

An Assessment of Software Development Practices of SMEs in Bangladesh

Md. Ashrafuzzaman, Mohammad Shahadat Hossain Chowdhury, Md. Akhtaruzzaman, Hasan Sarwar

Abstract—Software Process Improvement (SPI) can help the software practitioners to enhance their capabilities in the field of software engineering. Various models have been proposed in order to improve software process framework. However, implementation of such modules often requires huge cost involvement. Small and Medium sized Software Enterprises (SMEs), in Bangladesh, naturally fail to introduce or adapt such frameworks. So it has become a need of time to observe the Software Process scenario as a part of research activity which will ensure smoother transition to improved Process Framework. In this paper, various practical models and their practices in various SMEs and the importance of SPI system are highlighted and analyzed. Survey has been conducted to assess Real life practices with a view to compare with Benchmarks like Capability Maturity Model Integration (CMMI). This attempt also suggests a direction for minimum best practice that might be helpful for small and medium sized companies to improve their current methods of practice.

Keywords— Software Development Practices, CMMI, Small and Medium Software Enterprise, SMEs, Software Process Improvement, SPI, Software Process Optimization.

I. Introduction

Bangladesh is now focusing on improvement of process oriented activities in IT sectors. Motivated by this, we attempted to conduct an analysis on software industries in Bangladesh. The study has been performed in three steps. Firstly, various strategies followed in SMEs to operate their current practices have been identified. In this step, extensive and extended maturity questionnaires are used which are related to Organization and Project Management, considering CMMI level 3 as baseline standard [1] [2] [3]. Secondly, detail analysis has been performed in order to represent the status of the companies based on the success factors. Comparative analysis among the selected companies also presented in this phase of the study. Thirdly, primary factors are identified as the key points to handle the project successfully within the boundary line of time, costing, and scope. The findings shows that the strategies followed by SMEs in Software Development Process are basically the part of SPI system but never been recognized.

A number of researches have been conducted on software development practice in several countries, such as India, Malaysia, Europe, Australia, New Zealand, and North America, where SPI system, various types of questionnaires, case study and survey based models and methodologies are presented [4] [5] [6]. As no such studies are found in the context of Software Development Practice of SMEs in Bangladesh, the purpose of this paper is to discuss about the extent of minimal best practice in Bangladesh. Comparative analysis on success stories of some companies are also presented based on the data provided by the companies.

There is a recognized dissimilarity between Best Practice and Real Life Practice. Some facts are tried to highlight in this study, which might be useful to define a set of minimum practices that could lead the SPI system to the Benchmark practices for SMEs in Bangladesh [8].

II. Pitfalls Involved in Bangladeshi Small and Medium Software Industries

In Bangladesh, a majority of software companies are small (with 3–50 employees) [9] [10]. The definition of the term, SMEs, is ambiguous, as there is no commonly accepted definition of it. The SME sector is the key ingredient for sustaining the future growth of the software industries in Bangladesh. However, SMEs' need to align their offerings according to the demands of the market to emerge successfully in the long run which poses the following challenges [5] [7]:

- Resources of the best practices in IT are unaware.
- Besides resources, many organizations are unaware of existing software process assessment models and standards.
- Customers of software industry are also unaware of the Standard model and practices.
- There is an assumption that assessments conformant to existing models and standards will be expensive and time consuming, and therefore difficult to perform in small companies.
- Small organizations also do not perceive on assessment models and standards including documentation and process-formalization practices.
- Some procedures have been criticized as infelicitous for small companies, which generally have informal processes and informal organizational structures.

Small companies are now frequently engaged with large businesses but for small contracts. Basically, this situation is the reason of fear about the loss of advantages of lower overhead rates, if paying for SPI programs [10] [11] [12].

III. Research Method

We followed the Questionnaires based approach to ascertain a systematic review. Initially the questionnaire is structured based on 36 questions for 6 companies, where 12 questions are related to Organization and 24 questions are related to Project Management (PM). The questionnaire is designed based on Likert scale [13].



