Software Engineering Practices and Challenges in Bangladesh: A Preliminary Survey

Md Shamsur Rahim, Md. Hasibul Hasan, AZM Ehtesham Chowdhury and Shovra Das
Department of Computer Science, American International University-Bangladesh, Dhaka, Bangladesh.
shamsur@aiub.edu

Abstract—**The software development industry of Bangladesh seems to be a promising destination for business process outsourcing. But the question is, are the practitioners following proper software engineering techniques, or, what are the challenges they are facing? To answer the question, a survey has been carried out by the authors to understand the software engineering practices and challenges in Bangladesh. To the best of authors' knowledge, this is the first survey on software engineering practices carried out in Bangladeshi software development sector. A total of 41 organizations based in Dhaka were participated in this survey from 2016 to 2017. The survey was designed based on five objectives namely characterizing the organizations, identifying software development life cycles preferences and challenges, performance measurement, requirement prioritization, and communication. This paper presents the findings of the survey and provides recommendations and future research directions for academia as well as the industry.**

Index Terms—**Qualitative Research Method; Software Engineering Practice; Software Engineering Challenges; Survey.**

I. INTRODUCTION

Software Engineering (SE) practices can be considered as a collection of concepts, methods and tools which are called on a daily basis by software engineers to provide a crystal-clear view to the technical and management team regarding how the job is done and transforms a haphazard, unfocused approach to a more organized and focused one [9]. SE practices play a significant role in delivering products on time with higher quality within the budget. So, it is crucial to know which practices would be the best for an organization or for a team or for a particular product and the challenges. But the answers to these questions are not that easy to figure out where the nature of the product, structure of the team and organization and background knowledge regarding the SE practices are fundamental parameters behind choosing the best practices, choosing the right practices to be specific. In order to answer the questions, a survey was conducted on SE practices and challenges in Bangladesh between 2016 and 2017. To ensure the diversity, software development companies with different category (service, product, offshore, outsource, startup) and maturity level were invited for participating in the survey.

Several surveys have been conducted in New Zealand, Netherland, Italy, Turkey and other countries over the decades [6] but to the best of authors' knowledge, no survey record has been found yet regarding SE practices and challenges in Bangladesh. The inspiring factors for conducting this survey in Bangladesh are:
i. Bangladesh is a prospective country for Business Process Outsourcing (BPO). According to the A.T. Kearney Global Services Location Index, Bangladesh is at 22nd place with score 5.31 and compared to the report of 2014 the country has managed to leap 4 spots in ranking [7]. A.T. Kearney also reported that Bangladesh provides the best financial attractiveness score (3.34) right after Sri Lanka (3.37).
ii. IT sector is an emerging sector for the economic aspects of Bangladesh. The government has special attention to nurture this sector as it is expected to add 7.28 percent to GDP growth by the end of 2021 [8].

Although the above factors are quite convincing for the authors to carry out the work some couple of objectives were there too behind steering the survey.

Firstly, the authors' perspective is that Software Development Life Cycle (SDLC) affects the SE practices mostly. But it is not an easy task to choose the appropriate SDLC. Features like nature and expertise of the team, organization, client's preference, and product/service type very often influence the preference for SDLC. So in order to find out the SE practices and challenges, it is substantially significant to identify SDLC practices and challenges.

Secondly, to identify the practices and challenges in Performance Measurement of the development team as the performance measurement plays a vital role in determining how good/bad the team is performing.

Thirdly, to recognize the current Requirements Prioritization techniques [12] in the industry. With the increasing size of software and number of features, at present, almost all of the software products are delivered in several releases. But to deliver the right product with the most suitable features in each release requires proper requirements prioritization technique. So it is important to grasp which technique to follow and what would be the criteria.

Fourthly, to understand the Communication exercises with the client as well as among the team. Because the success of each feature highly depends on the communication. It is a recognized fact that due to the communication gap companies may deliver a product with missing requirements. As the software development sector in Bangladesh is mainly outsourcing based i.e. most the clients and some of the team members also may reside in abroad which marks it crucial to ensure the right communication practices.

