

THE VALIDATION OF EXTENDED SOFTWARE PROCESS ASSESSMENT AND CERTIFICATION MODEL USING FOCUS GROUP

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Abstract

The Extended Software Process Assessment and Certification (ESPAC) Model is a model that assesses and certifies the effectiveness and efficiency of software process, which focuses on the agile and secure software processes. The model was validated by assessing and certifying a real project from the software industry through focus group discussion. This paper discusses the execution of the validation as well as the results for the assessment and certification exercise performed on the project. Outcomes from the assessment and certification results show that the project has been implemented systematically; however, there exist some practices with low performance. Accordingly, improvements can be made by the software practitioners on the software practices which achieve low scores. Consequently, it indicates that the ESPAC Model is not only suitable for assessing and certifying software process, but can also be used for continuous improvement.

Keywords: Extended Software Process Assessment and Certification Model, focus group.

1.0 INTRODUCTION

Producing high quality software is one of the keys for an organization to compete and survive in the software industry. Nevertheless, even though software practitioners claim that they produce high quality software, complains on customers' dissatisfaction still exist. Consequently, software certification has become as one of the mechanisms that can give conformance on the quality of software [1,2]. Referring to The International Organization for Standardization (ISO), certification is defined as "*the procedure by which a third party gives written assurance that a product, process or service conforms to a specified characteristics*" [3]. With certification, customers will feel more confident on the quality and dependability in selecting organizations when making investment because it involves independent assessment which will then reduce the possibility of software failure.

Voas [4] points out that there are three approaches in certifying software, which are personnel, product and process. Even though many researchers believe product based approach can give confidence to customers about the quality of software [1,5], at the same time, they admit that the quality assessment for product based approach is hard to be practiced without utilizing the software for a certain period of time. Thus, based on the Deming's premise that "the quality of product is influenced by the quality of process used to develop it" [6], it is believed that process based software certification can be an alternative solution.

Numerous studies can be found for the process based approach, however they focus more on software process improvement (SPI) including ISO/IEC 15504 and Capability Maturity Model Integration. On the other hand, the ISO 9000 provides a mechanism to certify only on the quality system of an organization [7]. On the other hand, the Software Process Assessment and Certification (SPAC) Model [8] focuses on certifying software process in order to ensure that the software process was carried out effectively and efficiently. Unfortunately, this model did not address agile and secure software processes in its assessment. However, in today's business environment, both approaches have become determinant factors to produce high quality software [9]. Furthermore, existing software process certification models and standards do not consider weight values in their assessment even though the assessment involves multiple criteria. The weight value allocation is very important to be considered especially when the assessment process involves multiple criteria [10].

Consequently, a research was conducted to construct Extended Software Process Assessment and Certification (ESPAC) Model which addresses these software processes and considers weight values in the assessment. The objective of this paper is to discuss the validation performed on the ESPAC Model by using the focus group discussion.

The organization of this paper starts with an overview of the ESPAC Model, and continues with steps for executing the focus group. This is followed by the results

and discussions section. Finally, conclusion of the study is included in the conclusion.

2.0 OVERVIEW OF THE ESPAC MODEL

Figure 1 illustrates the ESPAC Model, which is aimed for assessing and certifying the quality of agile and secure software processes. In a nutshell, the ESPAC Model was developed based on the outcomes from the theoretical study as well as findings from exploratory study [11]. The existing software process certification models or standards which are SPAC Model [8], Capability Maturity Model Integrated, ISO/IEC 15504 [7], ISO/IEC 27001 [12] and ISO/IEC 21827 [13] were referred as the base models. Besides, the agile principles and methods were referred for eliciting the agile software process [14]. For eliciting the secure software process, three most prominent models were referred: Microsoft SDL, Touchpoints and CLASP [15]. Additionally, the synthesis technique is improved by incorporating AHP [10] for weight value allocation.

