Cultural Influences and Differences in Software Process Improvement Programs

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ABSTRACT

Implementing software process improvement (SPI) program successfully in a software organization is possibly the most challenging issue that the industry faces today. It is even more challenging to implement an SPI program in software organizations of developing countries like Bangladesh because of the difference in norms and values of the national culture, and organizational culture as compared to those of the developed European and Western countries. This research extends the prior research on SPI in Bangladesh (Wong & Hasan, 2006) and addresses the factors involved in the implementation of SPI programs in software organizations. A study of ten top software companies in Bangladesh was conducted to investigate whether cultural factors hindered the process improvement program and whether this hindrance led to deterioration of the business goals. The results showed that the lack of cultural awareness and lack of skills from the management perspective acted as barriers during the implementation of SPI programs and so affected the business goals sought by these organizations.

1. INTRODUCTION

Software crisis has been the common term in the software industry for the last 30-40 years. It has been in such a condition that uncertainty has become the key characteristic for the software industries, especially for the developing countries like Bangladesh, where many of them are either outsourcing or offshore development centers of software organizations of developed countries. One of the important characteristics of Software Process Improvement (SPI) is to help the software organization evaluate their current practices and guide them towards improving their performance. Therefore, SPI is largely dependent on the active participation of the all key people and employees in improvement program. It helps to concentrate easily on the problems, so that the whole program becomes more efficient and cheaper in terms of business benefit of the participating organizations (Dybå, Dingsøyr, & Brede Moe 2004).

However, it is not so easy, not every person is manageable and not every SPI program is successful. The main reasons, as identified in this research, are the management issues of the software organizations and the cultural issues in the participating organizations. To start a process assessment program, management commitment is a necessary condition. Without setting priority and clear signal for continuous improvement from the higher management, process assessment and improvement programs will just be a disaster.

In this research, we are motivated from our previous paper, Wong & Hasan (2006) and from the cultural dimensions of work-related values from the popular work of Hofstede & Hofstede (2005), to investigate the process improvement paradigm of Bangladesh.

In the next section, a brief background of this research will be given. This will be followed by our research objectives, and then by the research methodology, and research questions. Finally, we conclude by mentioning the future research direction.

2. BACKGROUND

There have been a number of studies over the past decade focusing on how cultural issues affect quality. Many of these studies replicate the work of Hofstede (1980, 1997). A preliminary study by Siakas, Georgiadou & Sadler (1999) have focused on how different cultures influence Software Quality Management (SQM) activity. The authors planned to assess the software organizations regarding the awareness and acceptance of software quality and the result were then correlated with work-related values those, which are identified by Hofstede (1980, 1997) to gain more insight about the influence of culture in the implementation of SQM. As this paper was a pilot study on cross-cultural research, the authors only formulated their hypothesis for future research.

In another paper, Siakas (2002) addressed cross-cultural issues in Software Process Improvement (SPI). She explored cultural factors, which might have a bearing on successful adoption and implementation of SQM systems. The study was a field-study across five countries. Siakas (2002) described the findings from research carried out about software quality issues and SPI addressing the importance of the organizational context, including influences from the national culture in which the organization is situated. The author compared national culture with organizational culture by mentioning Hofstede's popular four key cultural dimensions and some of the aspects from the organizational culture. She found that the economic, political and legal environment imposed by governmental rules as well as the technical

environment, like communication networks and the sociocultural environment, directly affect organizational culture and functioning of organizations, in which the organization exists.

Siakas & Balstrup (2002) conducted another study of a global organization to know the collaborating process and importance of diverse individual work values of their virtual cross-cultural teams. The authors conducted their study in the three divisions of an organization of nearly 20,000 employees around the globe and these three organizations with software development were in Denmark, Germany and in United States. This whole/corporate organization was ISO 9001 certified for consciousness of their product and process.

