainty of return on such investment.

The impacts of financial constraints on software innovation have been the subject of much debate in recent years. The view is that firms engaging in software innovation activities suffer from a variety of frictions that limit their access to debt finance from the private sector. Two key drivers of external financing constraints on software innovation activities are limited collateral, because assets held by software firms engaging in innovation are mainly intangible, and asymmetric levels of information between the firm engaging in R&D activities and potential external lenders.

The net cash flow of software firms engaged in innovating and commercialization of software solutions is negative at the seed and start-up stages. Many of the traditional sources of finance are not fully suitable for these enterprises. Given the negative cash flow and high risk of failure at their early stages of development, software firms ideally need forms of financing that do not seek guaranteed repayment. According to a recent study done by United Nations⁵⁹, two forms of finance are appropriate for the early development stages of innovative enterprises: merit-based awards (grants) and external equity. Typical providers of external equity financing are business angels, seed funds and venture capital funds (including private, corporate affiliates, or government-sponsored).

To foster University R&D based innovation and entrepreneurship, taking best global lesson such as the Purdue University's Emerging Innovations Fund⁶⁰, an integrated approach to research innovation, development and commercialization could be conceived as an option to support software innovation and formation of new companies around such innovations.

Although, some of the global Funds, which provide risk capital finance to support the growth of innovative ideas and companies around them, are present in India and other countries, but they do not have any activity in Bangladesh. One of the examples is: Intel Capital. Whether at seed stage or ready for growth, Intel Capital makes investment to take it to the next level. Since 1991, they have invested more than US\$11.4 billion in over 1,400 companies in 57 countries. In India alone, since 1998, Intel Capital invested >\$330 million in 90+ companies in 10 cities. It launched \$250 million Intel Capital India Technology Fund in Dec 2005 • - >80% deployed; approximately 40 portfolio companies. One of the investment focus of Intel India is Software and Service. There appears to be learning opportunity for both the Government, SMEF, BASIS and Software firms to figure out

⁵⁹ Policy Options and Instruments for Financing Innovation, United Nations Economic Commission for Europe, UNITED NATIONS New York and Geneva, 2009.

⁶⁰ <http://otc-prf.org/emerging-innovations-fund>

ways to attract such Funds in Bangladesh, which may partly address risk capital financing need to support the growth of software firms.

Access to Finance as Market Failure: From evaluation experience of EEF projects and review of inputs provided by Banking community, one of the main source of market failure related to financing software companies is to do with asymmetric information between these firms and external agents (e.g., investors such as banks). In particular, there perceived to be significant information asymmetries in that respect between software firms pursuing certain product innovations and mainstream financial intermediaries, such as banks and institutional investors, who lack the capacity to verify the specific technical information and claims of the entrepreneur. Potential investors are therefore skeptical of the likely returns on investments in developing new products. Although, hundreds of proposals were submitted for EEF financing, but due to such asymmetric information, reviewers could be not reach to decision to finance most of the companies, although there were urgency to rapid distribution of fund. Such information asymmetries not only affect the financing of software innovations, but also service delivery capacity—primarily by training.

Entrepreneurs who could offer attractive returns may have no credible way of conveying such potential to risk averse investors. The information asymmetry makes it very hard for a creditor or equity investor to predict the returns from a potential investment in software ventures, which implies that such funding is not likely to be forthcoming. In the absence of demonstrated cash flows or other collateral, a typical start-up software company or individual innovative entrepreneur will not have access to traditional sources of finance—this is the so called “funding gap”. At the most basic level, the “funding gap” implies that entrepreneurs face stiff constraints in the funding of innovations and therefore will not invest (or will invest too little) in innovative projects that may have high social returns. It has been learned that most of the software companies do not maintain audited financial records. Absence of such records makes the problem even worse in Bangladesh.

It has been learned that such funding gap is not unique in the Software Development Sector of Bangladesh. Countries from Europe and Central Asia are also suffering from such funding gap—caused largely by information asymmetry⁶¹. This “funding gap” has been studied in most detail in the United States, but the findings have direct implications for Bangladesh.

Given the short history of capital accumulation and profit-generating software enterprises in Bangladesh, internal financing by enterprises and “angel investors” is rare in the country and does not provide a viable basis for promoting innovation. The absence of “angel investors” is problematic not only from a funding perspective, but also given their role as sources of managerial expertise, as information brokers, and as access points to formal and informal networks of entrepreneurs and innovators. The role of government should therefore be different in Bangladesh than in OECD countries, India or USA. The lack of “angels” and internal financing is acute, and the capacity of government agencies to fill their place is also extremely limited in Bangladesh.

Early stage software technology (ESST) or solution development requires patient and high-risk tolerant investment capital to fund early, pre-revenue stages of research, development,

⁶¹ Public Financial Support For Commercial Innovation, *Europe and Central Asia Knowledge Economy Study Part I, 2006*.

and commercialization. Yet filling the “funding gap” requires specialized investors with the skills to evaluate and directly manage the risks of ESST (“angel investors” or innovative managers in firms that are willing to invest retained earnings accumulated in other activities in the highly risky innovative projects) or governments with a broader public policy objective of capturing some of the spillovers associated with ESST. For the software sector, such spillover effect is very high, as successful development and commercialization targeting the local market will not only improve financial position of software firms, but also will positively contribute to functioning of the target economic sector. In the absence of positive internal cash flows and “angel investors”, even if probability is adequate to yield a reasonable profit expectation, it may be impossible to secure the capital necessary to develop a new software solution. As discussed, in Bangladesh, the information asymmetry and “funding gap” problem is much more acute than in developed economies.

It has been referred that after experiencing an initial period of rapid growth, many developing countries have fallen into the middle-income “trap”⁶²—stuck between low-wage, low-technology markets and high-income, innovation-based developed economies. Financing problems being experienced by software firms to support revenue generation from innovations to be solved to develop a model to address similar constraints likely to be faced by other sectors of the economy. A software firm starts from the seed stage with an idea and grows through stages moving towards expansion. To address revenue shortfall, it accesses finance from sources: Funders’ 3Fs (Family, Friends and Fools), grants from Government, Business Angel, Venture capital funds, Debt/Bridge loans, and Public stock market. In developed nations, Death Valley is at the early stage, because such new born companies are not capable to support their growth through seed capital to access finance from Angels and Institutions. But in Bangladesh, due to absence of both seed capital and institutional investors, this Death Valley covers the whole life cycle, as shown in Fig.7.5.

Financing Instruments for Software Firms in Bangladesh: Broadly, they are classified in two categories: 1. Direct, and 2. Indirect, as explained below.

1. Direct Financing:

- i. **Private Financing:** Some of the entrepreneurs start software firms capitalizing good programming skill and some degree of relationships with potential clients. Senior students in CSC/CSE or experienced software development professionals fall in this category. For them, in most cases, early stage seed and start-up financing is provided by the entrepreneur’s own funds along with financing from family and friends. Bringing in partners is a common way to finance part of the expenses. Partners bring expertise as well as financing. Due to very limited private financing capacity, such strategy does not allow start-up software companies to develop products or strong service delivery capacity to produce profitable as well as growing revenue.
- ii. **Retained Earnings:** One of the common strategies practiced by entrepreneurs in Bangladesh is to finance software innovation or service delivery capacity through retained earnings. The generation of a dynamic profit–investment nexus where

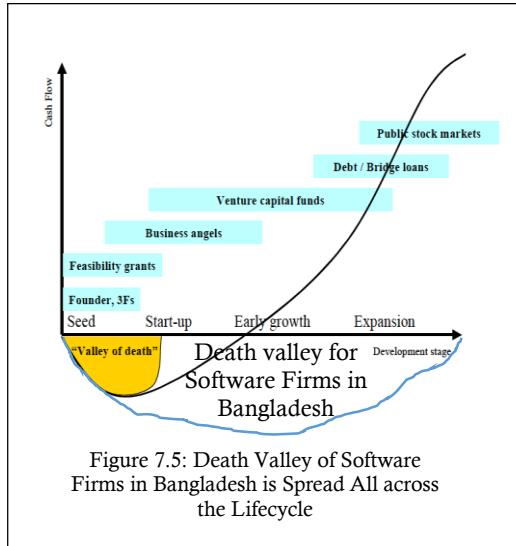
⁶² The World Bank, Poverty Reduction and Economic Management Network, Access to Finance, Product Innovation, and Middle-Income Growth Traps, 2013.

profits finance additional investment, leading to continued profitability and investment, could have been an effective mechanism for building a dynamic industry of growing firms. Due to very limited financing capability, most of these firms enter the market with cost+profit based pricing to offer customized solutions. Due to low reuse and high rework, cost of delivery is very high, in some cases higher than the revenue earned. As a result, these companies cannot exercise the journey in creating virtuous cycle of profit for investment leading to higher profit. As a result, such strategy does not allow most of the companies to develop financing solution leading to consistent growth.

- iii. **Business Angel Financing:** Business angel investors are an important source of financing at the seed and early growth stages in many developed countries and some developing countries. They are wealthy individuals who make early-stage equity investments in new or young ventures. They usually provide significant technical, managerial and business expertise in addition to finance. They are similar to informal, non-institutional venture capital but are likely to operate at a smaller scale and provide financing at an earlier stage than is the case with informal, non-institutional venture capital. Angels invest not only for a potential financial return, but in many cases, to give back by helping other entrepreneurs through mentoring and giving access to professional network. Also, being former entrepreneurs themselves, it is an activity they enjoy. But in Bangladesh, most of the Angels came with the success from conventional businesses such as Ready Made Garments and Trading. As a result, they fail to develop insights about unique nature of software business to extend their helping hands, beyond proving finance—mostly with non-compatible expectation. Such investment took place in several software firms of Bangladesh, unfortunately they failed to produce success stories. Due to lack of exposure in challenges faced by software companies, most or may be all of these investors failed provide needed finance in timely manner. Moreover, information asymmetry also created significant distrust or lack of confidence among these investors to continue funding such ventures. As a result, such model of very important source risk capital financing also failed to grow as strong source of finance needed by software companies to grow.

On the other hand, according to recent study conducted by OECD⁶³, Angel investment is the most significant source of outside equity for seed and early stage start-ups. Banks are even more reluctant than in the past to fund young firms due to their perceived riskiness and lack of collateral. Venture capital firms are, for the most part, focused on later stage start-ups and therefore have left a significant funding gap at the seed and early stage. According to this study, in Europe, the angel market in 2009 reached \$5.5 billion, surpassing all venture capital funding by some \$250 million, according to the report, which is based on interviews with roughly 100 investors, entrepreneurs and business leaders in 32 countries.

⁶³ OECD, Financing High-Growth Firms: The Role of Angel Investors, 2011



Data source: Study

Based on calculations by this Paris-based think tank suggest that the total amount of capital raised from angel investors in the U.S. was \$17.7 billion in 2009, compared to \$18.7 billion for venture capital. The bulk of the venture capital money went to companies that were at later stages in their growth cycles, the report notes.