The systematic survey or assessment procedure involves several stages and activities, which are briefly explained below.

- **Planning the survey or assessment process flow:** Identification of the needs of the study, Specification of the survey questions, and defining the review protocol or metrics.
- **Conducting the Survey:** Selection of the organizations and focus points of the primary studies, defining the quality questions of assessment questionnaires, and monitoring the survey.
- **Data analysis and report presentation:** Performing data extraction, scrutinizing the data obtained and synthesize, specifying the dissemination mechanisms of the identification, and representing the results of the study.

IV. Assessment Findings

For this survey only 6 organizations are selected where three organizations are involved in Local Software Development. Two companies are focusing on Outsourcing and Offshore respectively. Only one company is selected who are involve in both Outsourcing and Local Software Development. The types of the selected organizations are categorized in Table I. The results of the survey are presented in graphical format using bar chart. For this study, success factors are calculated by taking the average of obtained score.

TABLE 1
TYPES AND NUMBERS OF SELECTED ORGANIZATIONS

Organization Type	Number
Local software Development	3
Outsource Only	1
Offshore	1
Outsource and local software Development	1
Total	6

All of the six companies selected for this study are chosen from the top listed SMEs in Bangladesh. Number of employees of the selected companies is around 25 to 50. The most important point of this survey is that the study focuses on a single successful project completed by each company. Targeting only on that successful project the assessment is done. The characteristics of the selected project are represented as follows.

- Project is medium type and successfully completed.
- Duration of the project development is less than one year (at least 6 to 8 months).
- The number of employees for that particular project is 8 to 10.

Organization related questions (12 questions) are accumulated in the first part of the questionnaire which consists of Organization formal process, Project Management Professional (PMP) practice, Process awareness, Tools used, Roles, and Responsibility based activities etc. Figure 1 shows the average score achieved by 6 organizations based on the 12 organization related questions.

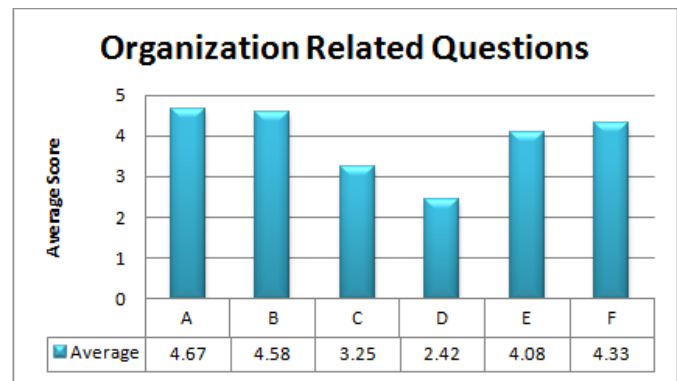


Fig 1: Average scores of 6 companies for organization related questions.

The above bar graph clearly represents that the company A has shown a best organizational practice during the development period of that particular project. Comparing with other companies, B also presents a Best Practice (B_p) as both of the companies, A and B, got more than 4.50 (90%) in average. The scores obtained by the last two companies, E and F, are 4.08 and 4.33 respectively which reflects the Good Practice (G_p) if we consider the score in between 4.00 (80%) and 4.50 (90%) in average. The range of Moderate Practice (M_p) can be considered as 2.00 to 4.00 (40% to 80%) based on the average score distribution. So, the companies C and D are representing the M_p which can be accepted as satisfactory level.

In practical, it is observed that the company A got more than 50% scores for 11 individual questions among the 12 organization related questions. On the other hand, company B got more than 50% for all the 12 questions. Comparing with this two real conditions, it can be said that the company B has presented the better practice than the company A. But this characteristics are not reflected in the bar graph shown in Figure 1. So there needs to stablish a complex mechanism to calculate a Quality Factor (Q_F) so that the level of quality practice of a particular organization can be identified and visualized. Equation (1) and Equation (2) represents the procedures to calculate the Average (A_V) and Collective Average (C_A) scores. The C_A score could be considered as the Q_F .

$$A_V = \frac{\sum_{i=1}^{i=N_Q} S_{ind}}{N_Q} \quad (1)$$

$$Q_F = C_A = \frac{\sum_{i=1}^{i=N_O} A_V}{N_O} \quad (2)$$

Here N_Q , N_O , and S_{ind} represent Number of Questions, Number of Organizations, and Individual Score respectively.