By applying the four dimensions from the national culture theory of Hofstede, the authors found that Danish people are very easygoing and take their jobs seriously, have very low power distance in the organization, work well in the team, tend to take fewer risks and are one of the most feminine countries. This differs from United States organizations' where the organizational structure is hierarchical and the organizational environment is competitive, with the boss generally making the decisions and very much individualistic. People from the United States want things to happen faster, very keen on stressing that they are ambitious, hardworking and like to be productive. Similarly, the German organizations also consist of taller hierarchy than Denmark. Germans are competitive, task-oriented and committed to organizational philosophy. Unlike the United States, Germans have a very good team spirit and seem to accept things they do not like more easily. Finally, the authors found that as a global organization, it took about one year for the employees to understand the behavior of other people in their own organizations. Siakas & Balstrup (2002) suggested that "…to be a truly global organization, the individual work values must converge and be integrated into common set of values". Here, the authors conducted their study in a large multinational organization. It is a very small sample size in terms of cross-cultural research point of view. This paper only explains the software developers' point of view and large categories of member were uncovered, like project managers, SQM team leaders, and senior management etc.

In another research, Borchers (2003) described the experiences to apply software engineering practices to the development projects' staff in three different countries; Japan, India and the United States. In this paper, Borchers (2003) described his observations in terms of chose cultural factors that posed impact on the

software engineering techniques used in their different projects. Borchers (2003) found in their multicultural development projects that software architecture are also culturally influenced and that different teams come up with different approaches, particularly in the area of how abstractions are chosen for the architecture. The author suggested that further research is needed in this area. Similar problems were found in their decentralized configuration management, especially with performance tuning and bug fixing time. However, the author observed that physical boundaries among different teams helped them to align the team assignment. Finally, in this experience paper, Borchers (2003) observed that cultural impacts need to be adjusted and adapted with the expectation to the reality for multicultural projects to be successful.

Dybå (2005, p. 410) mentioned that the roots of SPI were in quality management and is closely related to the organizational development approaches. Therefore, understanding the quality revolution is an important precondition to understand SPI. In this continuing research, the author identified six facilitating factors in the conceptual model that includes business orientation, involved leadership, employee participation, concern for measurement, exploitation of existing knowledge, and exploration of new knowledge. For each of these categories the researcher formulated hypotheses.

Finally, summing up all these literatures, measuring SPI success is a controversial issue and empirical research is not enough to support it. Several levels of analysis, conflicting dimensions, viewpoints need further study. As such, the main objective of this research is to analyze the barriers of implementing SPI programs in the software organizations of Bangladesh. Bangladesh is a developing country. Whilst it is not a rich country, it is a country offering software development.

The research will investigate the cultural factors and compare them with the cultural dimensions of Hofstede & Hofstede (2005). This research will aim to identify cultural awareness in organizations and how national culture affects the organizational culture. The research also investigates cultural awareness and adoption in the light of the management point of view. The intension here is to gain more insight of the software development process of Bangladeshi organizations, their awareness to the quality of software, their level of adoption of software process within the organizations, which are influenced by the cultural differences from other countries.

3. RESEARCH METHODOLOGY
The method adopted for this research will be a

qualitative investigation. The epistemological perspective of this research both interpretivist and critical realist. Lowe (2007) mentioned that qualitative research methods are associated with critical realist and Interpretivist approaches (Lowe 2007). Interpretivist views that the social world as constructed by people with shared cultural understandings; whereas critical realist aims to transform and change people.

In this research, the data from Hofstede & Hofstede's (2005) widely acclaimed book of cultural dimensions. will be used to compare with the results collected from this qualitative study. Case studies will be performed by sending questionnaires via email and interviews through internet group-blog. The study will address different aspects of the research problem, to confirm the findings from the questionnaire/interview and to test the research questions. The results from the case study will be analyzed in terms of Hofstede's cultural dimensions for work-related values.

Therefore, the main hypothesis or research question of this research is:

Cultural influences and differences interfere in successful implementation of Software Process Improvement program in the software organizations.