Fifthly, the findings from the survey may address potential research gap in the field of software engineering.

Finally, the insights gained from above-mentioned objectives can be utilized as guidelines by the Educational and Training institutes for preparing SE related curriculum to educate and train future software developers and engineers who will be capable enough to fulfill the demand of the industry.

This paper reported the observations obtained from 41 respondents who successfully completed all the questionnaire. Although the sample population may seem to be relatively small, the authors believe that in terms of Bangladeshi Software Industry, the sample is enough to obtain interesting findings compared to previous studies in different countries [6]. Besides the consistency of the data has encouraged the authors to present the findings in this paper.

The rest of the paper is structured as follows. Section II describes the objective of the survey, survey and sample selection method. Section III presents the results obtained from the survey. Section IV discusses the findings of the survey and Section V concludes the paper and provides future research directions.

II. RESEARCH METHODOLOGY

This research was steered using qualitative research approach. It is a well-known fact that qualitative research method is used to investigate and understand social and cultural phenomena [1]. Furthermore, qualitative research approaches are effective when the aim of the study is to understand the area of interest, to gain a synopsis of a complex area and to search for the diversities [2]. This method is also suitable when the understanding regarding the context is little as it emphasizes on in-depth information acquisition [3]. This is a survey-based study which is primarily built on face-to-face interviews where the respondents are asked a series of questions. The detailed description of the survey is discussed in the following subsections.

A. Survey Objective

The survey was designed in such a way so that it could fulfill the first four objectives described in the introduction part. Rest of the two objectives are considered as the outcome from the flow of previous objectives. The major objective of this survey is to determine the software engineering practices in Bangladesh which includes software process models, criteria for choosing appropriate SDLC, measuring the performance of development team, reasons for not following any particular SDLC, techniques and principles of prioritizing requirements, practice of communication with client/user as well as team members. The goal was to provide a crystal view of the current best practices in Bangladeshi software development industry.

The secondary objective of this survey was to provide insights from ICT industry of Bangladesh which would help the training as well as tertiary institutes to determine whether the existing curriculum on software engineering is adequate or not with the industry demand. If the curriculums are not met the industry demand, then this survey may help the institutes in designing state of the art courses on software engineering for Bangladesh. Furthermore, by identifying challenges of developing software in the industry, this survey may help to provide future research direction in the software engineering field.

The questionnaires and the nature of the survey were designed based on hypothesizes derived from these two objectives.

B. Survey Description

The survey targeted the junior to senior employees of an organization who are involved with software engineering practices and are most likely to understand their development environments.

Four major areas are investigated in this survey to meet the objectives described in the previous section. Furthermore, the introduction part was included in order to characterize the organization by its size, type, service type for correlating its software engineering practices. The questionnaires for the survey are arranged in five sections which are summarized below.

1) Section A - Characterization

This section explored the organization's characterization in terms of its age, organization type, product/ service type, size in terms of the number of IT professionals, and preferred tools. Furthermore, this section also captured the role and responsibilities of the interviewee.

2) Section B - Software Development Life Cycle Issues

Questionnaires related to chosen software development life cycle, criteria behind choosing particular SDLC, most challenging phase in the SLDC, reasons behind not following any traditional SDLC were included in this section.

3) Section C- Performance Measurement

This section explored the practices of measuring the performance of software development team as well as SDLC in Bangladesh. The goal of this section was to determine the traditional techniques used in Bangladeshi software companies for measuring the productivity.

4) Section D - Requirements Prioritization

This section was included to test one of the hypotheses on requirements prioritization. The authors believe that the existing prioritization techniques are too cumbersome and mainly depends on business value and cost. These methods lack other factors like effort, risk, market value, customer satisfaction, strategic and volatility. So the questions under this section were tailored to test the hypothesis.

