**A Case Study of Software Process Improvement With CMMI in Bangladesh**

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**1 Abstract**

This paper discusses various aspects of the software industry in Bangladesh. It highlights the emergence and growth potential of the sector, focusing on trends, client industries, workforce, and advantages. The challenges and strategies for implementing Software Process Improvement (SPI) in small enterprises are also covered, including customization of established models and the importance of tailored approaches. The paper also explore the prospects and challenges of the emerging software industry, particularly in terms of software exports, workforce composition, and competitive advantages. Lastly, the text touches on software development certification and quality practices in Bangladesh, featuring examples of companies that have achieved CMM certification and ISO standards, along with insights into their practices and challenges.

**2 Emerging Growth and Trends in the Software Industry of Bangladesh**

The software sector in Bangladesh has recently emerged as a significant national industry with promising growth potential. Recent trends indicate that the industry has reached a take-off stage, and it's positioned for high growth. Software companies in Bangladesh primarily focus on developing back-office automation and high-value customized applications like CRM and SCM. Key clients include the textile & garments sector, pharmaceutical companies, government, education, and financial sectors. While software exports are increasing, they're not yet on a large scale, with the United States as the main export market. The workforce comprises around 5,500 professionals in over 300 companies, with a majority holding at least a graduate degree in technical fields. Bangladesh benefits from advantages like low labor costs, high programmer productivity, proficiency in English, and cultural compatibility with client countries. Challenges include the need for improved distribution channels for software marketing and expanding the export market further. Despite challenges, the industry's growth trajectory appears positive.

**3 Software Process Improvement Challenges and Strategies for Small Enterprises**

The challenge facing software development enterprises is effectively applying Software Process Improvement (SPI) technologies to achieve improvement goals. Several studies have addressed this challenge by customizing established models like CMM, ISO 9001, and IDEAL to fit the specific needs of small and medium-sized enterprises (SMEs). These studies emphasize the importance of tailoring models, integrating SPI technologies, and aligning processes to achieve successful outcomes. The key takeaways include:

1. Customization for SMEs: Researchers have explored adapting established SPI models to suit the unique characteristics of SMEs, which often have tight deadlines, dynamic projects, and limited budgets.
2. IDEAL Model Adaptation: The IDEAL model, originally designed for larger organizations, can be tailored for SMEs, demonstrating that structured models can be adjusted to fit specific organizational contexts.
3. Integration of Models: Successful cases involve integrating SPI technologies such as ISO 9001 and CMM, aligning these frameworks, and utilizing structured approaches that involve gap analysis, training, and measurement.
4. Tailored Approaches: A tailored approach combining CMM with SEI's Personal Software Process (PSP) can address the specific needs of small enterprises, creating a "scaled-down CMM combined with a scaled-up PSP."
5. Importance of Process Modeling: Recognizing software development as a process aids in establishing effective practices. Process Modeling Languages (PMLs) help represent process features, roles, artifacts, and tools, while established models like CMM, ISO 9001, and improvement models like SPICE and IDEAL contribute to achieving process objectives and assessing process maturity.

Overall, these studies highlight the significance of adapting, integrating, and tailoring SPI technologies to enable successful software process improvement in various organizational contexts, particularly among small and medium-sized enterprises.

**4 Prospects of Bangladesh's Emerging Software Industry**

In recent years, the software sector in Bangladesh has rapidly emerged as a significant national-level industry with promising growth prospects. The industry has reached a take-off stage, indicating its potential for high growth. As per Mashroor (2005), the total Information and Communication Technology (ICT) market in Bangladesh is valued at around Tk. 1,100 crore (approximately US$ 170 million) annually, with the software segment accounting for Tk. 170 crore (around US$ 26 million) per year.The industry trends suggest that the software companies in Bangladesh are primarily engaged in developing and maintaining software products and services for back-office automation, such as accounting/finance, ERP, HR, inventory, and billing systems. Notably, the sector has shown a shift from data entry services to higher-value customized applications like CRM, SCM, and various front-end business applications such as web, e-governance, e-commerce, and point-of-sale systems.The primary clients of local software are the textile & garments sector and pharmaceutical companies, both of which are vital export-oriented industries in Bangladesh. The government, education, and financial sectors are also significant clients, indicating a diversification of software applications and a positive sign for domestic industry capability. While the domestic software industry is growing impressively, software exports have also increased rapidly over the years. Bangladesh has seen a growth of 122% in software exports within five months of the fiscal year 2004-2005. More than fifty software and IT support companies have expanded their product and service exports to approximately thirty different countries. The United States stands as a major export market, with software firms participating in events like the Comdex exhibition in the US. Efforts have been made to streamline the export process, including the establishment of marketing offices in Silicon Valley, California, and other potential expansions to North America and Europe. However, there are challenges, as highlighted by Habib et al. (2005), where some companies with the potential to develop international-standard software struggle to export due to a lack of distribution channels for marketing purposes, which is in contrast to other developed countries like India.The workforce in the software sector comprises about 5,500 professionals working in over 300 registered companies, with an estimated total of nearly 25,000 IT professionals across various sectors. Notably, the workforce has a substantial number of graduates with degrees in non-IT subjects and diploma/certificate courses in IT. These professionals are trained in recognized IT institutions within Bangladesh and are often employed as programmers, utilizing their strong English language skills.In terms of advantages, Bangladesh benefits from lower labor costs compared to countries like India, a high programmer productivity rate, and proficiency in the English language. The cultural compatibility with client countries has also been noted as a positive aspect.