As shown in Equation (2), the Quality Factor is calculated by taking the average of the values shown in Figure 1. For this case the Q_F is 3.80. Now the percent of the questions, which score is obtained greter than Q_F value, is calculated for individual company and presented as Percent Score ($S_{\%}$), shown in Equation (3).

$$S_{\%} = \frac{(N_Q > Q_F) \times 100}{N_Q} \quad (3)$$



Figure 2 shows the bar diagram for the 6 SMEs, based on Percent Score ($S_{\%}$) obtained for the 12 questions related to organization. The graph shows that the company B has shown the best practice, as it obtained 100%, to lead the project to successful delivery. If we define the same range of quality practice as explained in Figure 1, A and B will fall in B_p class, E and F will be in G_p class, C will be considered as M_p class, and D will come into Worse Practice (W_p) group. Hence A, B, E, F organizations have solid reference and evidence, that leads to the effectiveness of project closing.

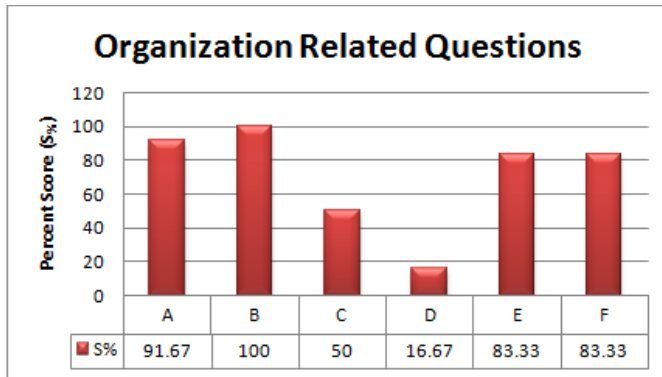


Fig 2: Percent Score ($S_{\%}$) of 6 companies for organization related questions.

The second part of the questionnaire contains Project Management (PM) related questions. For this section 24 questions are selected through which the quality practices are characterized for the selected 6 organizations. Like the first part of the study, same analysis has been conducted and the quality practices on PM are presented by bar graph as shown in Figure 3 and Figure 4.

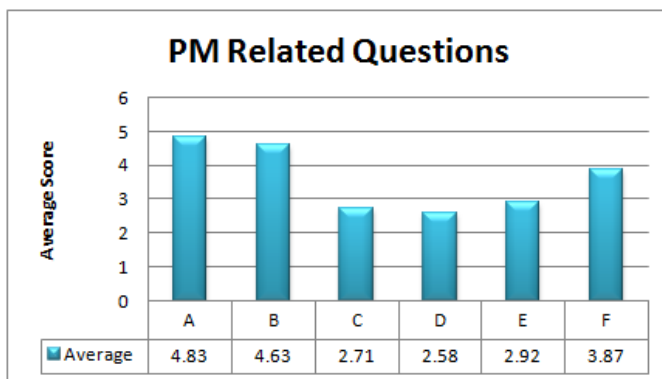


Fig 3: Average scores of 6 companies for PM related questions.

According to the graph shown in Figure 3, the companies A and B are in the range of best quality practice as both of them obtained more than 4.50 (90%) in average. The other four organizations, C, D, E, and F, obtained the average scores in between 2.00 (40%) and 4.00 (80%). So these four companies showing M_p level in managing their projects. But, this scenario of the four companies becomes different if analyzed by using the Percent Score ($S_{\%}$) as shown in Figure 4. The graph shows that the company F is in the range of M_p level and other three, C, D, and E, are in W_p level in practicing the project management system. Though, there are a lot of variations in practicing the PM system of the six companies,

all of them managed to complete their projects successfully within the time, costing, and scope.