5) Section E-Communication

The section held the questions to investigate and understand the communication practices with Clients/users and among the members of a team. One of the important aspects of this section was to capture the essence of communications in today's world where the team and the Clients can be geographically distributed.

C. Survey Method

As a survey method, face-to-face interview [4] comprised of both open and closed-type questionnaires is used. The survey interviews were held at the office of the interviewee and each interview took 30-45 minutes on an average. To allow more convenience, the questionnaires were sent to respective interviewee prior to the face to face session. During the interview session, printed or verbal explanation notes were provided to all the respondents. Finally, the confidentiality and privacy of the respondents, as well as the company, were assured.

D. Sample Selection

This survey was aimed at the population of organizational level or departmental level where more than one department is responsible for the development of software. At first, a draft questionnaire was prepared and performed over a small group

of five organizations experimentally. From the trial survey, few adjustments were made based on findings and experience. Finally, this survey was aimed at four types of participants: the first priority was the top-level executives, the second was development manager, the third was development team lead and finally, a general member of the development team.

The survey population was selected using random sampling method [5]. As we are performing qualitative research whose aim is to understand and investigate differences, so we have chosen random sampling over other sampling methods. At first, 100 organizations were invited through emails to participate in the survey but only 41 organizations/ individuals responded positively. The participation rate may seem low but the authors believe that this sample would be enough to represent the whole population.

III. SURVEY RESULT

A. Characterization

This subsection aimed to characterize the software development organizations in Bangladesh. Questionnaires were tailored to accomplish the task.

Firstly, the type of the software firm was asked which was a multiple-choice question. Out of the 41 respondents, 22 are product based, 21 are serviced based, 12 are offshore based and only 4 are startup based company. So the Figure 1 indicates that the respondents were mainly from product and serviced based sector.
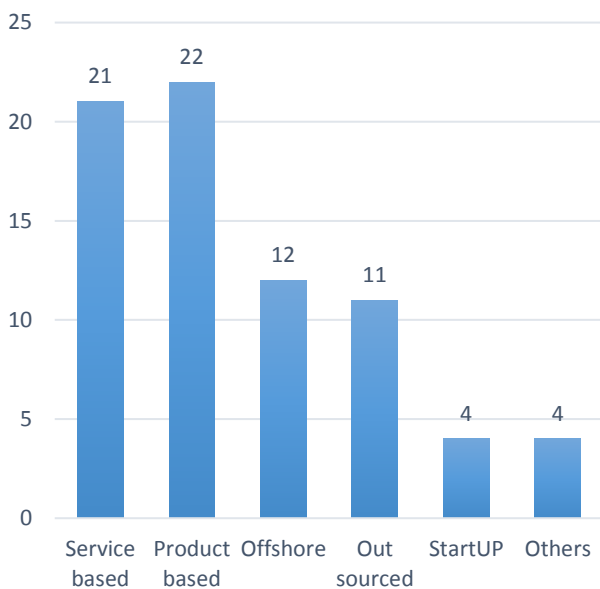

Figure 1: Bangladeshi Software Firms based on types

Next, the size of the organizations was investigated. 29% of the organizations can be considered as a large organization with the size of more than 80 personnel. 27% organizations have 31-50 personnel. Although from the perspective of Bangladesh it can be considered as a medium-sized organization. But compared to other countries where organizations have more 500 employees in 24.6% organizations these organizations fall below medium-sized [11]. Another fact that has observed regarding the experience in software development of the companies is that only 1

organization have more than 20 years' experience out of 41 firms. 16 organizations have experience of fewer than 10 years. This diversity points to the growth of software industry in Bangladesh from the past 12 years.

Later, the product or service type by the organizations was studied. Table 1 represents the findings where it can be seen that majority (51% organizations) of the organizations are providing their service or product in Web development, Application development, and Mobile App development field. Whereas product or service related to Cloud computing, distributed computing, embedded system development and security software development have got less attention.