Despite early failure, it seems that there should be focus on how to stimulate Angel investment in the software industry of Bangladesh to find solution for access to finance issue faced by the sector. Given the local nature of angel investing, there is no homogeneous national angel market. The level, sophistication and dynamics of angel investment can vary greatly across countries and therefore policy makers must take this into account. In fact, in a number of countries such as Canada and the United States, angel policies are implemented at the regional rather than the national level. In addition, angel investment can vary greatly across countries, both in terms of volume and approach. Policies that have worked in one country may not necessarily work the same way, or be as successful, in another country. Also, while policies targeting angel investment are being put in place in a growing number of countries, there have been few formal evaluations of these programmers to date.

iv. **Venture Capital:** Venture capital has existed in the United States since the 1940s, becoming a mainstream financing mechanism in the 1970s. Many developing countries (such as Brazil, Chile, China, Taiwan Province of China, India, the Republic of Korea and Singapore) attempted to develop venture capital markets during the 1980s and 1990s. Venture capital is equity financing provided by either venture capitalists or institutional investors, generally at the early growth or expansion stages, aiming to take advantage of high growth potential firms that have already started operations. They increasingly fund at the later expansion rather than early growth stage, and are later stage investors than business angels. In Bangladesh, EEF is the first state sponsored fund to address the financing need. According to data received to date from different sources, it seems that this intervention did not produce scalable growth model. Recent investment of Alarafah Bank to purchase of 51% share of Millennium Information Systems⁶⁴, a local software company, at a price of BDT15 crore is an example of venture capital

⁶⁴ DSE web site news, date Dec 12, 2014

investment. Such investment took place at very later stage of Millennium's life cycle. It appears that most of the software Firms in Bangladesh are not in a position to attract institutional investment as equity partner.

- v. **Commercial bank loans:** Commercial banks are the most traditional, and in most developing countries the largest, source of financing for enterprises. SMEs in many developing countries have difficulty in accessing bank loans at affordable interest rates, and the high cost of credit remains a major constraint. According to survey and key informant interview, commercial Banks are also single largest source of finance—despite high interest rate. But, such bank finance is typically to deal with short-term cash flow discontinuity, known as working capital. Such finance is not usually does not meet product innovation or service delivery capacity development.
- vi. **Stock Exchanges:** Stock exchanges allow firms to raise money through equity offerings, but only for already established companies seeking expanded financing; for many stock exchanges, this is only for companies of a minimum-size threshold that excludes most new firms. There exist several well-established exchanges for SMEs in developed countries such as NASDAQ in the United States. Secondary exchanges for SMEs also exist in developing countries such as the Growth Enterprise Market of Hong Kong, China, and others in Egypt and India. Financing from stock exchanges is generally at later stages, during expansion or maturity. It is particularly relevant in innovation financing as a traditional means for venture capital and angel investors to exit the investments that they make in enterprises. Exiting through initial public offerings on stock exchanges, along with selling their equity stakes to investors operating in the industry (trade sales), represent the two most common avenues through which venture capital investors liquidate their investment positions and release cash for additional venture capital investments. For most of the software companies in Bangladesh, Stock Exchange does not appear to be suitable instrument for financing, as most of the software firms are very small. Moreover, asymmetric nature of intangible asset valuation and not so attractive revenue flow do not appear to be favorable for software companies to raise investment from Stock Market.

Public Finance

- i. **Seed Finance:** Seed financing is for the initial R&D needed to establish the commercial feasibility of an idea, including both technical feasibility and market potential for the innovation. Financial markets in Bangladesh, also in most countries, do not provide financing for this stage of development. In many countries, government policies and financing instruments have been designed to address this market failure. Policies include incentives to encourage investors by providing seed financing. Financing instruments include the allocation of public funds to seed funds (grants, loans and investments – including co-investment funds and technology or innovation funds). In most cases, government grants represent an important source of seed capital for new firms. They may come in the form of matching grants that seek to match spending by the enterprise, and may be considered co-financing. They may also be straight grants, for example, for a feasibility study. Although it has been learned that MoPT & ICT has been providing finance to develop mobile Apps, so far, such public financing scheme has not been

exercised as a strong financing instrument. Investigation could be carried out to assess feasibility and design such financing instrument.

ii. International Development Assistance: International aid from donors and development financing institutions can be used for financing innovation. There is a case to be made for the increased financing of technology and innovation in developing countries, particularly those at the earliest stages of technological development with weak private sectors and severe financing constraints. In Bangladesh, such financing has been used for marketing and quality assurance purposes. Notable ones are 1. The Matching Grant Facility (MGF, 1999) Programme was a component of the Bangladesh Export Diversification Project (BDXDP) of the Ministry of Commerce, GOB, with IDA/ World Bank credit. Such funding was used to support financing need of software companies- primarily for promotion and market expansion, 2. Year 2005 saw the closure of the Bangladesh ICT Business Centre (BIBC) -- the first-ever overseas marketing office for the software industry of the country set up in 2003 in the heart of Silicon Valley in California at a cost of nearly half million dollars funded by the World Bank under the export diversification project of the ministry of commerce (MoC). Much was expected from BIBC in terms of channeling software outsourcing work from US to Bangladesh. Some work did come from BIBC but not enough to keep it going according to the MoC, 3. Several donor funded programs, including SEDF, provided financial and technical assistance to software companies in a number of areas, including market promotion, product development and getting international certification including SW-CMMI and ISO, 4. Danida through its PSD program provided assistance to number of software companies in Bangladesh to develop partnership with Danish companies, 5. NTF is a Dutch government funded program to support SMEs, including Software Companies, to develop business linkages with Dutch companies, 6. LICT is World Bank Funded USD70 million project has been providing training and other assistance to improve human competence, and 7. BASIS has been implementing a training program funded by ADB and other donors.

In addition to these donor funded programs, several other donor funded programs provided assistance to the software industry to improve production capability, develop product and expand market.

iii. Innovation and Programming Competition Prizes: Channeling public finance to organize programming competition, mobile app development competition and providing attractive prizes has picked up momentum in Bangladesh. In certain competition, potential idea holders are being groomed to develop products and also design business around those ideas. One of the examples is EATL-Prothom Alo App development competition, which offers BDT1 million as the first price money.

2. Indirect Financing

i. Tax incentives (tax credits, allowances, deductions): Many countries provide tax incentives for technology development and innovation, such as tax credits and tax deductions on R&D. These incentives aim to encourage R&D by allowing R&D spending to be deducted from tax liabilities, usually up to some maximum percentage of total tax liabilities. Bangladesh Government has been providing tax holiday to the software development sector for a number of years, and it's expected

that such policy will continue for foreseeable future.

- ii. **Public R&D spending and business–academic–Government R&D partnerships:** Such program is largely absent in Bangladesh. Recent World Bank Funded UGC's HEQP project's Window 4 has just started such program activities. This modality of financing to support the innovation need of software companies should be explored further.

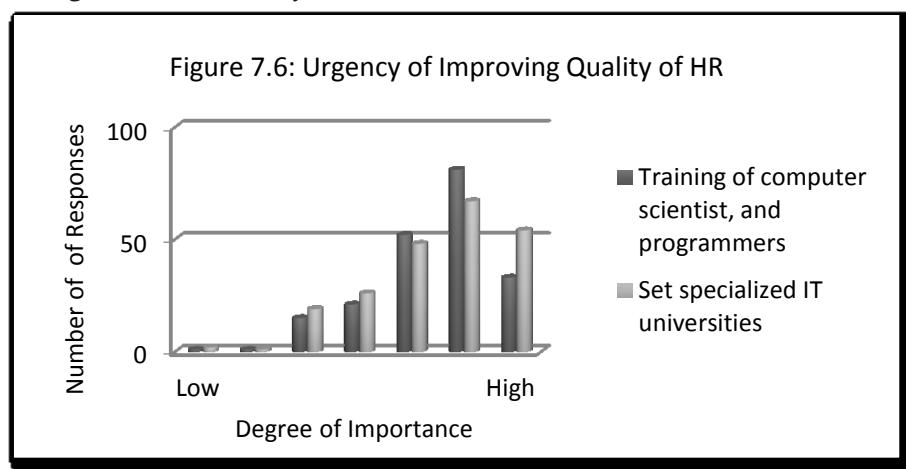
Challenges and Suggested Recommendations in Designing Schemes to Address Financing Needs of Software Firms:

1. To support product innovation as well as to develop capacity for delivering high services, successful funding programs should target clearly identified financing gaps. This calls for a good understanding of the needs and capabilities of different types of firms at different stages of development and operating pursuing various strategies in different market segments. Such funding programs should be articulated so that firms can access progressively more sophisticated support mechanisms as they develop their technological capabilities. This requires capacity-building efforts both among the managers of innovation funding programs and among their beneficiaries (for example, to develop project assessment and project formulation skills).
2. The relationship between national development policies to support the growth of different economics sectors, which might significantly benefit from software innovations, global trends of software innovation value chain, and funding for innovation needs to be considered and the relevant linkages to be strengthened. Since access to finance is only one of many bottlenecks for innovation, funding programs need to be planned in conjunction with other support measures to make the financing instruments successful. This relates in particular to issues such as collaborative networking, public-private partnerships, coordination and the overall promotion of an entrepreneurial culture.
3. We should look into strategies to maximize the impact of available funds for software innovation support programs, including EEF, and how to improve resource mobilization at the domestic and international levels. Some of the questions, which need to be answered, are: 1. How can the visibility of opportunity of financing to local software innovation in national and international development agendas be improved? 2. How can critical financing gaps be better identified? 3. How synergies between investment in software innovation and in other critical development priorities be strengthened?
4. We should also look into exchange of experiences about the design and management of funding programs for the software development sector in Bangladesh—notable examples are EEF and financing schemes of some commercial Banks. What can be learned from the experience of other developing countries that have put in place general and/or specialized innovation funding programs to support the growth of the software development sector? What are the key capabilities and skills that are critical for sustainable program impact?
5. Finally, how can Governments better involve all stakeholders in designing, implementing and assessing investments in the Software Development Sector of

Bangladesh? What role can international development cooperation play in this area as well? How can spillover effect be maximized through investment in the local software development sector to meet national development agenda?

7.6 Human Resource

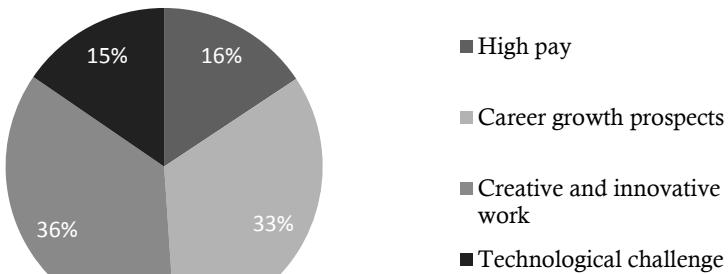
It appears that number of CSC or CSE graduates being produced by public, private and national university is no longer a limiting factor for the software industry to recruit. It's is the quality which is being questioned by respondents. A large number of respondents have mentioned the necessity of providing training to programmers, who have already degrees in CSE or CSC, as shown in Fig. 7.6. Moreover, certain needed qualities such as innovation management, product management, branding, positioning and managing IPR are not being developed among CSC or CSC graduates. There has been even strong suggestion on setting up specialized university. It's understood that GoB has been working on establishing such a University.



Data source: Field Survey

On the other hand, limited career growth prospect is dampening the aspirations of software professionals to enter the software industry. Major factors influencing the decision of software professionals to enter in the software industry of Bangladesh are shown in Fig. 7.7. Career growth prospects and opportunity to work on creative and innovative activities appear to be primary reason for entering in the software industry. In order to address motivation, loyalty and employee turnover, it seems that progress need to made along these two factors. High pay and technological challenge appear to be least influencing factors—may be contrary to conventional perception.

