Software Practices in Five ASEAN Countries: An Exploratory Study

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ABSTRACT
However, despite the above and the improving models of offshore software development/maintenance, there is a dearth of published studies on software development practices in Southeast Asia. In contrast, a number of studies have been conducted on software practices in other continents such as Europe [3], Australia/New Zealand [4], and North America [5]. While it is true that there have been “global” or “worldwide” surveys of software practices, as reported, for example, in [6] and [7], the respondents in these global surveys were mainly from the U.S., Europe, and Japan.

There is a lack of published studies on software development in Southeast Asia, which is fast becoming an IT outsourcing haven. For instance, McKinsey notes that the combined offshore market worth of Southeast Asia was USD2.3B in 2003 [1]. Though this figure might still be small compared to those of India (USD12.2B) and China (USD3.4B), it certainly surpasses the offshore markets of Latin America (USD1.8B), Eastern Europe (USD0.6B), and Australia (USD0.4B) [1]. In AT Kearney’s Global Services Location Index for 2005, the top six countries for offshore services were all Asian, and four (Malaysia, Philippines, Singapore, Thailand) of these top six were Southeast Asian [2].

However, despite the above and the improving models of offshore software development/maintenance, there is a dearth of published studies on software development practices in Southeast Asia. In contrast, a number of studies have been conducted on software practices in other continents such as Europe [3], Australia/New Zealand [4], and North America [5]. While it is true that there have been “global” or “worldwide” surveys of software practices, as reported, for example, in [6] and [7], the respondents in these global surveys were mainly from the U.S., Europe, and Japan.

This paper presents exploratory survey and case study results on fundamental software practices, especially software quality assurance practices, of some software development firms in five ASEAN countries: Malaysia, Philippines, Singapore, Thailand and Vietnam. We define a software development firm (or simply, software firm) as a for-profit organization whose main business is the development of software for customers external to the organization. Included in this definition are developers of generic software products (e.g., Microsoft) as well as providers of software solutions for specific domains (e.g., Infosys). Excluded are IT departments that cater primarily to the needs of the organizations of which they are part.

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Categories and Subject Descriptors

General Terms
Management

Keywords
Software practices

1. INTRODUCTION
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There are four reasons why this research has to be of the exploratory, rather than the conclusive, type. First, reliable data on even basic items like e-mail addresses of software organizations are not readily available in many ASEAN countries. Second, it is not known how diverse the software practices are, or could be, not only among countries in ASEAN, but even among organizations in each country. Third, it is not immediately clear which software process framework or model – whether, for example, the CMMI-SW Staged [8] with 25 process areas, or the BPA model of [9] with 444 base process activities, or the more ad-hoc approaches of the previously mentioned surveys ([3],[4],[6],[7]) – would be appropriate to use in a study of software practices in ASEAN. Fourth, none of the previously mentioned studies provided any metrics that could be readily used to compare organizations and countries.

2. DESCRIPTION OF THE STUDY
To help investigate if there are any fundamental software practices that software firms in the five ASEAN countries might be predominantly strong or weak in, and to help address the four
issues identified in the previous paragraph, the survey and case study methods were used.

The basic survey questionnaire had two parts. The first part contained a few basic questions about the respondent and the respondent’s organization. The second part had 55 questions. The first 52 of these dealt with whether the respondent’s organization performed certain software practices in all, some, or none of its development projects. The software practices and their groupings were based mainly on SEI’s SW-CMM Maturity Questionnaire for Level 2, and on some of the best practices of Microsoft and Infosys, as documented in [10] and [11], respectively. The remaining 3 questions in the second part of the questionnaire dealt with the respondents’ perception of (i.e., what they thought to be) the process areas that their organizations were (1) strongest and (2) weakest in, and (3) which they would like their new recruits to be better trained in by academia. A one-page mini-glossary was provided at the end of the questionnaire.