Table 1
Responses for Product or Service type

Product or Service Type	No. of Response	Response in %
Web Development	34	21
Application Development	25	16
Mobile App Development	23	14
Back End Development	15	9
API Development	14	9
Others	12	7
Data Science	9	6
Software tools Development	8	5
Security Software Development	6	4
Embedded System Development	6	4
Cloud Computing	5	3
Distributed Computing	3	3

To understand the current trends of preference over programming languages in Bangladesh, questions were asked to the practitioners. According to responses, Java, HTML and CSS are the most preferable programming languages among the practitioners. Whereas Objective C, Django and Rails are least popular preferences.

B. Software Development Practices and Challenges

This section mainly investigated the SDLC conventions, criteria for choosing a certain SDLC and determining the challenging phases of the chosen SDLC from the point of view of Bangladeshi software development practitioners.

Table 2 indicates that 27% organizations use Scrum which makes it the most popular SDLC in today's software industry of Bangladesh. A good percentage of teams are using Waterfall and Prototyping. In contrast XP, RAD and FDD are the least common models followed by the practitioners whereas other mentioned models are hardly practiced. Apart from these, an interesting fact has been observed that the usage of hybrid SDLC over the existing ones is quite considerable, being 17 percent of the overall population. This extends the opportunity for researchers to study further and report these hybrid SDLCs as well.

Next, the criteria for choosing a particular SDLC have been explored. The result in Figure 2 illustrates that the characteristics of the project are the dominant parameter behind the selection of SDLC with thirty-one percent responses. Furthermore, client's and organization's preference affect almost one-fourth of the decisions exclusively, having twenty-four and twenty-three percent respectively. Whereas the preference of development team is sixteen percent only which designates that this criterion is often less considered than the rest. This observation clearly indicates that client's preference dominates over firms' or development teams' preferences. The last part of this section was meant to pinpoint the most challenging phase of the SDLC.

Table 2
Status of SDLCs in Bangladesh

SDLC	No. Of Response	Responses in %
Scrum	24	27
Hybrid	15	17
Waterfall	13	15
Prototyping	11	13
XP	6	7
RAD	5	6
FDD	3	3
Other Agile SDLC	2	2
Spiral	1	1
DSDM	1	1
Others	5	1
Incremental	1	1
Kanban	1	1
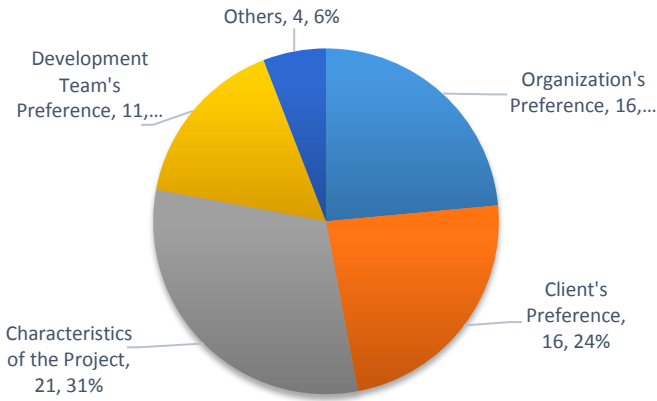
Figure 2: Criteria for choosing particular SDLC

Figure 3 demonstrates that Requirement Analysis & Prioritization is the most challenging phase encountered by forty-four percent of the organizations. Quite the reverse, in seventeen percent cases organizations identify Requirements specification to be the most challenging one. Surprisingly, communication gains the third place in terms of the most challenging phase of SDLC. This result points toward the necessity of further research and development of tools to ease these activities to the practitioners.
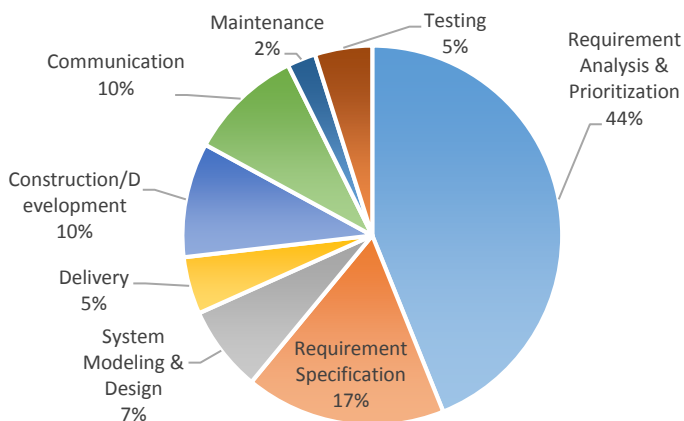