Figure 7.7: Factors Influencing the Decision to Enter in the Software Industry of Bangladesh



Data source: Field Survey

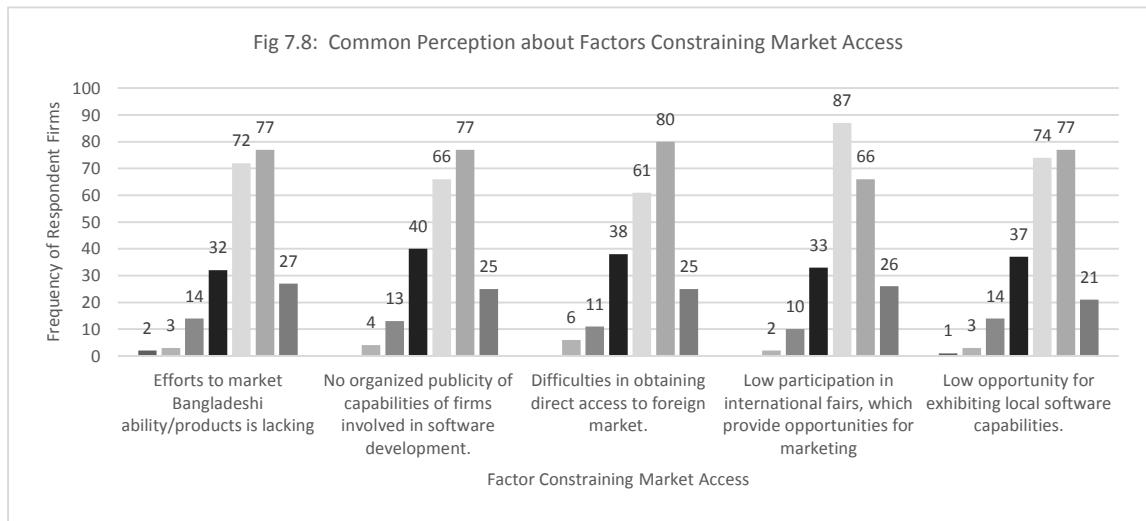
7.7 Access to Market

It is important to know the degree at which access to domestic and foreign market is limiting the growth of the software industry of Bangladesh. How far capacity expansion is simply restrained due to market access should be known to design interventions.

Historically, market access for software companies has focused on export market. During the process, domestic market has been taken over by foreign firms. This study looks into both domestic and foreign market. Constraints to access both domestic and export markets faced by software companies have multiple dimensions; some of them are explained below:

Proven Track Record: Due to the policy of purchasing finished solutions on internationally competitive basis, proven track record is a precursor to qualify. As Bangladeshi clients, including the Government organizations, are follower, so Bangladeshi companies cannot develop internationally competitive proven track record to qualify even in local market. Such constraint is growing day-by-day marginalizing Bangladeshi companies in the local market.

Following the path of Imitation: Mostly, Bangladeshi software companies propose to their clients to offer customized software solutions, which are mostly similar or inferior to already available solutions, whether locally or globally. And these companies are not in a position to make aggressive investment to upgrade those initial offerings. Although they were successful with the proposition of lower cost, but due to the emergence of cloud based offerings of best-of-breed applications at an attractive price, access to this local market, once dominated by local software firms, is being constraint.



Data source: Field Survey

Some of the common perception about factors constraining market access for Bangladeshi software firms is shown in Fig. 7.8. According to key informants, it is the quality, which is the most constraining factor.

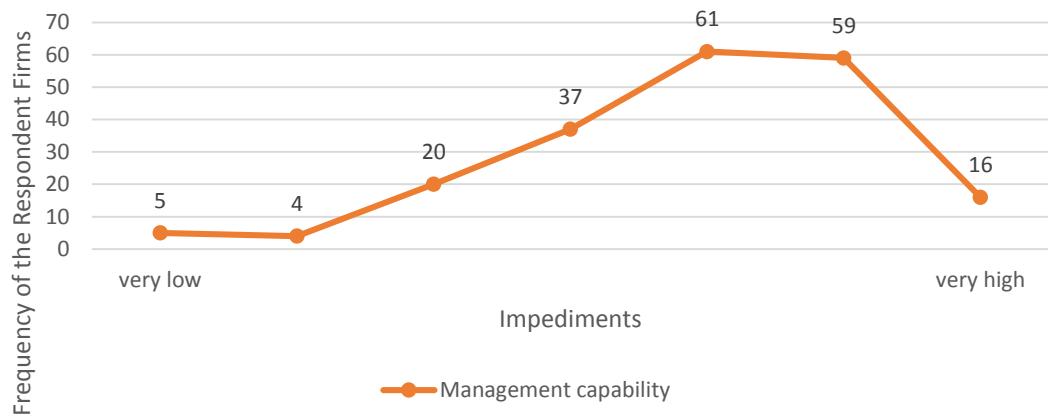
7.8 Management Capability

Software business is quite different from other businesses. In Bangladesh, most of the businesses can be categorized as replication or trading business. In software, replication does not produce any value; trading of software developed by others is also not attractive. Creating value through innovation is the core wealth creation opportunity. The cost of innovating a software application is quite high; such cost could not be recovered from a single or small number of customers, particularly in developing nations. As Bangladeshi customers have limited willingness to pay, so that project based customized software delivery, using cost+profit based pricing strategy, is not a viable option. So, the product to be developed around commonality of requirements of large number of customers, so that per unit cost of delivery will be quite low, very much within willingness to pay of target customers. This is a reuse challenge. Reuse economics round commonality of user requirements and product line architecture are core managerial competence to manage such journey.

On the other hand, productivity management of development team is a challenge. Due to growing communication and coordination overhead, per person productivity keeps falling with the growth of team size. This is commonly known as diseconomy of scale, which is naturally present in software production; which needs to be carefully managed by taking the advantage of production economics. Due to weak management of this diseconomy of scale, software companies in Bangladesh are of very small size.

Most of the cases, Bangladesh software firms focus on efficiency innovation. Customers also look into IT as a tool of efficiency and control innovations. The wealth creation scope using IT as an efficiency and control tool is very limited in a labor surplus country. As a result market expansion is very limited.

Figure 7.9: Perception of Firms About Management Capability as Constraint to Growth



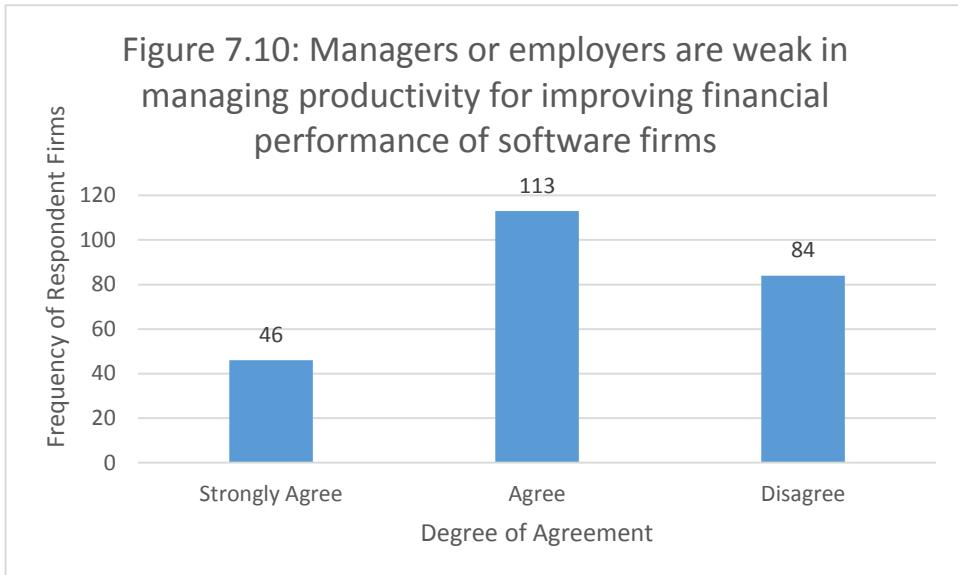
Data source: Field Survey

Six of the most important management challenges in developing software firms, focusing on local market, in Bangladesh are as follows:

1. Cost+Profit based pricing in delivering customized solution, starting from scratch in every project, is not a viable business model for software business in Bangladesh. To benefit from high level of reuse by taking the advantage of commonality of requirements and product line architecture is a management challenge of developing software business.
2. Managing diseconomy of scale through improvement of production technology, which flattens the growth of communication and coordination overhead and rework level with the growth of team size, is an important management challenge.
3. Managing disruptive innovations in existing way of doing things with the support of innovative software products or services is the key challenge to develop large scale software business in developing countries.
4. Codification of tacit knowledge acquired by programmers, improving production performances using such codified knowledge and developing protectable IP portfolio around pursued path of disruptive innovations is a management challenge.
5. Managing finance and moral of the team over a long period, 5 to 10 years, before generating significant profit from investment is a quite formidable challenge.
6. Managing partnerships with diverse stakeholders, even changing policies of clients, funding agencies and Government, is also an important requirement.

For export business, one of the key challenges appears to be connecting to the global value chain of software engineering and implementation service delivery. Usually, it is difficult to succeed as a green field project. Rather success in domestic market should be capitalized to expand in the export market.

In general, there appears to be awareness in the industry that management capability is not good enough to succeed to develop software firms as shown in Fig. 7.9 & Fig. 7.10.



Data source: Field Survey

7.9 Process Capability to Deal with Productivity, Quality and Predictability

Conventional CSC or CSE programs teach technology to future programmers. Knowledge related to software production management is not usually taught to these graduates. They usually start software development using mental model centric design, coding and testing. As a solo programmer, such approach produces reasonable good result to produce small sized applications. But scalability of such software production technology is very limited. The communication & coordination overhead, waiting time, and rework (largely caused by misinterpretation and personalized conventions) with the growth of team size shows exponential behavior ($n(n-1)$). Reuse also keeps falling with the growth of team size. If production capability or technology is not improved, per person value addition or marginal productivity keeps falling with the growth of team or firm size. For this reason, very often a competent freelancer makes more money being solo performer, rather than working in a team or Firm. There appears to be perception among developers that improvement should be brought in production process as shown in Fig. 7.10. But solution does not appear to be readily available.

There are two main body of knowledge in the process arena of software production: 1. SW-CMMI, and 2. ISO. SW-CMMI was developed to prevent very expensive defects, fixing these defects through testing is very costly (such as defects in software in controlling missiles) and to deal with the complexity of very large software projects. The recommendations of SW-CMMI of producing a long list of documents in compliance of detailed standards, partly recommended by IEEE, and to carry out a series of review appears to be cost effective, when saving from prevention of even a defect is millions of dollar, particularly in defense projects. It's also useful in a situation when there will be the opportunity of developing a piece of software to be sold to millions of customers. Financial implication of detection of a single defect after delivery is quite large in such a situation. The management of long life of software also benefits from such a rigorous process framework. ISO's recommendations also deserve similar review. But for small software companies, who are facing the challenge of growing through delivery of small applications to relative a small customer base, the cost of compliance of such a process appears to be much higher than derived benefits. For this reason, upon achieving certification of SW-CMMI or ISO, Bangladeshi software companies could not improve financial position. But

Indian software companies apparently benefitted from such certification. Most of the Indian software companies are basically contractors of delivering software engineering services. The challenge of these companies is to work in partnerships with global development teams of clients. Moreover, management of client companies, particularly US based, found it less risky to justify in giving work to a India based contractor, who had SW-CMMI certification. As a result, Indian companies benefitted from SW-CMMI certification in serving large US based customers. But to serve small clients, visible financial benefit over short span of time in producing executive application is more important than production of a series of documents, in compliance with certain process framework like SW-CMMI.