In this research, two cultural variables are identified, which are national culture and organizational culture. Thus, the main research question can be break down into two sub-hypotheses:

a) National culture influences and interferes in successful implementation of Software Process *Improvement program in the software organizations.*

b) *Organizational culture influences and interferes in successful implementation of Software Process Improvement program in the software organizations.*

This research identifies two research variables:

National Culture: In this research, national culture of Bangladesh will be analyzed and established from the categories of cultural dimensions found in the Hofstede & Hofstede's (2005) work. However, Oyen stated in 1992 that different years and time intervals could have different meanings for different countries and activities (Siakas, Georgiadou and Sadler 1999). Therefore, for cultural studies it is important that country selection and time-points are theoretically justified (Siakas, Georgiadou and Sadler 1999). For this research, Hofstede's data about Bangladesh need validation

within the investigation.

Organizational Culture: Similarly, organizational cultural will be measured by analyzing each surveyed organization on the scale of Hofstede & Hofstede's (2005) six dimensions of organizational cultures. Furthermore, the authors indicate that uncertainty avoidance also affect our thinking about organizations (Hofstede & Hofstede 2005, p. 242). All of those organizational factors will be analyzed from the survey of software companies of Bangladesh.

For this research, 10 software companies from Bangladesh were selected for participating in the interviews. The companies were selected based on their experiences in the software development, adoption of software process, ISO 9001:2000 or interest on CMMI certification and their determination of continuous quality and process improvement strategies.

It should also be mentioned here that there are not many Bangladeshi companies, except those mentioned above, who have implemented a software process improvement program in their organization. As a result, the scope of this research is limited to the software organizations who are working on process improvement currently and those who already have some experiences in process improvement area.

4. RESEARCH RESULT AND ANALYSIS

We have conducted a small-scale study of 10 software organizations from Bangladesh to gain better understanding of their process improvement practices, management practices, and their organizational culture. We asked them whether the national culture influenced their process improvement initiatives. In our research we identified two research variables, which are national culture and organizational culture.

4.1 NATIONAL CULTURE

Hofstede & Hofstede (2005) claim that national culture varies and has large impact on the work-related values in each culture. According to their study, the authors categorized five cultural dimensions. We have used these cultural dimensions to analyze the results of our study and to show that national culture influences and interferes in implementation of software process improvement in software organizations of Bangladesh.

4.1.1 Power Distance

Hofstede & Hofstede (2005, pp. 43-44) have collected data from 74 countries. According to the author's Power Distance Index (PDI), Bangladesh is scored 80 in a ranking of 12-14. It summarizes that Bangladeshi societies are *high-power-distance* society. The nature of

this type involves more supervisory personnel, privileges and status symbols are normal and popular (Hofstede & Hofstede 2005, p. 59).

From our survey result, we have found that Hofstedes' observations are valid for the software organizations of Bangladesh. Almost all of the participants agreed that they have a hierarchical organization structure and management is centralized. Most of the times, decisions come from the top management and employees are obliged to do accordingly. Group meeting, open conversions are not very frequent during decision-making to have the full understanding of the project. Therefore, it is found that because of this power distance in the organizations, the project timetable/schedule changes '*almost always*' and some respondent mention it changes '*half of the time*'.

4.1.2 Individualism and Collectivism

According to the data found in Hofstede & Hofstede (2005, pp. 77-78), the Individualism Index (IDV) for Bangladesh scored 20, which means that Bangladeshi society is not individualistic and they poses collectivism characteristics. In this type of culture, people are born into extended families and they learn to think in terms of 'WE' not 'I'. This has a great impact in terms of SPI in the software organizations.

From the study, it is found that most of the organizations' working environment is very friendly. They tend to help each other in the team to face any difficulties. In some cases, it is observed that they help their peers during the time of coding (Ariful Haque, Southtech Ltd., pers.
Comm., 2 June 2007). The negative impact of this is that they cannot finish their jobs on time and ultimately projects suffer from not meeting deadlines. On the other hand, their emotional attachment to each other increases and they become friendlier which help them improve in their communication and team spirit, which are key elements of SPI.

4.1.3 Masculinity and Femininity

The Masculinity Index (MAS) for Bangladesh in the Hofstede & Hofstede (2005, pp. 120-121) ranked 30, whereas Australia ranked 20. This MAS index means that Bangladeshi society is less masculine in nature than that of Australia. However, from the study the results found that male employees are dominant in terms of the number of jobs in the organization. Some respondents have mentioned that female professionals *do not* participate with the same enthusiasm as the male colleagues though females are not discriminated in any way in the organizations.