Figure 3: Most Challenging Phase of the SDLC.

C. Performance Measurement

This section was aimed at understanding the performance measurement practices in the ICT industry of Bangladesh. To accomplish that, certain questions were asked to identify the techniques or methods that are being used to measure the performance of chosen SDLC and Software development

team.

In case of measuring the performance of the chosen SDLC, Figure 4 reveals that 21 organizations use Key Performance Indicator (KPI) [10] whereas seven (7) organizations do not measure the performance of the chosen SDLC at all.
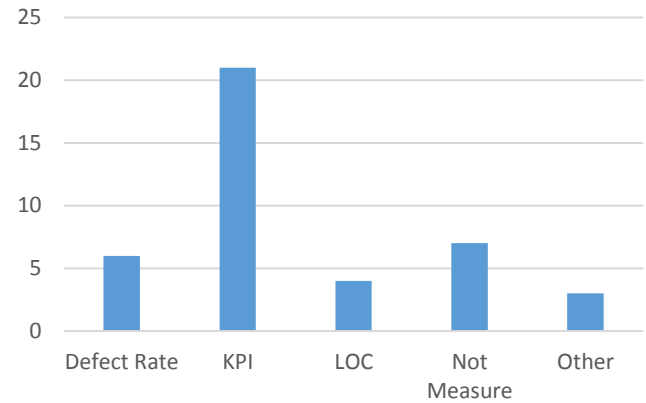

Figure 4: Response for performance measurement of SDLC

On the other hand, Figure 5 displays nearly half (19 out of 41) of the respondents were uncertain regarding the performance measurement issue of the software development team. The cause behind this result might be the information are only accessible by the managerial or senior executive personnel. But among other techniques, KPI is the most used technique here as well.
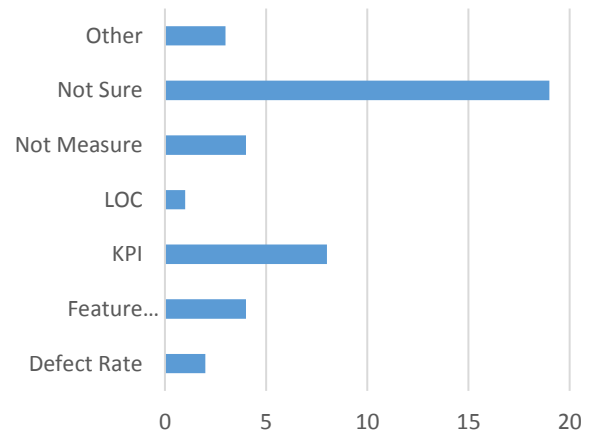

Figure 5: Techniques for measuring the performance of team

D. Requirements Prioritization

The goal of this section was to explore the Requirements Prioritization (RP) techniques and factors that are used to prioritize a requirement in Bangladeshi software development companies.

At first, a question was asked whether the company does apply any specific prioritization technique or not. Table 3 depicts the responses towards the question. Overall, it can be seen that 34% respondents do not use any specific technique to prioritize requirements and 42% respondents are unsure regarding using any kind of techniques. On the other hand, only one-fourth of the respondents apply specific techniques or methods for requirements prioritization. We were shocked to see the result which leads us to investigate further. The findings are discussed in Section 4.