It appears that a process framework which contributes to cost reduction and improvement of quality is a binding constraint for Bangladeshi software companies to grow.

7.10 R&D Capacity

Most of the software companies in Bangladesh can neither be typical software product based company like Microsoft nor afford to develop each customized application for individual customer from clean slate without taking into consideration of reuse. Software companies are under increasing competitive pressure for improving delivery parameters such as cost, quality, and time. Systematic reuse is an opportunity of continued cost reduction, quality improvement and lead time reduction in software delivery. Systematic reuse largely depends on the scope of delivering customized software applications in the same market segment repeatedly to multiple customers. Thorough market analysis provides basic inputs for defining generic product concept for delivering mass customized solutions. The problem of establishing a successful new business around a generic software product concept is not challenging because of shortage of ideas, but rather problems exist in proper analysis of the market and adoption of reuse capability for continued price reduction and quality improvement to deal with evolving market forces for delivering mass customized solutions⁶⁵.

In academic institutions, technology is taught to CSC or CSE students, irrespective of type of institutions. But technology knowledge is not good enough to innovate a software product to be sold to many customers at an affordable price, which is a fraction of development cost. It takes a great deal of effort and long time to model business processes of target customers' business, perform commonality and variation analysis and develop reusable core assets for delivering partially customized solution to every target customer. This kind of process R&D is basically missing in any academic institution of Bangladesh. Knowingly, or most unknowingly, software companies in Bangladesh kept experimenting with the development of product, which adds significantly high value to clients' business and which could be seamlessly integrated within customers' business processes without having the need of significant new development effort. As a result, companies fail to figure out ways to reduce the cost of delivery, without sacrificing acceptable profit to revenue ration. Limited risk capital and very low profit do not allow these companies to continue investing in improving the product so that quality increases and per unit cost of delivery decreases. As a consequence, most of the companies have multiple conventional products such as ERP, but most of them have not become successful to make sale of thousands copies of the same product, without much of modification.

⁶⁵ Economics of Software Reuse and Market Positioning for Customized Software Solutions
M. Rokunuzzaman+ and Kiriti Prasad Choudhury, 2011

Since the beginning of programming software reuse has been of interest because people want to build software solutions that are bigger, more reliable, less time consuming, less expensive, and that are delivered on time. Although this is a simple idea and benefits are clearly visible once successful reuse of software assets developed in past projects is made in current projects. Despite the simplicity of the idea and visible benefits, systematic reuse as a strategic capability to deal with ever-growing complexity and diversity in products, and decrease in lead time has not been realized with mass satisfaction yet, in Bangladesh. The key bottle neck appears to be the ability to undertake R&D to predict commonality and variations in products to be offered to justify proactive investment for reusability and positioning program.

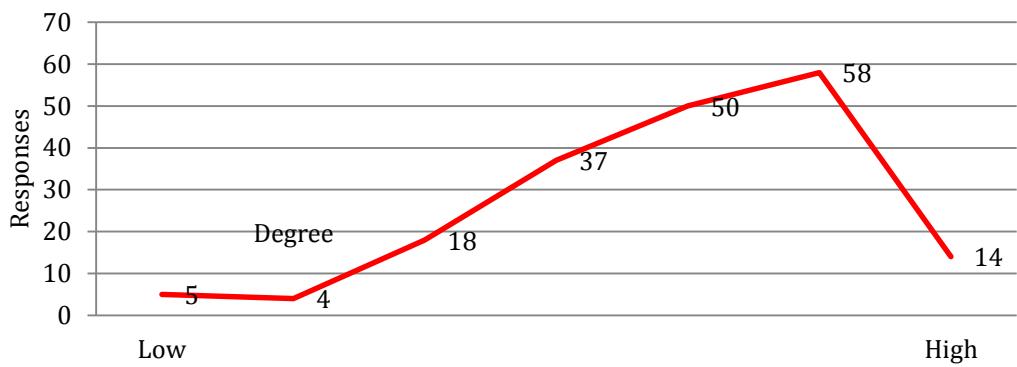
7.11 Partnership with Value Chain Members

There appears to be two major kinds of ecosystem: 1. An innovation ecosystem in which a software companies take inputs from complementary service providers such as IPR management service providers, business process consulting, etc., and 2. The product ecosystem in which large software vendors typically engage in a formal way with each of the following ecosystems: Supplier ecosystem, Partner ecosystem and customer ecosystem.

Marketers, programmers, consultants, and lawyers all participate in the software ecosystem. Users, and what they need software to accomplish for them; software engineers and developers, who translate the user's needs into program code; managers, who must orchestrate the resources, material and human, to operate the software; industrialists, who organize companies to produce and distribute software; policy experts and lawyers, who must resolve conflicts inside and outside the industry without discouraging growth and innovation; and economists, who offer insights into how the software market works must cooperate in an interdependent way forming the ecosystem. It appears that such ecosystem in Bangladesh is very weak as shown in 7.11. The participation of lead users, university research groups and companies in pre-commercial R&D project to develop software solutions to address performance improvement issued faced by a sector has not become a reality yet in Bangladesh. Policy research using evidence based economic fundamentals has not become a professional practice in Bangladesh to address growth issues faced by the software industry in Bangladesh. A number of policy issues, such public procurement and PPP to increase the local value addition capacity in delivery software solutions needed by both public and private institutions, requires participation of diverse stakeholders. So far no much institutional practice is in place to bring those stakeholders together to undertake evidence-based research for proposing sound policy direction.

Partnership of software companies with Universities for developing commercially attractive product and carrying out research for improving software production process are yet to take place in Bangladesh. The policy of both the Government and Software using private sectors such as Banks of purchasing finished products appears to be major cause of such weak partnership with value chain partners.

Figure 7.11: Perceived Impediment Due to Weak Partnership with Value Chain Partners



Data source: Field Survey

7.12 Political Stability and Country Image

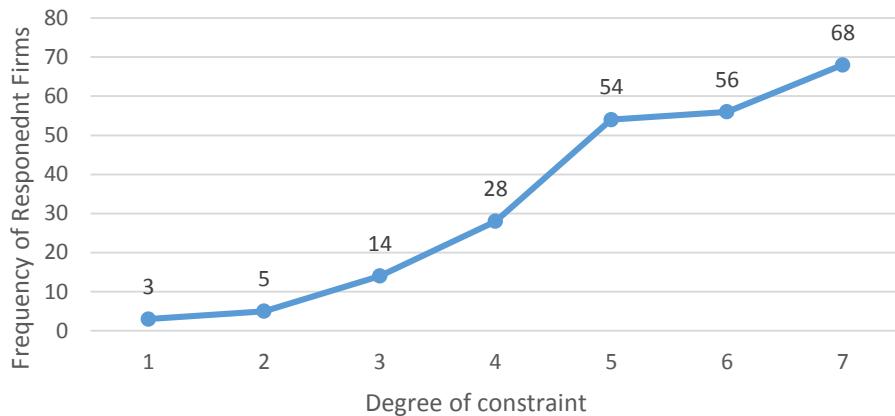
These are very common concerns, particularly for foreign direct investment and export. Country risk factor matters to convince foreign clients to contract out work. Despite presence of such factors, certain sector such as Textile, Leather products and Pharmaceutical are growing. The success of Grameen Phone in generating more than USD 1 billion revenue in fiercely competitive connectivity market indicates that political stability and country image do not hold the flow of FDI and growth of high performing company in Bangladesh. Although Bangladesh achieved favorable positions in ratings of international consultancies such as Gartner (Bangladesh on its list of top 30 destinations for global IT outsourcing for 2010-11)⁶⁶ and AT Kearney (26th best destination for IT outsourcing globally, 2014)⁶⁷, but there has not been any significant change in FDI or export work order flowing in the software sector in Bangladesh. Ensuring political stability and better country image have many dimensions to work with, which may not be fully within the scope of software industry development agenda. On the other hand, Government's Digital Bangladesh vision has the merit to reflect commitment of political leadership to ICT led growth agenda.

There is a perceived strong concern among respondents that weakness in these areas are impeding the growth of the sector, as shown in Fig. 7.12.

⁶⁶ http://archive.thedailystar.net/newDesign/news_details.php?nid=167623

⁶⁷ <http://www.thedailystar.net/bangladesh-26th-best-destination-for-it-outsourcing-42306>

Figure 7.12 Political Instability as a Constraint to Growth



Data source: Field Survey

7.13 FX Regulation

There appears to be need of updating FX regulation to support the need of outflow of foreign exchange, primarily for import of software license, Cloud based services, software implementation services, and professional services, both on site and off site. Bangladesh's existing FX regulation related to import primarily deals with physical import of goods, such as CD for software. But now a day, high value software applications SAP and Oracle enterprise applications, are no longer shipped in the form of CD. Rather, users' keys are delivered to access such applications over the Internet.

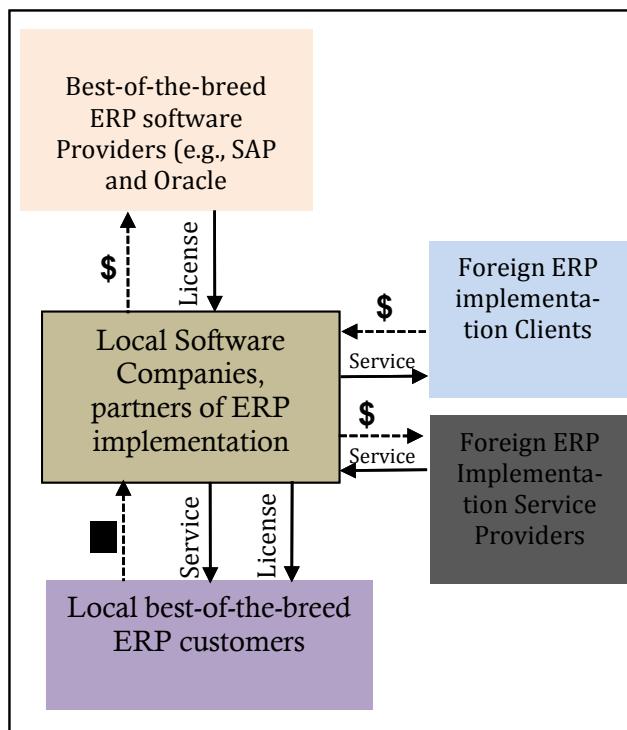


Figure 7.13: Flow of foreign currency to support the trading of license and professional service fees for the best of the breed enterprise applications

Best-of-the-breed ERP implementation service is a high paying untapped service delivery export opportunity for Bangladeshi software companies. In a typical ERP, such as SAP and Oracle, implementation service consists of more than 70% of project value. A typical project of SAP or Oracle ERP implementation even in Bangladesh costs around US\$ 1 million. At present, more than 80% of this service cost goes to pay for foreign professionals, mainly from India, Philippine and Pakistan. Regulatory barriers should be removed to encourage local software companies to import both best-of-the-breed software licenses and high end implementation services to support their implementations to meet demand of local clients. Such engagement will not only improve performance of client companies, but also will help local software companies to develop expertise and partnership to export ERP implementation services to lucrative foreign markets. Some of the global consulting firms such as Deloitte, Infosys, TCs and PWC are generating more than US\$1 billion each from technology integration and ERP implementation services from North American market alone⁶⁸. Typical fund flow for best-of-breed enterprise applications is shown in Fig. 7.13.