Overall, the emergence of the software sector in Bangladesh is marked by significant growth potential and favorable industry trends. The industry has transitioned from data entry services to more sophisticated applications, and while software exports are expanding, there are ongoing efforts to tap into the international market. The advantages of a skilled workforce, cost-efficiency, and language proficiency contribute to the positive trajectory of the sector.

**5 Software Development Certification and Quality Practices in Bangladesh**

The first company in Bangladesh to achieve CMM Level 3 certification is 'TigerIT,' a BASIS member. TigerIT operates two technology centers in Virginia and Dhaka, with the Dhaka office serving as an offshore development center. They use a web-based project management tool and a US-based project manager to enhance communication with remote teams. The Dhaka office has 60+ developers, hiring top local graduates, while the Virginia office employs 20 developers. TigerIT's CMM Level 3 certification is attributed to disciplined management, extreme quality standards, and a combination of the IDEAL model and CMM framework, along with using Extreme Programming for development. They diligently follow Level 3's key practice areas and are aiming for CMMI Capability Level 4. TigerIT's financial stability and US-based status facilitated their certification. Despite their success, the company's website lacks updated information. Millennium Information Solution Ltd.,' is a BASIS member and holds CMM Level 2 certification. It is a dynamic and rapidly growing software solution provider in Bangladesh, known for its commitment to quality, innovation, and customer satisfaction. They follow a rigorous Quality Management System (QMS) through their internal Software Engineering Process Group (SEPG) and utilize Rational Unified Process (RUP) for quality development. They also combine Personal Software Process (PSP) with CMM to enhance software engineer skills, although adhering to all PSP Key Process Areas can be challenging.

Millennium aims to achieve CMMI Level 3 certification and has recently completed a gap analysis for this purpose under an overseas consultant. They have also obtained ISO 9001:2000 certification, showcasing their dedication to organization-wide quality improvement. The company serves a diverse client base, including repeat customers in the US, Europe, and prominent local clients. They outsource certain non-core software development tasks. Although the exact cost of obtaining CMM Level 2 certification is unknown, the company acknowledges that financial constraints could pose challenges for smaller companies in Bangladesh. Interestingly, Millennium's website is well-maintained and informative, reflecting its CMM-certified status.

Technohaven Co Ltd,' the third surveyed company, holds ISO 9001:2000 certification and is a prominent ISO-certified software firm in South Asia. They prioritize software quality, aligning with ISO 9001 guidelines through rigorous coding, documentation, and testing standards. According to senior software developer Mr. Mizan Uddin, the company relies on its self-developed processes and doesn't prioritize expensive CMM/CMMI certifications. Their strong client base, including government agencies, defense, and multinational companies, contributes to their confidence. Mr. Uddin underscores that external market focus isn't a concern due to their extensive experience, while emphasizing that certifications alone don't guarantee quality outcomes, citing instances from India.

**6 Conclusion**

software process is not a very difficult task for software companies of Bangladesh as long as they adapt a software process model. However, as a developing country, it has to deal with other factors like poverty, illiteracy, and economy. Having all of those factors, government of Bangladesh is trying its best to make Bangladesh a next destination of software outsourcing nation. However, software process improvement is both expensive and time-intensive process. There is no doubt that Bangladeshi software companies want to adhere to a software process like CMM/CMM1; however, it is taking more time for them to implement a process among software companies because of some other factors, which Bangladesh cannot deny either There are also many areas of improvement such as Bangladeshi software companies have to exploit the advantages of having no major cultural differences.

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