Table 3
Response for applying Specific Prioritization Techniques

Any Specific requirements prioritization technique used?	Response (in %)
Yes	24.00
No	34.00
Maybe	42.00

Next, the factors that have an impact on the priority of a requirement were enquired. The result presented in Figure 6 shows that business value is the most important factor which is used by 25 organizations followed by priority defined by stakeholders. Cost & Effort is also a common aspect of prioritization which is used by 16 organizations. In contrast, risk and other aspects of prioritization like volatility, strategic benefit, and benefit over competitors are rarely used.
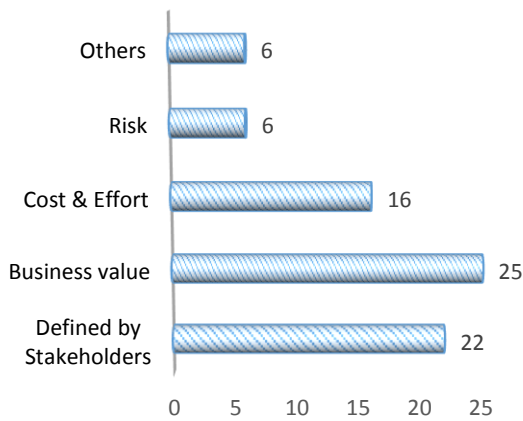

Figure 6: Usage of aspects of defining priority

Figure 7 illustrates the combination of factors that are being used by the respondents in this survey. The authors have observed that only 4 organizations determine the priority of a requirement based on the combination of Business value, Risk, Cost & Effort, and Stakeholders' importance.
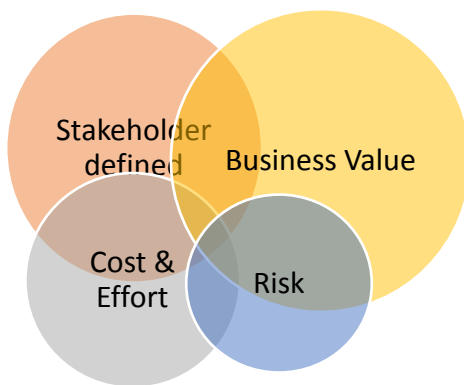

Figure 7: Illustration on Combination of Prioritization aspects

On the other hand, 10 out of 41 organizations completely depend on their stakeholders for defining priority. These findings indicate that Bangladeshi software organizations are heavily dependent on their stakeholders (mainly clients) for RP and other prioritization aspects are rarely considered for RP other than Business value and Cost & Effort.

E. Communication
This section investigated the communication practices

between a company and their clients, and among team members. The authors' initial hypotheses were that Skype or any other similar tool would be the most popular choice as a medium of communication with clients and Face to Face meeting would be the most popular medium of communication among the team members. Both the hypotheses were tested by the result of the survey.

Figure 8 Illustrates that Email communication is the most common practices with the clients. The chart shows that 29% organizations accomplish their communication through email, 28% organizations use skype and 21% organizations organize face to face meetings. This result proves that the authors' initial hypothesis was wrong. Surprisingly only 5% organizations use Issue Tracking System (ITS) as a medium of communication with the clients.
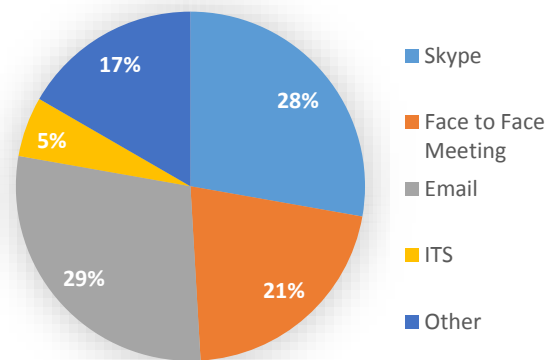