Local IT companies, not necessarily software companies, having strong financial positions and the ability to face Bangladesh Bank's audit are primarily involved in transacting large license and implementation service fees on behalf of foreign companies. But, small software companies having the capability to develop competence to deliver implementation services under the supervision of foreign professionals, through both on-site and off-site presence, are failing to penetrate in this market for a number of constraints including foreign currency remittance ceiling to pay for foreign professionals. As a result, lucrative implementation service market is largely dominated by Foreign Service providers. In Bangladesh's implementation service market of foreign ERP, such as SAP, Oracle, IFS, Microsoft, local value addition currently stands at less than 20%. At present, local implementation service market's size is above US\$7 millions per annum. This service market has been growing at rate of 15% to 20% per year is expected to continue the growth for the foreseeable future. As a result, Bangladesh's software industry as a whole and small software companies in particular are missing the opportunity to develop the capacity around local market to export high paying implementation services to foreign market. As shown above, we should allow the flow of foreign currency to buy license and professionals service to develop the service delivery competence for the export market as shown in Fig. 7.13. Change of foreign currency regulation in favor of small software companies to import enterprise application implementation service to develop the local capacity is a precursor to open the door of exporting high value implementation service to large as well as growing export market.

Due to adoption of hybrid model of professional service delivery by the IT industry, it may be cheaper for Bangladeshi companies to access professional services over the net instead of having on-site physical presence of foreign professionals. But existing FX regulation is a constraint to import services over the net.

Cloud Service Import has Strong Potential to Reduce Hardware Import and Energy Bill: Bangladesh's import of high end servers, storage, database systems, switches, and middle wear has already crossed more than US\$100 millions per year. In 2012, Oracle's red stack revenue alone from Bangladesh was more than US\$50 millions. It has been gathered that average utilization factors of this capital machinery is less than 15%.

⁶⁸ Gartner, Forrester Research, IDC and other International Consultancies

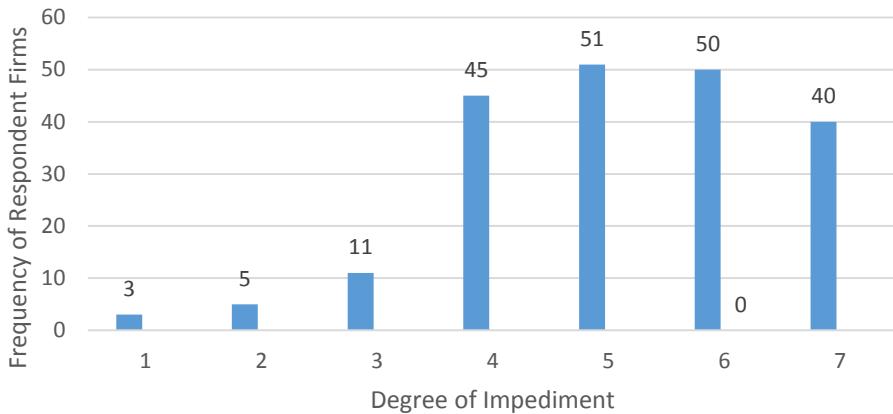
Moreover, significant amount of electrical power is required for running and cooling these devices. Cloud computing has been emerging as a solution to increase this utilization factor significantly and to reduce energy bill substantially. Temporal demand variation and aggregation of large volume of equipment in strategic locations are the underlying main causes of significant improvement of utilization factor and reduction of power requirement, primarily for cooling. There are daily recurring cycles in people's behavior: consumer services tend to peak in the evening, while workplace services tend to peak during the workday. Capacity has to be built to account for these daily peaks but will go unused during other parts of the day causing low utilization. This variability can be counted for running the same workload for multiple time zones on the same servers or by running workloads with complementary time-of-day patterns on the same servers. Due to continued fall of international bandwidth price, more than 30% on an average per annum [5], it's likely to be significantly cheaper to buy cloud based enterprise grade computing services from North America or other places having suitable time difference instead of having on premise dedicated IT facilities or in-country cloud. In order to avail this service to reduce foreign currency bill payment requirement for hardware import, local software/IT companies will be required to pay to foreign cloud providers.

According to IT research and advisory firm Gartner, the cloud services market in India was projected to grow 32.4 per cent in 2012 to total \$ 326.2 million (about Rs 1,665 crore). Software as a service (SaaS) is the largest segment and was forecasted to grow to \$ 115.6 million in 2012, while infrastructure as a service (IaaS) was estimated to grow from \$ 35.2 million in 2011 to \$ 42.7 million in 2012.

In order to benefit from this emerging model of delivery of IT infrastructure and enterprise applications to Bangladeshi customers as a service from foreign cloud platforms, small and medium sized software companies should be facilitated to start experimenting with delivery of different services. To support such experimentation, software or IT companies should be allowed to remit foreign currencies to foreign cloud operators. It's highly likely that such payment obligations in foreign currency will be growing and very well will cross US\$20,000 figure very quickly. Moreover, the growth will be incremental in nature. The requirement of small software companies to face Bangladesh Bank's audit for getting approval to remit cloud service fees will be a significant constraint for these companies to explore this new avenue. Therefore, existing foreign currency regulation for software companies should be revised to facilitate the cloud based service import to reduce import bill for on-premise hardware, and software and to eliminate energy bill to run and cool those hardware devices.

In the field survey, perceived impediment caused by foreign exchange regulation is shown in Fig. 7.14.

Figure 7.14 Perceived Impediment Caused by Foreign Exchange Regulation



Data source: Field Survey

7.14 Knowledge about Tax's and Regulatory Environment (Tax/VAT)

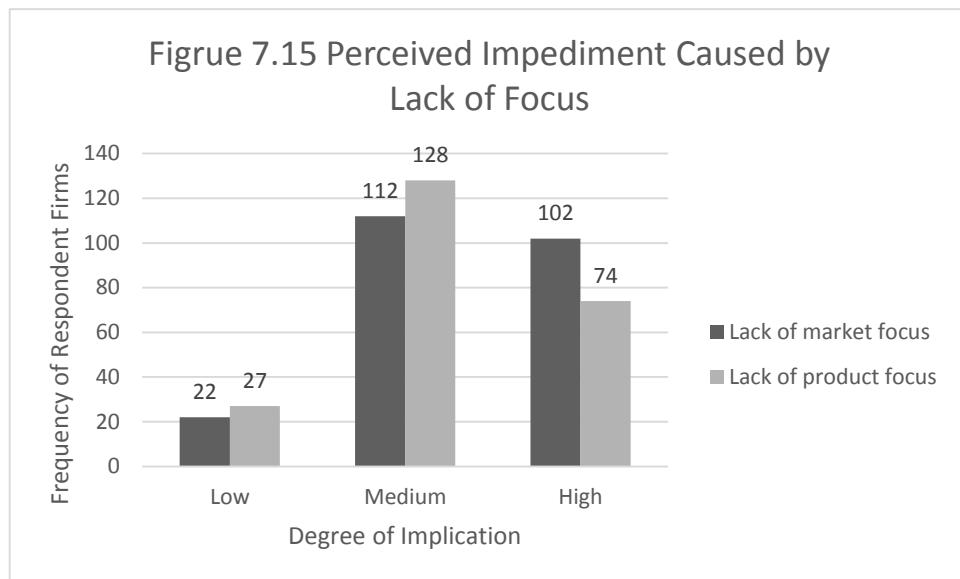
It has been learned that many of the entrepreneurs are not clearly informed about different relevant government policies and their clear implications within the context of software firms. There appears to be incidences when certain NBR officials took the advantage of such lack of clarity to gain undue material advantage from certain software firms.

7.15 Fragmentation of Local Market

From the Table 7.1, it indicates that functional expertise of local software companies is highly fragmented. Almost every responding software company has offering of ERP application. It has been learned that it takes years of R&D to develop globally competitive ERP applications. The offering of a single company of diverse applications, as perceived from the table, indicates that domain focus is very limited. Such lack of focus on a developing a product, with very little R&D capability as mentioned before, indicates that offerings by these companies have very low focus on target customers' business processes.

Due to high level of fragmentation, most of these software companies do not have unique value proposition to customers. Basically, all are commodity providers. As a result, selection process pursued by clients is based on cost. Instead of offering unique value, least cost bidding becomes the winning strategy for software firm. It has been learned that in many situations competition software companies end up in quoting price, at which no way solution could be delivered. Upon getting the work order as least cost bidder, both the winning company and the client get into trouble. Invariably, the Software Company fails to deliver in compliance to ToR and the client ends up not getting the full solution. As a result, reputation of the end suffers. And clients start developing the perception that through software real performance improvement of business process is not realizable. Due to high fragmentation, software companies cannot also benefit from reuse through delivery of slightly customized solution, around reusable assets, to large number of customers. As

a result, both the two sides of the market suffer. According to some insiders, this appears to be a key constraints to growth of software firms in Bangladesh. Professionals working in the sector appears do have awareness about such constraint as shown in Fig.7.15.



Data source: Field Survey

Software companies in Bangladesh appear to be caught in typical dilemma of software business:

1. If your quote based on actual cost, starting every project from scratch for delivering customized solution to every single client, you will lose the bid.
2. Based on unrealistic costing, if you win the bid being least cost bidder, either you will fail to deliver or lose money.
3. If you keep failing to deliver or losing money, very soon either you will be bankrupt or proven to be unreliable supplier, which will lead to out of business.

Solution to this dilemma is about developing unique value proposition and reuse capacity. Consistent focus on the market and the product is the key to again momentum along these two important dimensions. It seems that software companies in Bangladesh have not made much progress along this line. It appears that local software companies are seriously caught into this constraint.

Table 7.1: Domain Exposure of Local Software Firms

Functional Focus	Frequency of Responding Firms		
	Low	Medium	High
ERP and integrated business application	35	40	94
Accounting and financial software	35	71	57
Banking application	21	77	35
HR and payroll solution	30	61	69
CRM, marketing and sales automation	15	44	54
e-commerce and portals	16	56	58
Web development service and hosting	15	55	39
Communication solution	10	41	41

Functional Focus	Frequency of Responding Firms		
	Low	Medium	High
Mobile application	19	64	82
Customized software development	9	42	53
Education institute management application	15	42	21
Enterprise content management	9	41	39
Hospital management system	11	31	24
POS and inventory management system	16	38	24
Security, biometric and alert systems	9	31	23
Capital market solution	7	36	16
Office management solution	10	36	32
e-learning	11	37	19
Insurance management system	14	32	17
Micro finance solution	12	25	16
Media content management system	13	21	14

Chapter 8: Overall Observations and Recommendations

8.1 Overall Observations and Scopes of Making Improvement

In comparison to national income level and value addition record of other industries, per person value addition in the software development sector—on an average USD 12,000/year—appears to be significantly high. The scope of performance improvement of the functioning of the Government and different wealth creation sectors of the nation through software appears to be also high. For example, software innovations to improve codification, causality analysis and sharing of field level knowledge have strong potential to improve the production function of the agricultural sector. The reduction of yield gap by 10%--from existing 30% to 20%-- through such innovation has the potential of creation of additional USD2 billion worth of agricultural output every year. Moreover, such growth of field level productivity will directly lead to income growth of more than 15 million farming families—most of them belong to economically marginal group of the society. Similar examples could be drawn in other sectors, including the functioning of the Government.