The survey questionnaires were mailed to about 100 randomly selected samples of software firms in each of the following countries: Malaysia, Philippines, Singapore, and Thailand. On the other hand, purposive sampling was performed in Vietnam due to difficulties in acquiring a list of software firms. However, despite (1) a clear explanation of the benefits and confidentiality of participating in the survey, (2) translation of the survey questionnaire into Thai and Vietnamese for the respondents in Thailand and Vietnam, respectively, and (3) multi-type follow-up through e-mail and telephone, only about 13% of the firms returned the questionnaires in every one of the four countries where random sampling was done. Though we were not able to ascertain whether the major reasons for the low response rate were the same or different across these four countries, it is clear that subsequent studies of this nature and in this region will need to address this risk very carefully. The low response rate notwithstanding, the survey results, which could therefore be exploratory at best, seem to point to what could be common strengths and weaknesses of the aforementioned countries.

3. RESULTS AND DISCUSSION
3.1 Survey Results and Discussion
To facilitate comparison among groups of software firms with respect to software development practices and process areas, we introduce the notion of “performance” of a group of firms as:

\[
P(p_i) = s(p_i) * (1 - w(p_i))
\]

where \(P(p_i)\) is the performance of a group of firms with respect to a software practice \(p_i\); \(s(p_i)\) is equal to the number of firms in the group that observed \(p_i\) in all their projects, divided by the total number of firms in the group; and \(w(p_i)\) is equal to the number of firms in the group that never observed \(p_i\) in any of their projects, divided by the total number of firms in the group.

We also introduce the notion of “strength” and “weakness” of firms in a group with respect to software practices. Strengths are practices that are performed in all projects by a majority of the firms in a group AND not performed in any projects only by a minority of the firms in the group. On the other hand, weaknesses are practices that are performed in all projects only by the minority of the firms in a group AND not performed in any projects by a majority of the firms in the group. Clearly, performance and strengths/weaknesses, as defined above, are related: The closer the value of \(P(p_i)\) is to 1.0, the “stronger” a group of firms is with respect to practice \(p_i\). On the other hand, the closer the value of \(P(p_i)\) is to 0.0, the “weaker” the group of firms is with respect to practice \(p_i\).

In general, the respondent firms from each of the five countries had one or two strengths (practices whose \(P>.50\)) in the areas of Software Requirements Management (SRM) and Software Project Planning (SPP). This is consistent with their perception (i.e., their answer to question 53 of the second part of the questionnaire) that they were strongest in these two areas. Under SRM, the groups of respondent firms from Malaysia, Philippines, Singapore, and Thailand were all strongest in the practice of reviewing requirements (SRM practice 1). No single SRM practice seemed to be a weakness that was common to all the groups of respondent firms from all the five countries.

Under SPP, the groups of respondent firms from Malaysia, Philippines, Singapore, and Thailand were all strong in the preparation and use of software development plans (SPP practices 1, 8, 13). On the other hand, the groups were all weakest in the use of automated estimation tools (SPP practice 7). This may be due to the high cost of acquiring or developing such automated tools, and the lack of historical and quantitative data upon which to base cost estimation, which, as we shall soon see, is also a weakness common to all the five groups.

However, whereas the groups of respondent firms from the five countries had one or two strengths in the areas of SRM and SPP, survey results showed that this was not so in the rest of the areas. That is, no practice had \(P>.50\) in SPT, SQA, or SCM in any of the countries except Singapore.

The groups of respondent firms from the five countries had common weaknesses in the areas of Software Quality Assurance (SQA) and Software Configuration Management (SCM). Interestingly, these two areas were, in the perception of the majority of the respondents, the areas in which they were weakest, as reflected in their answers to question 54 of the second part of the questionnaire. They were also generally weak in Software Subcontract Management (SSM), but since not all the firms engaged subcontractors, not many firms perceived this as a weakness in the same way that SQA was.

Under SQA, the groups of respondent firms from all five countries were all weakest in the practice of measuring quality quantitatively (SQA practice 5). This could be due to the lack of knowledge or confidence in the use of quantitative quality management methods, or the difficulty of determining cost-effective quantitative measures. Alternatively, it could also be that they used agile (as opposed to plan-driven, e.g., CMM/CMMI-compliant) software development methods, which normally focus on qualitative descriptions of quality. We look at the implications of this in the last section of this paper.