Moreover, since the key activity in software certification is evaluation, thus the Evaluation Theory [16] is closely related. Therefore the components of the proposed model were adapted based on this theory: the target, evaluation criteria, reference standard, data gathering technique, synthesis technique, assessment process and Achievement Index. Each

components is elaborated further in the following sub sections.

2.1 The target

Referring to this study, the target is the software process implemented in the projects that have been completed and ready to be delivered to customers. Furthermore, the software process comprises of the Agile and secure software processes.

2.2 The evaluation criteria

This component defines the required evaluation criteria for assessing the target. Basically the evaluation criteria are comprised of the characteristics that need to be accomplished in order to achieve the effectiveness and efficiency of software process. The effectiveness is measured based on the completeness, consistency and accuracy of the process in developing software which can fulfill customers' expectations through involvement of good quality people, use of appropriate technology and stability of working environment. On the other hand, the efficiency is measured based on the capability of software process to produce software within estimated time and budget. Each of the factors is decomposed into measurable sub factors and evaluation criteria, as illustrated in Figure 2.

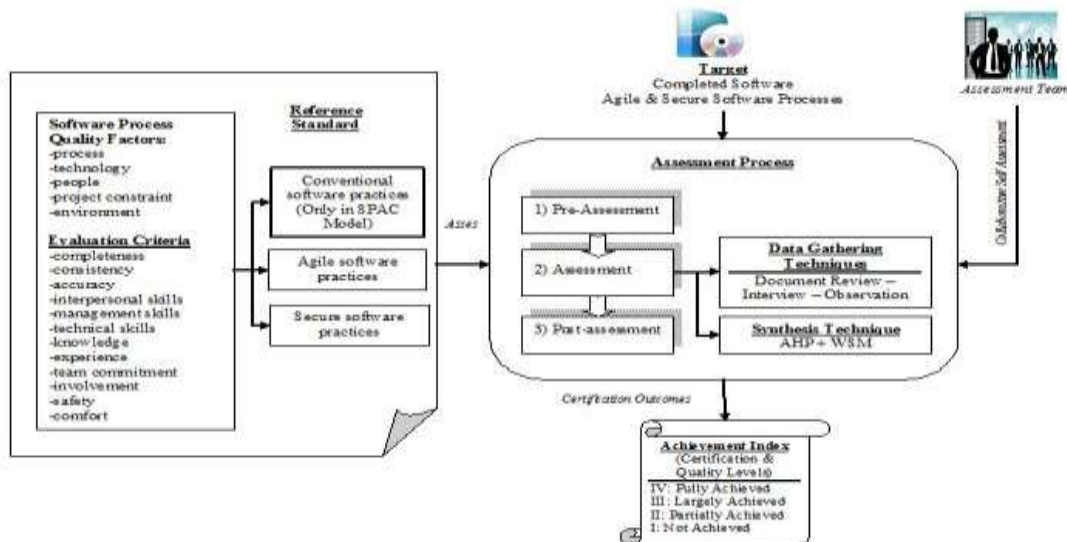


Figure 1 The ESPAC Model

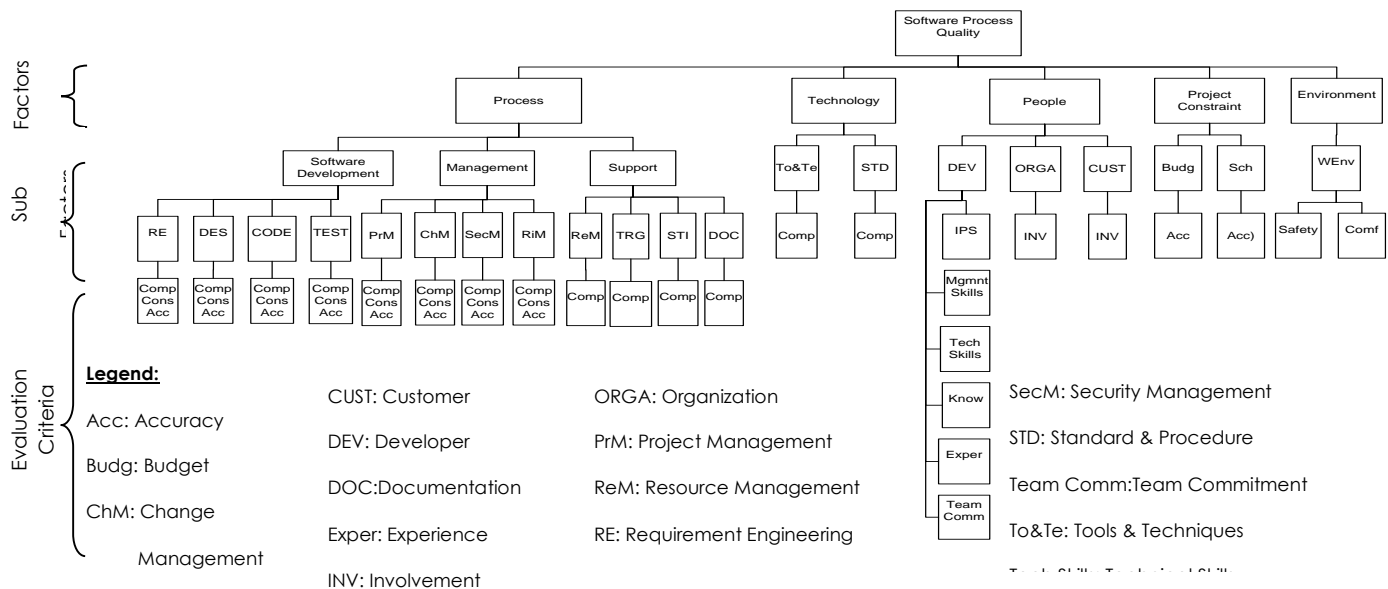


Figure 2 The evaluation criteria

2.3 The reference standard

Based on the defined target and evaluation criteria, the reference standard is constructed. It consists of the best practices of agile and secure software processes. The Quality Function Deployment approach [17] is utilized to organize them. Each evaluation criteria is assigned with appropriate agile and secure software processes which are obtained from the theoretical and exploratory studies.

2.4 The data gathering technique