Growth Opportunities: Software product innovations have significant potentials to improve the competitiveness of the local economy. Due to increasing role of software in industrial products and services, increasing number of enterprises, across the world, are expanding their software production capacity. With adequate HR quality, R&D investment, IPRs culture and physical infrastructure, some of these companies could be attracted to open software development center in Bangladesh or contract out such work to existing companies. Already, there are development centers in Bangladesh. We need to scale up this model. Creative entrepreneurship of youths could be harnessed to create path breaking development opportunity for Bangladesh. Existing software companies could be supported to benefit from economy of scale and scope to increase the value, reduce the cost and improve profitability of their deliveries. Progress along this line has the potential to create snowball effect for expanding the local market, and increasing access to global market. Improvement in IPRs culture has the potential to address information asymmetry and intangible asset valuation to ease the process of risk or venture capital financing in the industry.

Basic Strategy: Government should catalyze the creation of snowball effect for the growth of market, creative entrepreneurship and software Firm size. Once the virtuous cycle starts, industry will solve issues facing the scalability of growth of the industry.

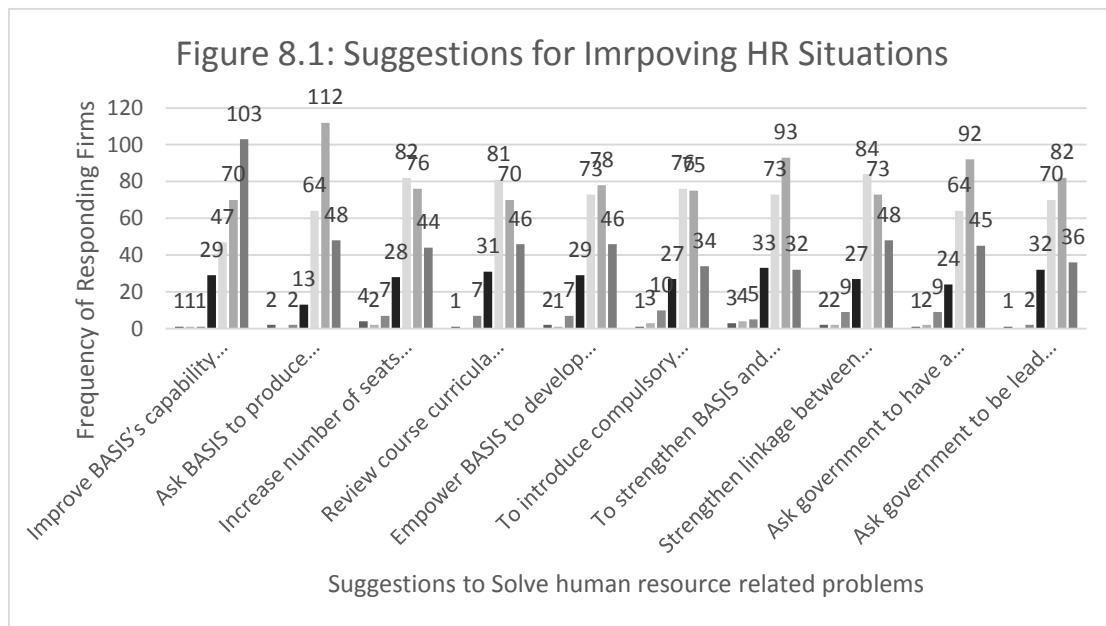
Scope of Making Improvement:

1. Improve firm level capability to benefit from economy of sale and scope. The focus on process and product innovation should be given high priority to make progress along this line. Progress in economy of scale and scope has the potential to create snowball effect, which will keep decreasing the cost of delivery and increasing profit. As a result, market will be expanding and individual software firms will be growing creating career growth path for software professionals.

2. Improve IPRs culture among all stakeholders of the software industry. Such improvement will address information asymmetry, which is critically needed for market expansion and investment mobilization.
3. Invest in university based collaborative R&D focusing on software innovations targeting different domestic sectors. For example, image processing based inspection system software has significant scope to reduce wastage and improve quality of our export oriented RMG sector.
4. Promote university based entrepreneurship to unlock creative entrepreneurial capability of youths, which may open path breaking development opportunity.
5. Bring change in academic programs to educate students to figure out the scope of improving diverse work processes through software innovations. Education related to software production economics, and innovation and new product management should also be included in CSE, EEE, and BBA programs.
6. Develop a micro innovation and entrepreneurial ecosystem in the form of software Innovation Park, preferable at location of Dhaka city. Investment in such facility should be looked upon from the perspective of public goods to create new growth opportunity. This software park will not only support local entrepreneurship, but also will facilitate the piloting of foreign investment.
7. Policy of different ministries should be updated to use software innovations as strategic tool to address agenda of corresponding ministries. For example, software innovations could be strategic tool to increase productivity of Agricultural or Health sectors.
8. Long term development agenda around software innovations should be formulated. Public procurement should be in sync with the growth of local software industry to address such long term software led growth agenda.
9. A virtual software innovation and industry R&D center should be developed having nodes among most of the public and private universities. Under the coordination of central body, these nodes will be conducting research in collaboration with the industry to address each of 78 issues, looked into in this study.
10. Improve the capacity of demand side for intelligently figuring out the scope of use of software to improve organizational performance. The capacity improvement should include planning and acquisition management to develop software asset in an incremental manner.

8.2 To Ensure Supply of Consistent Quality of HR

Survey respondents in the CEO category have suggested the most important role for BASIS to address HR requirement of the industry. 103 respondents have given the highest priority for the urgency of improving the capability of BASIS for providing industry focused training, as shown in Fig. 8.1. There is a strong urgency that BASIS should provide training for trainers, so that adequate number of quality trainers is available in the market. It appears that we need to engage faculty members of Universities in R&D programs to envision and implement software innovations led growth agenda of the nation. Such engagement will lead to improvement of both quality and quantity of HR supply.



Data source: Field Survey

There has also been urgency that Government should have funding provision to provide training to mid-level management of clients' companies for improving the performance of organizations through intelligent use of ICT. It has been learned through key informants that mid-level management of clients' companies do not have adequate exposure to process centric understanding of their respective organizations. As a result, their insights are not adequate enough to project development and execution focusing on work process performance maximization through business process reengineering with IT. As a result, local value addition through software has limited role. Rather, most of IT projects focus on HW procurement, network development and generic software application deployment. The improvement of HR quality in the client side will play an important role to address the human competence of the demand side facilitating local value addition and growth of the software market. It may be good idea to introduce courses in business education of performance maximizing of business processes through reengineering with the support of ICT or software innovations.

There appears to be high importance on the idea of encouraging the government to be lead users of software solutions, so that during the development and delivery of such cutting edge solutions professionals of software companies will get on job training, which could not be supplemented by other conventional means. There has also been importance given to improved linkage between software industry and academic institutions.

It has also been mentioned that BASIS should also get involve in providing need based training to fresh university graduates, so that they are ready to start working on clients' projects and commercial product development projects. Relatively, there is weaker emphasis on compulsory education in computer studies at the School and College level. The importance felt by respondents for the BASIS to introduce certification program to categorize industry ready competence of CSE/CS graduate is also relatively weak.

It appears that the model of exporting coding and testing services is dominating growth aspiration of most of the survey respondents. For this reason, significant importance has been mentioned in the role of BASIS to promote training. The history indicates that although coding and testing services have created large industry in India, but Bangladesh's performance is insignificant. It appears that Bangladesh should look into the model, which works well within the given context. It appears that both BASIS and BCC should focus more on policy, IPRs, strategy and ecosystem development issues, instead of giving training. Rather we should increase the scope as well as capacity of our academic institutions to address such HR development need.

8.3 Recommendations for Improving the Infrastructure Limitations Facing the Industry

Physical Infrastructure: Although there are limitations in road infrastructure and traffic situations of Dhaka city, but as a specific development agenda addressing the limitation faced by software companies, importance has been given on Software Technology Park. This technology park should be located in secured and well-connected area of Dhaka city, may be around Gulshan. This park will provide quality office space at an affordable rate, should be much lower than that charged by commercial properties in prime locations of the city. Such facility appears to be crucial for three major purposes: 1. this facility will provide easy piloting option for potential foreign investor to test the water. With the necessity of significant overhead of facility preparation and ensuring security, management of such potential investors will be able to channel their limited piloting resources, time and management overhead, on production team development and integration with their global value chain. It has been referred that scalable growth model should be developed first and district level facilities should be developed to scale up such model.

Connectivity: Although international connectivity situation has improved significantly over last few years, particularly in wholesale bandwidth price in Dhaka. But at the end user level, particularly in rural Bangladesh, where cellular is the primary means of Internet connectivity, has not improved, as far as price is concern. Such high cost connectivity, which is unaffordable to many target customers of content, service and Apps. As a result, not only private sector, but also many development programs of the Government is facing serious limitations. The critical bottleneck appears to be the nationwide transmission network. Both cost and scale of this critical infrastructure should be improved by many folds. If fiber optics transmission is made available at the village/union levels for offering nationwide transmission services at an affordable rate (such as BDT500/Mbps), there could be flurry of activities of micro entrepreneurship of providing WiFi based Internet services at the village level. It has been learned that large investment need and week prevailing demand are discouraging the private investment to address this critical problem. There could be important role for the Government for laying basic infrastructure in the

facility level such as empty ducts and dark fiber, and stimulating demand creation. Once such step is taken by the Government, competition in private investment will address the service delivery.

Electrical Power: There appears to be some degree of satisfaction of improvement in the power supply. Although, sharp rise of power tariff, has caused some dissatisfaction. Commissioning of large scale power, low cost power plants and phasing out of rental power plant may reduce pressure on the government, which may lead stable pricing of power in the long run.

8.4 Recommendations for Market Expansion

The highest priority has been given on arranging meetings and/or seminars in USA, particularly in areas where concentration of software professionals having Bangladeshi origin is very high, as shown in Table 8.1. Historically, such activities failed to produce expected results.