Figure 8: Illustration of Communication with Clients

On the other hand, Figure 9 demonstrates the communication practices within the team where face to face meeting is found to be the most common practice. 29% organizations communicate among the team members through face to face meetings which verify the authors' initial hypothesis.
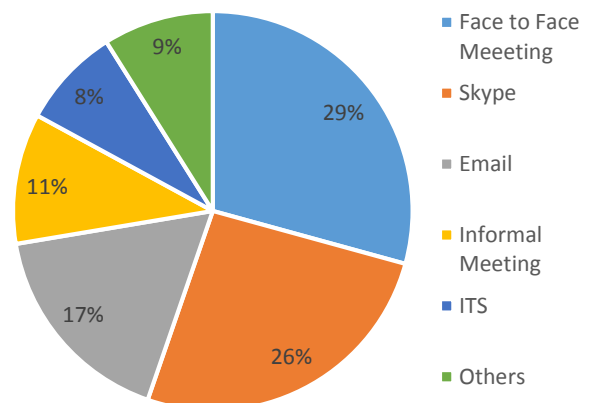

Figure 9: Demonstration of Communication within the Team

But remarkably, Skype turns out to be the more popular choice (26%) rather than Informal meeting (11%) or email communications (17%). Again, the preference of ITS seems to be very uncommon as a communication medium.

Details of the findings from this section are discussed in Section IV.

IV. DISCUSSION AND RECOMMENDATION

This survey provides some valuable insights regarding the practices in the software industry of Bangladesh. This survey shows that the Bangladeshi software development organizations are relatively smaller in terms of employees and have less number of highly experienced firms compared to the developed countries. On the other hand, these organizations are mainly focused on web development, desktop-based application development, and mobile app development. As a result, other promising products or services like data science, distributed and cloud computing are getting less attention. The decision and policymakers in the Government and organization can use these facts for making future policies and decisions.

The insights from the survey show that Scrum is the most popular SDLC model among the organizations and Waterfall model holds the third position. The authors' impression regarding the popularity of Waterfall model is that this choice may be risky for the effective software development because most of the organizations indicated that the requirement analysis & prioritization are the most challenging task in software development process. The authors have also observed that five percent of the respondents do not follow any kind SDLC at all. The reasons behind this fact are defined by the practitioners as existing SDLCs do not match with the real-life scenarios, they are lengthy in terms of processes' length and they are complex.

The authors have investigated the facts behind the challenges of requirement analysis and prioritization. Due to the communication challenges (preference of skype/email rather than face to face/ITS) and complexity of the prioritization techniques, the practitioners are facing challenges in this phase mostly. So, in order to overcome the challenges, the organizations require effective communication and simple, efficient prioritization techniques.

The authors have observed that the clients have influence over critical decision making such as choosing SDLC method, prioritizing requirements without considering the concerns of the development team. This practice should be carefully considered as the development team is the one who will follow the practices.

In the case of performance measurement of the chosen SDLC and the team, KPI is the widely used performance measurement technique. But the survey result shows that many of the team members are quite unaware of the fact. The authors believe that each of the team members should have clarity regarding the performance measurement.

As most the clients may be from abroad, so they prefer Email communication over skype for several reasons: availability, organizing, documentation etc. As a consequence, the use of ITS is not so popular among the practitioners. The current practice of using Skype or email as the communication medium seems to be inefficient as backtracking for information can be time-consuming from the authors' perspective.

So, based on the observation, the authors have made following recommendations:

i. Government and organizations should emphasize on promising products or services like data science, distributed and cloud computing.
ii. Tertiary as well as training institutes should update the curriculum to support the industry demand.
iii. Devise new prioritization techniques to efficiently prioritize requirements.
iv. Increase the involvement of development team regarding decision making.
v. Organizations should have transparent performance measurement techniques.
vi. The use of ITS should be amplified among the development team regarding communication.
vii. The collaboration between the academia and the industry should be increased which would be beneficial for both sides.

V. CONCLUSION AND FUTURE WORK

This paper presented the preliminary survey on software engineering tactics and challenges and analyzed the findings. The survey was conducted between 2016 and 2017 among 41 software development companies resided in the capital of Bangladesh, Dhaka. It may seem that the population size of the survey is smaller, but the findings from the survey make the authors confident enough to present the analyzed results. The authors believe that the findings reveal some of the trends and challenges of the current software engineering practices in Bangladesh which will help the Government and the organizations in decision making regarding software development sector.