One of the important reasons of this phenomenon is that in Bangladesh females do not tend to do jobs where technical skills are necessary especially in software development and process improvement related field. Hofstede & Hofstede (2005, p. 127) mention that skilled occupations like scientific, engineering and technical jobs are masculine occupations in nature, where semiskilled, internal office, managerial jobs tend to be feminine occupations. However, in all of the 10 surveyed organizations, we have not identified any females working in top management.

In terms of SPI, in this research survey all of the participants were male, who were involved in the SPI program in their respective organizations. From the analysis point of view, we can infer that as half of the population is not participating in the process improvement program or in any management-related jobs, it is assumed that half of the innovative and useful ideas are missing, which would potentially boost the SPI implementation.

4.1.4 Uncertainty Avoidance

Uncertainty Avoidance is a measure of how a culture feels threatened by unknown situations. The score for Bangladesh in Uncertainty Avoidance Index (UAI) of Hofstede & Hofstede (2005, pp. 168-169) is 60. It implies that the society of Bangladesh has a high UAI.

Uncertainty avoidance has a great impact on SPI programs. Borchers (2003) mentioned that UAI has a large impact on project management and tracking. He found that a team with high UAI waits until the project is about to start for up-front planning. On the other hand, low UAI teams have to know exactly when the planning is finished.

In our study, we found that most of the employees do not feel secure in their current job irrespective of the team leader, SQA engineer, and department head and so forth. From the SQABD blog (short for web log), we tracked one thread 'Job security in SW company'. We found that most of them are not satisfied and feel threatened in their job. One of such thread mentioned that in a very well-known software company in Bangladesh, a very experienced engineer came to his office in the morning. He was very busy with his project. A few hours later top management of that company called him for a meeting and sacked him (SQABD 2007). This type of situation is disastrous in terms of implementation of SPI. We later found that that man was working in the QA team and because of his departure the company's process improvement program was delayed, which greatly affected their business target.

4.1.5 Long and Short Term Orientation

In the Long-term Orientation (LTO) scale of Hofstede & Hofstede (2005, p. 211), the rank of Bangladesh is 17-18. It indicates that Bangladeshi societies are long-term oriented. From a discussion in SQABD blog and from the survey data, we have found that participants are worried about the salary structure in their organizations. It is found that salary structures varied among different organizations for the same type(s) of role. Other than job security, instability of job had a large impact on SPI effort. It is not possible for a SPI team member to work with concentration and devotion while being uncertain about his or her job, salary and so on. As a result, the way of thinking from the long-term oriented society would become synthetic in nature.

4.2 ORGANIZATIONAL CULTURE

Dybå (2005, p. 410) mentioned that the roots of Software Process Improvement is closely related to the organizational development approaches. In fact, SPI is the management initiative, where it is necessary that all top management agree on initiating an SPI program in their organization. One of the main reasons is that the management body is the one who allocates sufficient money, time and staff to reflect their decisions. Dybå, Dingsøyr and Brede Moe (2004) added that these arrangements include physical, organizational and technical conditions of the company.

Hofstede & Hofstede (2005) mention six dimensions of practices in the organizational cultures after surveying twenty organizational units, where one-third of the respondents were managers, one-third were professionals and the last one-third were non-professionals. The authors also mention that these six dimensions are mutually independent, which means that they can occur in all possible combinations (Hofstede & Hofstede 2005, p. 292).

On the other hand, Lofland & Lofland (1995) compared two ideal types of organizations, which were originally from Rothschild-Whitt (1979) as mentioned in Lofland & Lofland (1995, p. 130): Bureaucratic and Collectivist-Democratic organization. The authors mention eight dimensions for each of the organization type, which are authority, rules, social control, social relations, recruitment and advancement, incentive structure, social stratification and differentiation. Siakas, Georgiadou and Sadler (1999, p. 90) mentioned that bureaucratic organizations have similarities with high Power Distance Index (PDI) and Individualism Index (IDV) and collectivist-democratic organization have similarities with low PDI and Collectivist Index of Hofstedes' cultural dimension.