Table 8.1: Suggested Recommendations to Address Market Related Problems

Market Related Problems	Low	Frequency of Responding Firms						High
	1	2	3	4	5	6	7	
Arrange meetings/seminars in selected locations in USA with a concentration of software Professionals of Bangladeshi origin (e.g. Silicon Valley, California, USA) to inform them about the incentives being provided by GOB and mobilize their support to help Bangladeshi entrepreneurs.	4		2	20	28	108	96	
Ban use of all pirated software in all organizations, both in the public and private sectors.	16	2	5	23	58	120	26	
Encourage all public sector organization to replace the manual system of documentation and records by computerized system through the use of locally developed customized application software.	2	3	12	31	62	79	65	
Send marketing missions to North America/ EU consisting of members from IT associations and EPB, on a regular basis.	1	5	5	34	82	84	43	
Explore the possibility of obtaining business on sub-contract basis from other countries.		2	16	24	74	92	26	
Empower EPB to ensure regular participation in all major International Exhibitions / Fairs for software products and services.			10	29	54	103	42	
Ask the concerned Trade Associations to organize International Exhibitions / Fairs in Bangladesh.	1	2	8	34	66	87	36	
Encourage software firms to take different certification	1	3	8	30	72	78	39	
Produce sufficient skilled software professionals for export.		4	7	38	63	74	29	

Data source: Field Survey

The importance of banning pirated software in local organizations appears to be very high. As high as 120 respondents in the CEO category has mentioned its importance. There has been strong suggestion for empowering EPB to ensure regular participation in all major International Exhibitions/fairs of software products and services. There is strong

acceptance of the idea sending marketing missions to North America/EU consisting of members of IT associations and EPB, on regular basis.

There is a strong suggestion to for the Government to go for using ICT in its work process for increasing the efficiency and quality of access of public services. A large number of respondents have positively responded to the suggestion of encouraging all public sector organizations to replace the manual system of documentation and records by computerized system through the use of locally developed customized software applications.

There are also suggestions for encouraging software firms to acquire international certifications. Trade associations are encouraged to organize Exhibitions or fairs in Bangladesh to promote locally developed software applications. It appears that the focus should be on economy of scale and scope so that cost of delivery decreases and profitability increases leading to market expansion.

8.5 Policy Suggestions

As shown in Table 8.2, it appears that strongest policy suggestion is on infrastructure, quality, cost and accessibility of infrastructure must be improved. The political stability takes the 2nd position in the priority.

Table 8.2: Suggested Policies

Policy Suggestion	Low	Frequency of Responding Firms					High
	1	2	3	4	5	6	7
Infrastructure Development (power, connectivity,)	1		8	15	34	86	104
Tax exemption	2	2	4	26	77	72	47
Export promotion		3	5	25	68	70	51
Trade licensing facilitation		1	6	31	50	96	35
Export licensing facilitation		3	11	19	58	74	40
Training of computer scientist, and programmers	1	1	15	21	52	81	33
Arrange trade expo across the countries		8	13	31	48	67	43
Arrange country specific expo		1	20	29	56	66	37
Ensure application of intellectual property rights	2	2	12	18	58	58	48
Ensure power for 24 hours		3	12	37	50	79	40
Make lower interest rate		1	10	21	68	65	59
Easy loan		1	11	36	47	69	68
In house training		4	7	35	47	82	31
Set specialized IT universities	2	1	19	26	48	67	54
Have collaboration with different country govt. for market development and joint venture		2	10	39	55	60	36
Setting software park		1	11	37	50	59	62
Ensure political stability		2	12	36	43	64	64
Vat exemption		3	8	40	54	68	40
Improve online payment system		2	19	25	52	53	57
Reducing power bills	1	1	13	31	54	67	36
Provide R&D grants	2	2	11	36	55	58	45
Tax on software import	1	2	14	31	53	57	37
Tax on import of software engineering and implementation service		4	16	39	53	50	35

Policy Suggestion	Low	Frequency of Responding Firms					High
	1	2	3	4	5	6	7
Minimum local value addition for implementation of foreign software	1	2	17	43	58	55	22
Requirement of local development partnerships for foreign software firms to sell software in Bangladesh	1	2	15	31	54	60	32
Promotion of venture capital funds	1	1	15	36	45	68	26

Data source: Field Survey

The policy of providing soft loan to software companies has also drawn quite strong interest; more than 130 CEO category respondents have placed high importance on this policy issue. Public policy of setting up specialized IT University appears to be important to respondents. There has been strong emphasis of reducing on line payment issue. There has been urgency that policy of imposing high tax on license procurement of foreign software applications and importing software implementation services should be given due consideration.

The policy of ensuring adequate local value addition in procuring foreign software solution and services has got high responses. Such local value addition policy, particularly in public procurement, appears to be critical for preparing local firms for large scale e-Government projects. Such local capacity development through local value addition in public sector projects will also prepare local firms to be competitive in the export market.

Policy of ensuing uninterrupted power supply and lowering power bill is also on the card of policy recommendations. The intellectual property rights has drawn string importance. More than 100 CEO category respondents have mentioned that policy agenda of ensuring application of intellectual property rights in local software market is high.

8.6 Recommendations Regarding to Roles of Different Organizations

SME Foundation: The software development sector of Bangladesh is basically populated by micro, small and medium enterprises. Due to high per capita value addition and significant scope of improvement, constraints facing the sector should be addressed. In doing so, recommended approach for SME Foundation to follow is shown in below:

1. Envision scenarios, strategy and policy to address each of major constraints.
2. Promote such scenarios to concerned stakeholders including Government, Business Associations, Academic Institutions, etc.
3. Partner with stakeholders to implement projects to materialize selected scenarios, which are with the mandate of SMEF.
4. Develop a progress monitoring framework and periodically report progresses being made to stakeholders.

Recommended Roles for SMEF to address identified constraints to capitalize growth prospects:

1. **Policy Constraints:** Organize workshop to create awareness and to provide technical assistance to concerned GoB's departments to address identified policy constraints. Technical assistance should also be provided to software companies, in partnership with BASIS, to take advantage from existing policy framework.
2. **Information Security, Software Asset Loss Threat and IPR:** Create awareness and provide technical assistance to both software companies and Intellectual Property & Copy Right office to codify software assets and claim as well as provide ownership of such assets. Changes to be made in legal framework so that dispute arising out of loss or infringement of such assets could be addressed in shortest possible time frame.
3. **Ethics, Values and Loyalty of Software Professionals:** SMEF may organize workshop in Academic Institutions as well as at BASIS to create awareness about the importance of this important aspect—which is critical to develop intellectual assets and business around it. SMEF should also work with the Ministry of Education to include this important topic in academic curricula.
4. **Infrastructure:** SMEF should articulate relevant issues and propose design of appropriate solutions to concerned agencies to address this important element of the ecosystem.
5. **Access to Finance:** SMEF may work with BASIS and other stakeholders to figure out the scope of improvement of risk capital financing for the software industry. SMEF may also provide technical assistance to management of EEF. Upon taking lessons from EEF, SMEF may also design and promote more suitable risk capital financing instrument. The role of SMEF to reduce the interest rate of working capital finance will be also useful for the industry.

6. **Human Resources:** At present, BASIS and BCC are implementing large training projects for the IT industry. SMEF may provide inputs to these training programs about areas where training should focus on to address growth limitations faced by software companies due to weakness in HR capacity. SMEF may also work with BASIS to promote career growth issues among software companies. SMEF should also work with Universities and Academic institutions to promote components of software based wealth creation or work process performance improvement with software in the study of IT/CS.
7. **Access to Market or Creation of New market:** SMFE may provide training and technical assistance to software companies to focus on improving productivity and increasing economy of scale to reduce the cost of delivery. Technical assistance should also be provided to innovate high value solutions and create new market for software solutions, particularly following the path of disruptive innovations. It seems that SMEF may work with BASIS to promote the idea that cost+profit based business model of delivering software solutions from clean state has very limited market penetration capacity. SMEF should provide technical assistance to software companies to reduce rework, increase reuse and enhance value creation in delivering software solutions. SMEF may also promote envisioned growth scenario led by software innovations to different ministries and economic sectors. Suggested policy options should also be promoted to increase software use to address economic growth, governance and compliance issues. For example, the policy option of using software to reduce wastage in different economic sectors such as Textiles, RMG and Agriculture should be a key instrument for SMEF to promote to increase market access.
8. **Management Capability:** SMEF may provide technical assistance to software companies to increase the capability of management to understand market, develop products and positioning those products in the market. Technical assistance to be provided to management to manage software production process from the perspective of production economics. Management capability should also be improved to manage risk capital finance, and attract quality people as well as nurture them to grow.
9. **Software Production Process Capability:** SW-CMMI and/or ISO do not appear to be suitable for small software companies to reduce cost of delivery and increase profit to revenue ratio. SMEF should support the development and promotion of suitable process centric development among software companies so that cost of delivery decreases, and profit to revenue ratio increases.

To summarize recommendations, SMEF should create awareness and provide technical assistance to reduce the cost of delivery of software by making progress in reuse, rework, and economy of scale. SMEF should promote policy options to different GoB's ministries and economic sectors to increase performance through software based innovations. SMEF should also provide technical assistance to both supply and demand sides to pursue the path of disruptive innovations to create new opportunities of wealth creation through software innovations.

Ministry of ICT: Ministry of ICT should pursue policy options to increase surplus in consumption and production of software innovations. Therefore, it's recommended that following policy changes should be institutionalized:

Public Procurement: It's understood that GoB is defining Key Performance Indicators (KPIs) of all public institutions, including ministries and sub-ordinate agencies. From the perspective of production or work process, software is a production technology. Such production technology has a strong potential role to improve most of the KPIs. Policy should be promoted to focus on gain in KPIs through procurement of software technology solution over adequate period of time to maximize return from public investment. Moreover, software production is growing as strong opportunity for high paying job creation. Instead of having short-term focus of purchasing discrete software solutions, public procurement should focus on two following objectives:

1. Maximize gain from software investment—preferable through maximum local value addition.
2. To support the growth of local software production capacity through public procurement.

Public-Private Partnership: ICT ministry should promote joint product and process R&D to engage academic institutions, software firms and concerned government agencies to innovate software solutions to address growth potential of government agencies and economic sectors. Such policy will address HR issues, R&D financing to create new market and linking academic institutions with the industry.

Investment in R&D: The ministry of ICT should promote the policy to different Ministries to figure out the scope of addressing their agenda through investment in software R&D. For example, the agricultural yield enhancement agenda could be pursued, partly through investment in R&D to innovate and diffuse high value software innovations. Upon having this scope identification, Ministry of ICT should coordinate financing of R&D projects in partnership with Universities, Software Industry and related ministries.

Cadre Service Pool for IT Professionals and Poor Planning for Software led Growth: The ICT ministry should promote the policy of accommodating new Cadre in Public Service for increasing expertise within the Government. This expert pool will focus on envisioning software innovation led scenarios for improving KPIs of different public institutions and economic sectors of the nation. This pool will be in charge of implementing those envisioned scenarios with the support of software industry, Universities and other institutions.

Specialized Infrastructure and Services: The ICT Ministry should focus on rapid development specialized facilities, including office space and other services, in shortest possible time. Such facility should be preferable located in Dhaka's prime location, and cost of accessing such facilities should much lower than current commercial rates. Such facilities are essential for enabling prospective foreign investment to pilot development centers without facing much difficulty. Moreover, existing software firms and new initiatives need such facility to address infrastructure and support service limitations. The development of Kaliacore high-tech park or district level software Technology Park should not be given high priority at this point in time. Upon supporting successful piloting, such facilities should be developed at later stage to support

the scale up of piloting success. The ministry of ICT should also look into policy options to encourage private investment to develop such facilities.

Weak Focus on Disruptive Innovations: The ministry of ICT should promote as well as support significant growth of different ministries' agenda through disruptive innovations of software. For this reason, long term, over a span or 10 to 20 years, growth strategy should developed. Software firms, academic institutions and R&D capacities should be developed to the realization of benefit from such disruptive innovation led growth strategies. For example, software based distributed knowledge management could bring disruptions in conventional way of delivering extension services, resulting in high yield growth.