This survey was mainly designed to investigate the overview of software engineering practices in Bangladesh. Thus, deep analysis had not been performed. But author's impression is that every phase should be investigated thoroughly to discover more insights of software development practices in Bangladesh. So as for future work, the authors have decided to perform more surveys elaborately on other Software Engineering activities. Furthermore, the authors plan to study and report the hybrid Software development lifecycle models that are currently being used in Bangladeshi software companies.

APPENDIX

Table A
Summary of the interview instrument

No.	Instrument
1	Characterization
	1.1 Let us know about your company (size of the organization, age, type of the organization etc.)
	1.2 Let us know about the product/service (type, tools being used)
	1.3 Let us know about yourself (your designation, role etc.)
2	Software Development Life Cycle Issues
	2.1 Which Software Development Lifecycle is used?
	2.2 How the SDLC is chosen?
	2.3 Which phase is the most challenging phase of the SDLC?
	2.4 If no SDLC is followed, then what are the reasons?
3	Performance Measurement
	3.1 How the performance of the team is measured?
	3.2 How the performance of the SDLC is measured?
4	Requirements Prioritization
	4.1 How the priority of a requirement is defined?
	4.2 Is there any technique used to prioritize requirements?
5	Communication
	5.1 How the communication with the clients is maintained?
	5.2 How the communication with the team members is maintained?

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REFERENCES

[1] L. Karlsson, S. G. Dahlstedt, B. Regnell, J. N. och Dag, and A. Persson, "Requirements engineering challenges in market-driven software development-an interview study with practitioners," *Journal Information and Software Technology*, vol. 49, no. 6, pp. 588-604, 2007.

[2] C. Robson, and K. McCartan, *Real World Research*. John Wiley & Sons, Inc., 2016.

[3] M. C. Hoepfl, "Choosing qualitative research: A primer for technology education researchers," *Journal of Technology Education*, vol. 9, no. 1, pp. 47-63, 1997.

[4] K. Kelley, B. Clark, V. Brown, and J. Sitzia, "Good practice in the conduct and reporting of survey research," *International Journal for Quality in Health Care*, vol. 15, no. 3, pp. 261-266, 2003.

[5] F. J. Fowler Jr., *Survey Research Methods*. USA: Sage Publications Inc., 2013.

[6] V. Garousi, A. Coşkunçay, A. Betin-Can, and O. Demirörs, "A survey of software engineering practices in Turkey," *Journal of Systems and Software*, vol. 108, pp. 148-177, 2015.

[7] A. Sethi, and J. Gott, "On the eve of disruption," in *2016 A.T. Kearney Global Services Location Index*. A.T. Kearney, Inc., 2016. Available at https://www.atkearney.com/strategic-it/global-services-location-index. Retrieved March 2, 2017.

[8] Editorial of The Asian Age, "Exploiting potentials of the ICT sector," in *The Asian Age*. June 2016. Available at http://dailyasianage.com/news/21403/exploiting-potentials-of-the-ict-sector. Retrieved April 4, 2017.

[9] R. S. Pressman, *Software Engineering: A Practitioner's Approach*. Palgrave Macmillan, 2005.

[10] D. Parmenter. *Key Performance Indicators: Developing, Implementing, and using Winning KPIs*. John Wiley & Sons, 2015.

[11] S. P. Ng, T. Murnane, K. Reed, D. Grant, and T. Y. Chen, "A preliminary survey on software testing practices in Australia," in *2004 Australian Software Engineering Conference Proceedings*, 2004, pp. 116-125.

[12] M. Aasem, M. Ramzan, and A. Jaffar, "Analysis and optimization of software requirements prioritization techniques," in *2010 International Conference on Information and Emerging Technologies (ICIET)*, 2010, pp. 1-6.