4.2.1 Process-Oriented Vs. Results-Oriented

In a process-oriented culture, people are more risk-avoiding, spending limited effort in jobs, and every day is almost the same. On the other hand, in a results-oriented culture, people are comfortable in unknown situation; they tend to put maximum effort into their jobs and each day come with new challenges (Hofstede & Hofstede 2005).

From our study, it is found that almost all of the respondents think that the characteristic of their organization is results-oriented. We have found that this type is related to the Uncertainty Avoidance Index of Hofstedes' national culture. As Bangladeshi societies are more uncertainty avoiding in nature, when the people of this culture engage in the organizations they also tend to be uncertainty avoiding. Hence, they are more focused on results rather than process. However, Hofstede & Hofstede (2005) mention that to be result-oriented is not always bad; similarly, to be process-oriented is not always good as both of poses their own set of characteristics. The authors also have found from their survey that a strong culture was interpreted as 'homogeneous culture', which was significantly correlated with results orientation to an extent that results oriented stands for effective. The effectiveness of the strong culture was actually confirmed from the proposition of Peters and Waterman (Hofstede & Hofstede 2005, p. 293). However, in our research, we did not justify the effectiveness of the result-oriented culture as it is outside the scope; future research is necessary to consider it.

4.2.2 Employee-Oriented Vs. Job-Oriented

In an employee-oriented culture, people feel that their organization takes responsibility for the welfare of the employees, their personal problem are considered and groups or committees make important decisions. On the other hand, in a job-oriented culture, people feel that organizations are only interested in the work of the employees and are not interested in their personal or family welfare. Employees usually feel strong pressure to complete their job (Hofstede & Hofstede 2005).

From the study, we found that most of the Bangladeshi software organizations are job-oriented in nature. Employees feel higher pressure from their higher management to complete the job. Most importantly, the employees feel insecure about their current job. Staff turnover is moderately high to average and it is completely dependent on the top management whether you are skillful or not. We have discussed a scenario regarding this in the 'Uncertainty Avoidance' section of national culture. We have found that one reason for this job-oriented nature of the organization is that the Power Distance in the Bangladeshi society is high and it

reflects the organizational culture.

Hofstede & Hofstede (2005) found in their survey that an individual may be both employee and job oriented at the same time; however, organizational culture tends to favor one at a time and not both. In our case, job-oriented culture gets the priority in the software organizations of Bangladesh.

4.2.3 Parochial Vs. Professional

In a parochial culture, employees derive their identity largely from the organization. They feel that in hiring employees, companies consider their social and family background as much as their job competency. On the other hand, the people of professional culture are identified with their type of jobs and they feel that organizations hire them by considering their job competence only (Hofstede & Hofstede 2005).

We have found from the online discussion that employees are not fully hired based on their job competence; in addition to this, social and family backgrounds are equally important. Some of the respondents believe that they were hired based on their social and family backgrounds only (SQABD 2007). Therefore, it turns out that Bangladeshi organizational culture is a mixture of parochial and professional.

Although we observed from our sample organizations that almost all the employees were hired on their computer-related degrees achieved from good reputable universities from home and abroad. We also have identified that Power Distance and Long-term Orientation nature of societies have inherent influence in this.

4.2.4 Open System Vs. Closed System

In an open system culture, almost anyone would fit into the organization and it takes only a couple of days for the newcomers to feel and adapt to the nature of the organization. On the other hand, in a closed system culture, the environment is closed and secretive, and staff members need more time to adapt to the flow of the organizations (Hofstede & Hofstede 2005).

From our study data and online discussion, we found that employees are adaptive to the organization flow, although some of the respondents mention that sometimes some decisions of the top management make them feel like outsiders even though they have been with the company for a couple of years.

We found that Collectivism of the societal culture made it easy to adapt quickly to the culture of organization and the top management decisions are influenced by the Power Distance nature of the Bangladeshi society.

4.2.5 Loose Control Vs. Tight Control

In a loosely controlled organization, staff members do not think of cost, nor do they think about punctuality in meeting time. They also take their jobs less seriously, frequently joking about the company and their jobs. On the other hand, in a tightly controlled organization, members are conscious about the cost, punctuality about the meeting time, jokes related to the company and jobs are very rare (Hofstede & Hofstede 2005).