For the purpose of certification, the data are gathered by using multiple techniques, which are the document review, interview and observation. Using multiple data gathering technique, it can improve the understanding for the assessment team and give better confirmation on the assessment made. Table 1 depicts the data gathering techniques used.

Table 1 The data gathering technique

Factors	Data gathering techniques
Process	Document review + Interview
People	Interview
Technology	Document Review + Interview
Project constraint	Document review
Environment	Observation

2.5 The assessment process

There are three phases of assessment process, which has several activities, as adapted from SCAMPI [18], SPAC Model [8] and Lascelles and Peacock [19]:

- i. Pre-assessment: develop commitment, form the assessment team, identify and analyze the candidate project, plan the assessment, prepare

the assessment team and prepare for assessment conduct.

- ii. Assessment: prepare assessment participants, review documents, perform interviews, observe, record the information gathered and synthesize the data.
- B. Post assessment: determine certification level and quality levels, present assessment results and gather feedbacks, collect lessons learned and prepare technical report.

The assessment process applied in ESPAC Model is collaborative self-assessment method. It is adapted from self-assessment [19,20] and collaborative assessment [5,8]. By applying collaborative self-assessment, the assessment team consists of organization's own people. It is lead by a project manager and composed of assessors who are software developers from other team. This is aimed to eliminate biased assessment [5]. Additionally, one representative from the assessed team co-operates as one of the assessment team members to facilitate ideas exchange between the assessment team. The assessors are among software practitioners who have knowledge in software engineering and assessment.

2.6 The data gathering technique

At the end of the assessment, ESPAC Model produces two certification outcomes, which are the quality levels of each evaluation criterion and the certification level. They are determined based on the defined Achievement Index, as depicted in Table 2.