Under SCM, the groups of respondent firms from all five countries were all weakest in the practice of having a Change Control Board evaluate and approve or disapprove change requests (SCM practice 6). This could be due to the lack of knowledge in the implementation of this practice, or the lack of belief in its cost-effectiveness when used in all projects.
Finally, when asked which area they would like universities and colleges in their countries to better train future software professionals in, a majority of the respondent firms pointed to the area of Software Quality Assurance. However, it will be noted that in Singapore, the majority of the firms indicated Software Requirements Management training as a much bigger concern than training in SQA.

3.2 Case Study Results and Discussion

It is interesting to note that there were one to two respondent firms per country that considered SQA as the process area in which they were strongest in, and these firms’ ratings of their SQA practices confirmed their perception that SQA was indeed their strength. Since many of the respondent firms identified SQA as an area in which they were relatively weak and would like academia to better train its students in, the firms which perceived themselves to be strong in SQA (henceforth we call these firms SQA-strong or quality-strong firms), were studied with respect to their best practices. Data on these best practices were obtained through interviews with management and staff, questionnaires, software demonstrations, and document analysis. Though confidentiality prevents us from divulging the names of these organizations, it might be interesting to note that all were exporters of products or services, though they were of different sizes.

The best practices of the quality-strong firms were: (1) a quality orientation; (2) independent testers and software engineering process groups; (3) peer reviews; and (4) the use of quality management systems.

A quality orientation means that the desire to produce products and provide services of the highest quality exists in each member of the organization. Thus, directives to attain firm-wide quality certification such as for ISO 9001:2000 came from the highest levels in all the SQA-strong respondent firms from Malaysia, Philippines, Singapore, and Thailand. Moreover, the quality orientation of top management could also be seen in the relative ease by which funding for quality activities and initiatives were approved. The quality activities undertaken throughout the software process (itself a best practice), from contract to implementation, reinforced this quality orientation in the minds of the staff. Promotion and merit increases were tied to performance bars by which the quality of staff performance is measured.

Each project in these firms had independent and well-trained personnel responsible for developing test plans and performing non-unit tests. The SQA-strong firms also had engineers responsible for, and trained in, defining processes (or helping process users define processes), ensuring that these processes were followed, monitoring and analyzing the implementation of these processes, and improving these processes when, for example, data suggested the possibility of improvement, or when new strategic objectives needed to be met.

Peer reviews were conducted in the SQA-strong firms after every major software activity: requirements development, project planning, high-level design, detailed design, coding, testing, integration and maintenance. The defects detected during these reviews were tracked to closure using the system that will be described next.

Software quality management systems were used extensively in all the SQA-strong respondents. The features of these systems included the following: (a) repository of processes, standards, and forms; (b) repository of best practices; (c) repository of metrics data collected from each software activity and software project; (d) project folders for all software activities, containing links to all work products (software, documents, forms), if not the work products themselves; (e) requirements traceability matrices; and (f) defect tracking worksheets.

It will be noted, however, that if future work will in fact confirm this study’s preliminary finding that most ASEAN software firms do not use most of the best practices of SQA-strong firms in the same region, this will only show how similar the ASEAN firms are with their U.S. counterparts, for as [5] notes: “Improved practices have been available for decades, but most organizations (apparently in the U.S.) aren’t using them” (parenthetical comment ours).

4. CONCLUSION AND RECOMMENDATIONS FOR FUTURE WORK

The software industry in the ASEAN/Southeast Asian region has significant potential to expand rapidly due to the abundance of skilled ASEAN knowledge workers with relatively low salary requirements. In light of these realities, insights, even preliminary ones, into software practices in the region’s software firms become very important. We now list the main findings of this study. Since the study is exploratory, these findings should be treated more as preliminary insights, rather than conclusive results. Therefore, together with each finding we also provide suggestions for further work.