In the study, we found that the software organizations of Bangladesh are neither too loosely controlled nor too tight. Most of the respondents replied that their relationship with other members of the organization is very friendly. However, when it comes to the top management, the relationship is still friendly with maintaining a level of hierarchy. From the online discussion, it is observed that staff members tend to joke about their company and job with their peers and other people outside their company as well. Most of the time, it happens when an employee is not happy with management, feel stressed, or feel insecure about their job. It appears that this also happens in small organizations with a limited or no organizational structure. Our analysis have found that Collectivism of the societal culture is associated with the loose control over the organization.

4.2.6 Normative Vs. Pragmatic

Normative structures emphasises correctly following organizational procedures, which is more important than the result. On the other hand, pragmatic units are market-driven and major emphasis on meeting the customers' needs and results rather than following correct organizational procedures (Hofstede & Hofstede 2005).

In our study and from the online forum discussion, we found that all of the participants agreed that their organizations focus on customer demand, and outcome of projects. There were no organizations found to prioritize organizational norms, procedures over results and customers' needs and satisfaction.

4.2.7 Other Organizational Issues

In our study of 10 software companies, most of the participants have doubts regarding the management related knowledge of the top management. Regarding this pattern, our analysis found that, as Bangladeshi societies are more Long-Term oriented, where family-owned business are present, a little knowledge about business, management have great impact when the company grows. For the same reason, most of the top management do not consider their lack of management skill but rather put blame on other members of the organization for their faults and

problems.

4.3 SOFTWARE PROCESS IMPROVEMENT PROGRAMS AND CULTURE

Dybå, Dingsøyr and Brede Moe (2004) mention that most techniques for software development are human-centric in nature and are often very difficult to measure and replicate. To enforce good practices, thus ensure continuous improvement in QTC (quality, time and cost) implementation of SPI program in the software organizations in necessary. Bangladeshi software companies are keen to improve their developed software quality and be in the competition. Other than the technical shortcomings, national culture and the organizational culture has been a significant cause for adopting and implementing SPI program in the respective local organizations. SPI program is process-centric and tends to follow some specific characteristics that an organization must adhere. From the survey, we have found that for the assessment purpose local organizations are dependent on foreign consultants, because of the lack of acceptance of SPI culture among the software organizations. Our analysis shows that other than the finance, technology and other related issues another reason for lack of acceptance of SPI is the one, which the local organizations never think of – Culture. An external assessor may give a temporary solution for SPI adoption in any organization; however, the main assessment must come from the management of the participating organizations. Before deciding to go for any formal assessment for SPI, culture of the organization has to be assessed and the management has to find an acceptable solution, although culture cannot be changed overnight. Fox (2002) mentioned that the main problem of culture is it develops very slowly and changes over the long period.

We also have observed that employees are not happy with the management people; they think that top managements have limited knowledge regarding certification like CMMI, ISO and further very limited knowledge about SPI, continuous process improvement etc. Some of the respondent even criticized them by saying fickle minded, when it comes to the software quality, certification, process improvement issues and so. Therefore, adoption of SPI program is slow in the local software organizations of Bangladesh.

5. CONCLUSION AND FUTURE RESEARCH DIRECTIONS

Investigating cultural influences and differences in SPI in a developing country like Bangladesh poses a challenge, because of the economic, political and societal conditions of the country. From our research, after analyzing we found that differences in both national and organizational culture have influence in the implementation of SPI programs in the software organization of Bangladesh.

The organizational culture that is mentioned in this research is not enough to judge completely an organization from different cultural settings. Moreover, this research only deals with the Bangladeshi software organizations. Many organizations are developing software successfully in that region like India, Pakistan and some other Southeast Asian countries. Therefore, more cross-cultural research with maximum exposure on field studies are necessary to assess practically the SPI initiatives of the organizations in terms of cultural awareness of the members of the organizations, level of SPI adoption, national and organizational factors and so. It is then possible to successfully adopt all these cultural factors in the SPI program that would lead the organization to develop high quality software products within time and budget.

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