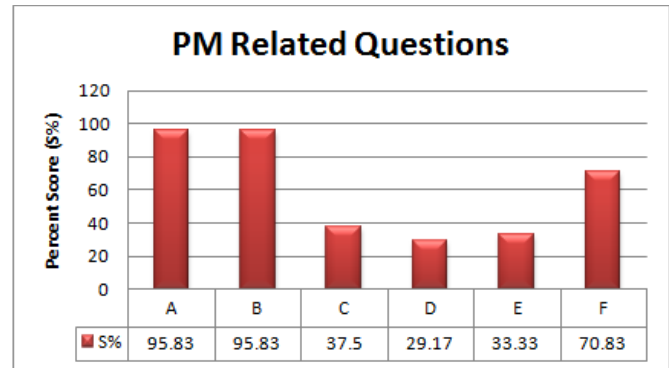


Fig 4: Percent Score ($S_{\%}$) of 6 companies for PM related questions.

v. Result Analysis

In our research, we have chosen Score Average Analysis (SAA) technique among the selected companies and found that the SAA is useful and convenient strategy to find out the real scenario and facts of the quality practice. The findings of the SAA technique are illustrated by keeping the following limitations of the research in mind.

- Limited number of organizations, only 6 companies, is visited for this Research.
- Only local SMEs are selected and categorized based on the recommendation catalog of Bangladesh Association of Software & Information Services (BASIS) [11].

Analyzing the results obtained from SAA, discussion and brain storming has been conducted to establish minimum salient practices for SMEs in Bangladesh. The proposed suggestions are also applicable for any organization having common standard of SMEs. The suggested minimum best practice will assist the practitioners to achieve project success in terms of cost, time, scopes, and resources.

A. Practices towards Project Success

The analysis shows that the selected project of each company was a successful project in terms of deadline meets and completion with satisfactory level, due to the following reasons.

- The actual list of requirements is uniquely identified with prioritization and by defining the baseline.
- Proper planning and frequent monitoring of the project development.
- Traceability of the requirements is maintained through development, Implementation, and Change request (if any).
- Controlling all documents and codes with version control and release methods.
- Tracking, Monitoring, Controlling, and Measuring project time, cost, and quality in a systematic way.

B. Limitations towards project success

Among the various limitations towards project success, the following practices should be avoided by the practitioners.

- Accepting client requirements which are mostly impossible or not logical.
- No activities to arrange training for clients who are not able to represent their requirements in proper manner.
- Arrangement of formal training on standard domain practice for clients.
- Less involvement of Sr. Management and insufficient focus in project practice.
- Improper guidance to the team for understanding the type and manner of the project.
- Less focus on lessons learning, sharing or taking measurement.

VI. Conclusion

The research is based on SMEs and Software engineering practices in Bangladesh. The survey questions are based on best model references like CMMI and ISO. This case study represents some key factors as the minimum best practice to complete software projects successfully. The suggested factors could lead software development team to the best practice towards the project achievements and quality outcomes. More focus on SPI approach and methodology will help practitioners to learn and implement the best practices. A software projects should follow the minimum best practice as suggested in this study. These will lead the practitioners towards success by avoiding the barriers to the project goal.

Acknowledgment

The authors would like to express their gratitude to the Department of Computer Science and Engineering, United International University (UIU), Bangladesh, for providing necessary supports to conduct the research.

References

- [1] David M. Northcutt and Mark C. Paulk. Statistical Sampling for Process Assessments. *Software Quality Professional*, 2010, Vol. 12 No. 4. pp. 19 – 28.
- [2] Watts S. Humphrey. *Managing the Software Process*. SEI Series in Software Engineering, Addison-Wesley, 1991.
- [3] Jianguo Li, Jinghui Li, and Hongbo Li. Research on Software Process Improvement Model Based on CMM World Academy of Science, Engineering and Technology, 2008, pp. 368 – 371.
- [4] Claude Y. Laporte, Simon Alexandre, and Alain Renault. The application of International Software Engineering Standards in Very Small Enterprises. *Software Quality Professional Magazine*, Vol. 10, No. 3, 2008. pp. 4 – 11.
- [5] Tracy Hall, Austen Rainer, and Nathan Baddoo. Implementing Software Process Improvement: An Empirical Study. *Software Process: Improvement and Practice*, January 2002. pp. 3 – 15.
- [6] M.P.Thapliyal and Dwivedi Pratibha. Software Process Improvement in Small and Medium Software Organisations of India. *International Journal of Computer Applications*, Vol. 7, No. 12, Oct. 2010. pp. 37 – 39.