First, one must be especially careful when planning studies of this type in this region. The researchers did not expect that the response rates would turn out to be equally low in all four countries where random sampling was used. One could only surmise what the reasons were behind the equally low response rates of software firms in these countries, and whether these reasons were common to all four. Whether these have anything to do with the software industry (as opposed to other industries) in the region might be a problem worth studying in its own right.

Second, firms in these countries might be strong in Software Requirements Management and Software Project Planning, at least relative to the other process areas of SW-CMM/CMMI Level 2. Future research might ascertain whether this can be generalized to the entire population. Training modules or case studies can then be developed, based on best practices in these areas (SRM, SPP) in the region, for use by what could be a burgeoning number of new software firms in the region.

Third, software firms in the region might be weak in the following best practices: the use of automated estimation tools (SPP practice 7), the use of requirements traceability matrices (SPTO practice 2), the use of quantitative quality metrics (SQA practice 5), and the use of change control boards (SCM practice 6). It will be noted that while automated estimation tools and the gathering of quantitative data are expensive, requirements traceability matrices are not, so not performing what would be considered a best practice may not necessarily be due to lack of funds. However, all four practices can be viewed as affecting software product quality. This observation can then be related to the next finding.
Fourth, software firms in the region might be weak in certain SQA best practices, though this of course does not imply that their software products are weak in quality. It remains to be determined whether this apparent weakness of respondent firms in certain SQA practices is true of the population, and if so, whether this might be intentional (due, for example, to local clients’ being unwilling or unable to pay the price for these practices), or due to difficulties in quality process definition or compliance, among others. If future studies reveal that SQA could be a challenge that most organizations in the region face, then the next finding would prove quite useful.

Fifth, the respondent firms that were strong in SQA had the following specific best practices in common: a quality orientation, independent testing teams and SEPGs, peer reviews, and quality management systems. As stated earlier, these best practices are not unique to these firms, but are in fact discussed in many standard software engineering textbooks. It might be useful, however, to investigate how these practices could be implemented in a not-so-expensive manner (technically and organizationally) for countries in the ASEAN region. The implementations of these in our case studies can serve as initial models.

Sixth, there might be a need to improve the way software quality concepts and practices are taught in universities and colleges in the region, as suggested by the result that many of the respondent firms wanted their new recruits to be better trained in this area by universities or colleges. Though it will have to be ascertained whether this is a need of the population in general, it will not harm anyone if modules, including case studies of ASEAN firms, are developed even now, that would focus on any or all of the practices mentioned in the previous three paragraphs. These modules could be taught as part of a software engineering or software quality management course.

Seventh, the relatively low P scores of the respondents in the SQA process area might be due to their use of agile rather than plan-based software development methods. There is a need therefore to ascertain this, and to study the appropriateness of plan-based and documentation-intensive approaches (e.g., CMM/CMMI) to software development in the ASEAN/Southeast Asian region in light of: (1) the emergence of agile methods as viable alternatives to plan-based methods of software development, and (2) the existence of many small development firms in the region. However, [12] suggests that agile methods, though good for small firms and projects, depend on dedicated, collocated customers and are therefore best when developing products or providing services in-house. There might be a need, therefore, for more case studies such as [13] on the successful use of agile methods for software development offshore, including ASEAN.

Eighth, there might be a need to study the possibility of introducing, for software firms in the ASEAN region, an “intermediate” level(s) between levels 1 and 2 of SW-CMM or CMMI-SW Staged. Such intermediate level(s) might make it easier for firms in the region to institute quality-related changes in their processes without incurring too much cost.

Ninth, the P(p) measure introduced in this study needs to be studied further in terms of its effectiveness in summarizing and comparing practices of groups of firms.

Tenth and last, it might useful to investigate relationships, if any, between the size of a firm and its SQA process/practices, and also between the volume of a firm’s software exports and its SQA process/practices. This exploratory study seems to indicate that it is the latter, rather than the former, that might have a relationship, but this and the nature of the relationship remain to be determined conclusively.

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6. REFERENCES