BASIS: BASIS should focus on policy options as important tool for market creation and increasing access to finance. BASIS should work in partnership with ministry of ICT to design and institutionalize such policy changes. BASIS should work with complementary institutions to develop capabilities of software firms to reduce cost and increase value of delivery BASIS should contribute to envisioning the scenario of software led growth of KPIs of different government agencies and economic sectors and promoting resource mobilization to implement those scenarios. BASIS should promote career growth of software professionals among member companies. BASIS should also promote capabilities of member firms' products and services and facilitate stakeholders' engagement.

8.7 Specific Recommendations

Sl	Recommendations		Roles and Responsible Organizations	Time Line
	Areas to be improved	Strategy		
1	<p>Access to Finance, particularly risk capital to support product development and improving software production process.</p> <p>Seed capital financing to support university level entrepreneurship.</p>	<p>Supporting collaborative R&D in partnership with software firms and universities.</p> <p>Facilitating venture capital (VC) finance, which will proactively look for potential companies to be financed. Promotion of IPRs culture to address information asymmetry and valuation of intangible assets has the potential to facilitate VC.</p> <p>Low cost financing could be arranged to address working capital issue.</p> <p>An innovation fund to be created to support University based entrepreneurship.</p>	<p>SMEF may work with Ministry of Finance and ICB to address VC related issues.</p> <p>Bangladesh Bank should look into low cost working capital finance.</p> <p>ICT division of Ministry of MoPT should look into R&D Financing.</p> <p>HEQEP project of UGC could be better aligned to address this purpose.</p> <p>UGC should work with Ministry of Finance to create innovation fund.</p>	<p>Kick off 2015, R&D support should be ongoing.</p>
2	Incentive to Buyers to acquire local software solutions.	Tax break attached to productivity improvement through integration of locally developed software.	Ministry of Industry and other domain related ministries should work with NBR.	Policies are formulated by 2015-2016

Sl	Recommendations		Roles and Responsible Organizations	Time Line
	Areas to be improved	Strategy		
3	<p>Human Resources</p> <p>Quality human resources, to support both usages and production of software</p>	<p>Improving academic knowledge for both using and developing software to enhance wealth creation capacity.</p> <p>Academic knowledge of innovation, product and project management, and production economics should be included in CSC/CSE/ECE/EEE curricula.</p> <p>Industry-academia collaborative R&D.</p>	<p>Ministry of education and UGC should include appropriate content. It should be noted that ICT education should not only focus on technology, but also its usages to improve performances of work processes.</p> <p>ICT division of Ministry of MoPT</p> <p>ICT contents of academic curricula of NCTB and BTEB should be updated to include software/IT usages in work processes.</p> <p>SMEF may provide expert services to propose updated curricula.</p>	2015-2016
4.	<p>Market Access</p> <p>Domestic market should be expanded and local software companies should be empowered to serve that market.</p> <p>Constraints related to foreign market access should be addressed.</p> <p>Suitable policy should be formulated to encourage usages of locally developed software to reduce transaction cost and increase efficiency.</p>	<p>Policy of collaborative R&D for empowering local software firms to pursue both efficiency and disruptive innovations to expand local market.</p> <p>Technical assistance should be provided to mid management of local buyers to conduct BPR with software.</p> <p>In public procurement, preference should be given to local value addition and strengthening capacity of local software firms.</p> <p>Software firms should be given assistance in partnering with foreign software and IT consulting firms.</p>	<p>BCC should work on developing software technology park in prime location of Dhaka.</p> <p>SMEF may provide technical assistance (such as training and procurement guideline) to large scale corporate software buyers for BPR to facilitate the sourcing of software and services from local small and medium sized software firms.</p> <p>BASIS should work with concerned ministries to address public procurement issues.</p> <p>EPB may promote local software firms to foreign partners.</p> <p>NBR and Ministry of Commerce should look into policy issues to increase usages of</p>	2015--onward

Sl	Recommendations		Roles and Responsible Organizations	Time Line
	Areas to be improved	Strategy		
		Suitable office space should be provided to pursue joint development and project delivery with foreign partners.	software by both public and private institutions.	
5.	Intellectual Property Rights	To empower software companies to package their intellectual assets and claim intellectual property rights. Office of IPR and Copyright should be given technical assistance to take care local context. Technical assistance (such as training and guideline) should also be given to judiciary and legal community such as Police, Lawyers and Judges to address software assets related IPRs issues.	SMEF may choose to provide needed technical assistance. It should be noted that local issues to be given adequate attention within the context of global best practices. Just copy of best practices of other countries may not be suitable solution. Bangladesh Computer Samity (BCS) should take steps to discourage their members, mostly hardware vendors, to load software for free in selling computers; rather they should start charging for software. Government may also negotiate with large software providers for special price for Bangladesh.	2015-2016

Sl	Recommendations		Roles and Responsible Organizations	Time Line
	Areas to be improved	Strategy		
6.	<p>R&D Capacity, both Product and Process</p> <p>Process of software production as well as work processes to be improved with software should be within the scope of process R&D.</p> <p>R&D to support disruptive innovations should be given adequate attention</p>	<p>Collaboration</p> <p>Establishment of center of excellences in selected universities for software innovation in strategic areas such as e-Government, e-Agriculture, m-Health, and e-Education.</p>	<p>ICT division of ministry of MoPT</p> <p>Ministry of education and UGC.</p>	2015-12017
7.	<p>Infrastructure</p> <p>Office space</p> <p>Connectivity</p> <p>Electrical power</p>	<p>Specialized office space to be developed either by the government or by the private sector on land given by the government in prime location in Dhaka.</p> <p>End user level broadband price should be reduced through demand creation.</p> <p>OTT policy should be given due consideration to accelerate broadband based service and content innovation.</p> <p>Software technology park is expected to address electrical power issue.</p>	<p>BCC and BASIS</p> <p>MoPT and BTRC, SMEF may provide technical assistance to prepare consultation paper to address this important issues.</p>	2015-2017

Sl	Recommendations		Roles and Responsible Organizations	Time Line
	Areas to be improved	Strategy		
8.	<p>Productivity and Economy Scale as well Scope of Production of Software Firms</p> <p>Due to very poor economy of scale, software companies in Bangladesh are very small. Productivity is also low, due to that per person value addition is low, almost 40% of that in India.</p> <p>Until this issue is addressed, firms will not grow to offer attractive career to professionals, lucrative return to investors and attractive consumer surplus.</p>	<p>Increase reuse, lower rework, and reduce communication & coordination overhead.</p> <p>Market positioning strategy, product portfolio and production process should be the focus.</p> <p>It should be noted that USA established SEI to address complexity and defects handling limitation of defense and space contractors.</p>	BASIS and SMEF may work together to develop a research center, preferable in partnership with academic institution, to address this vital issue of Economy of Scale and Scope .	2015-2017
9.	Career Paths for Software Professionals	Growth of Software Firms by taking advantage from economy of scale and scope will address this issue.	SMEF may provide training and guideline to software firms to design organizational structure to offer career paths to software professionals to benefit from high level decision making and research capabilities of senior professionals, to lower cost and increase quality of software production.	

Sl	Recommendations		Roles and Responsible Organizations	Time Line
	Areas to be improved	Strategy		
10.	Increase Female Professionals	<p>Improve work environment, and address leave and office time issue.</p> <p>Create awareness and provide incentive to software companies to increase female professionals.</p>	<p>BCC and BASIS should work to improve work environment and incentive.</p> <p>SMEF may work with BASIS and ministry of labor to design the guideline and formulate policies to enable software companies to offer needed leave.</p>	
11.	<p>Training for Industry Ready Professionals</p> <p>Already technology training being addressed by BCC and BASIS. Focus should be to provide training on innovation and product management, management of software assets & IPRs, management of productivity and economy of scale, business process reengineering and implementation as well as integration of COTS, ethics, motivation and loyalty, and managing carrier in software industry.</p>	<p>Instead of engaging BASIS and BCC for training, academic and training institutions should be supported to offer such trainings.</p> <p>BASIS should assess and recommend HR development need.</p>	Universities and Training Institutions	2015

Sl	Recommendations		Roles and Responsible Organizations	Time Line
	Areas to be improved	Strategy		
12.	Strengthening the Ecosystem for Supporting the Growth of Software Firms to Maximize Wealth Creation. Software firms alone cannot maximize consumer and producer surplus from software production. There should be supporting institutions in this regard.	Ecosystem elements such as education, training, R&D, management consulting, venture capital financing and IP management services should be strengthened and better linked with both supply and demand side of the industry.	SMEF may provide technical assistance such as studies to BASIS and ministry of ICT to detect weakness of current ecosystem and recommend improvement to be made.	2015-2018
13.	Public Procurement and Local Value Addition In many countries, Gov. is the largest buyer of software. Through public procurement, supports are provided to local value addition capacity, which eventually expands to global market. The policy of finished product procurement through competitive bidding, with the need of proven competence in doing similar or bigger projects, place local software firms in disadvantageous position.	Long term strategy of acquiring software assets to meet the Government is developed. The long term need is divided into incremental deliveries by keeping it in line with local delivery capacity. Local software firms keeps improving their capability through these incremental deliveries. Instead of looking software companies such as supplier, Government should look into them as new opportunities of growth, which should be supported through incremental public procurements. Government should look into procurement of software solutions from local firms as development	The ICT division should work with different Ministries to develop long term software asset need and formulating incremental acquisition strategy. BASIS should collaborate with the GoB to enable member companies to develop needed capacity to meet incremental delivery targets. SMEF may provide technical assistance such as assessment of current situation, preparation of guideline, recommendation of policy changes and providing training to both BASIS, software firms, and relevant Government Agencies/Ministries.	2015-2017

Sl	Recommendations		Roles and Responsible Organizations	Time Line
	Areas to be improved	Strategy		
		agenda to create a new area for wealth creation.		
14.	Promote Creative Entrepreneurship Among Youths to Create Path Breaking Development Opportunity	Invest in university R&D, provide incubation space and seed finance	SMEF, Ministry of Education and UGC	2015-2018

8.8 Specific Recommendations for SME Foundation

1. SMEF should work with Ministry of Finance, Bangladesh Bank, Ministry of ICT and ICB to address risk capital financing issues.
2. SMEF should provide technical assistance to large scale corporate software buyers for business process reengineering to ease the process of sourcing of software solutions from small local software firms.
3. SMEF should choose to provide technical assistance to software firms and the Government to develop IPRs culture in software asset development, management and consumption.
4. SMEF should provide technical assistance to prepare consultation paper to develop micro innovation ecosystem as software Technology Park.
5. SMEF should work with BASIS to develop a research center, preferable in partnership with academic institution, to address this vital growth issue faced by software firms: Economy of Scale and Scope.
6. SMEF should work with BASIS and ministry of labor to enable software companies to offer needed leave and offer other facilities to attract female professionals in the software industry.
7. SMEF should provide technical assistance to enable increased participation local small software firms in public procurement of software and services.
8. SME Foundation should promote creative entrepreneurship among youths to create path breaking development opportunity through the support of university level incubation centers and risk capital financing.
9. SMEF should provide technical assistance to software firms in software innovation and product line management, targeting local market.
10. SMEF should provide assistance to SMEs of other sectors to make intelligent usages of software and services delivered by local firms.



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