- [7] Mosharrof Hussain Masud, Md. Akhtaruzzaman, S. M. Sadakatul Bari, and Farhat Anwar. Engineers' Obligations towards Sustainable Environment. 2nd International Conference on Professional Ethics and Education in Engineering 2011 (ICEPEE '11), Kuala Lumpur, Malaysia, pp. 85 – 92.
- [8] Barbara Kitchenham and Stuart Charters. *Guidelines for Performing Systematic Literature Review in Software Engineering*. EBSE Technical Report, Keele University, Version 2.3, 2007.
- [9] Software and IT service Catalogue 2011. Published by, Bangladesh Association of Software & Information Services (BASIS). <http://www.basis.org.bd/publication/Software%20&%20IT%20Service%20Catalog%202011.pdf> (Extracted on 11th January, 2014).
- [10] International Organization for Standardization, Quality Systems – Model for Quality Assurance in Design/Development, Production, Installation, and Services, ISO 9001:1987. International Organization for Standardization, Geneva, 1987.
- [11] Dirk Stelzer and Werner Mellis. Success Factors of Organizational Change in Software Process Improvement. *Software Process: Improvement and Practice*, Vol. 4, Issue 4, December 1998, pp. 227 – 250.
- [12] P. Jalote. Use of Metrics in High Maturity Organizations. *Software Quality Professional*, Vol. 4, No. 2, March 2002, pp. 7 – 13.
- [13] Likert scale. http://en.wikipedia.org/wiki/Likert_scale (Extracted on 11th January, 2014).

About Author (s):



Md. Asharafuzzaman is a student of MSc. in CSE, United International University (UIU), Bangladesh. He is also a development manager of edusoft consultants ltd. His current research focus is on Software process improvement. *Email: eng.emon@gmail.com.*



Mohammad Shahadat Hossain Chowdhury is a DGM, QA and lead ERP consultant of IBCS-PRIMAX software (Bangladesh) Ltd., He is also playing the role as an Oracle ERP functional consultant, ERP implementer and as well as Project manager in various software development project. He is the Appraisal Team Member of SEI USA for the CMMI for Development ver. 1.3 and SCAMPI ver. 1.2, beside the current role, he is playing the role of BASIS (Bangladesh Association of Software and Information Service) QA core team Member and Research Assistance with MSc. students of the Dept. of Computer Science and Engineering, United International University, Dhaka, Bangladesh. He Completed his BSc. in Computing and Information System from London Metropolitan University, London (2004) and MSc. in CSE from United International University. His current research focus is on Software Process Improvement, software engineering, Project Management. *Email: bp0417@gmail.com.*



Md. Akhtaruzzaman is a Ph.D. candidate in the Kulliyah of Engineering, International Islamic University Malaysia (IIUM). He was awarded his MSc. in MCT from the same university in 2012. He got his BSc. in CSE degree from International Islamic University Chittagong (IIUC), Bangladesh, in 2005. *Email: akhter900@yahoo.com.*



Dr. Hasan Sarwar is a Professor in the Dept. of Computer Science and Engineering, United International University, Bangladesh. He Completed his BSc. in Computer Science and Engineering from Bangladesh University of Engineering and Technology (BUET) in 1995 and Ph.D. in Applied Physics, Electronics and Communication Engineering from University of Dhaka (2006). His current research focus is on tele-medicine, software engineering, cloud computing, education etc. *Email: hsarwar@cse.uiu.ac.bd.*