2.7 The synthesis technique

Synthesis technique is "the technique used to judge each criterion, and in general, to judge the target, obtaining the results of the evaluation" [16]. In this

research, there are two main stages for synthesizing. First stage is to determine the weight for each evaluation criterion, which is accomplished by performing the Analytic Hierarchy Process (AHP) technique [10]. The second stage is to perform the assessment by comparing the reference standard with the practices implemented during software development. Each practices is assigned with appropriate score which ranges from 1 (Never) to 5 (Always). Then, the total scores are obtained for each evaluation criterion by utilizing the Weighted Sum Method [21]. Next section discusses on how the ESPAC Model was validated

Table 2 The Achievement Index

Score Values	Descriptions
Level IV Fully Achieved 86 ≤ Score ≤ 100	This level indicates a fully satisfying achievement. The software processes were implemented effectively, systematically and perfectly or almost perfectly.
Level III Largely Achieved 51 ≤ Score ≤ 85	This level indicates a largely satisfying achievement. The software processes were implemented quite systematically. However, some software processes of low performance exist.
Level II Partially Achieved 16 ≤ Score ≤ 50	This level indicates a partially satisfying achievement. A systematic approach has been used; however almost all of the assessed software processes were not implemented properly.
Level I Not Achieved 0 ≤ Score ≤ 15	This level indicates unsatisfying level of achievement. The software processes were not implemented systematically and below average. The methodology usage was neglected. The software process is considered as fail to achieve its goal.

3.0 FOCUS GROUP EXECUTION

The focus group which was attended by seven (7) software practitioners aimed to validate the ESPAC Model. This section discusses its execution, whereby the key steps are adapted from [22, 23], as in Table 3. A detail explanation on the focus group can be found in our previous paper [24].

Table 3 The stages and activities of focus group

Stages	Activities
Stage 1: Plan the focus group	i. Defined the objectives of the focus group ii. Identified and recruit the participants iii. Identified and book the meeting place iv. Prepared interview guide and materials v. Remind the participants
Stage 2: Conduct the focus group	i. Informal: - informal conversation with participants to create rapport between moderators and participants, served with refreshments ii. Formal: - introduced to each other

	- briefed on the ESPAC Model and AHP - validated the ESPAC Model
Stage 3: Analyze data and report results	i. Analyzed data to determine the quality and certification levels ii. Prepared technical reports iii. Emailed the technical report to participants v. Participants provided feedbacks on ESPAC Model

4.0 RESULTS

The ESPAC Model was validated by assessing seven projects; however only one of the projects is discussed in this paper (Project A). The results obtained from the assessment and certification exercise are discussed in this section subsequently.

4.1 Profile of project A

The assessed project is the web services hub project which was developed by one of the global information services organizations in Malaysia. This organization provides data and analytical tools for the clients all over the world, since year 1980. The employees are about 17 000 people from 40 countries, headquartered in Dublin. This organization has more than 100 000 clients globally, and among them includes BMW Financial Services and Hilton Hotel. The Web services hub project which was started on the March 2013 has five main functions, which are restful web services, phone validation, email validation, reporting and billing. It was developed by using multiple languages, which are C#, Asp.net MVC. For the database, SQL Server and Azure Service Bus were used. It was developed by using Scrum method. This software does not include any security features, so the team did not perform the secure software process.

4.2 Quality levels

The quality levels for Project A are determined based on the scores of the evaluation criteria, as in Table 4.

4.3 Certification level

Based on the cumulative score of quality levels, the certification level is determined for the agile software process, which is 73% (LEVEL III). This reveals that the project was developed systematically. However, there were some practices with low performance. Since the project did not involve with secure software process, thus the assessment was only performed for the agile software process.

5.0 DISCUSSIONS

Majority of the assessed evaluation criteria achieved Level III or IV, except for the completeness of training

(Level II). This section elaborates the achievements of Project A in detail.

5.1 Software development process

The completeness of four main activities in the agile software process achieved a mixture of LEVEL III and LEVEL IV. Testing activity scored the highest. This demonstrates that the practices were performed effectively and almost perfectly by following the proper standard and procedures, as well as tools and techniques. On the other hand, the coding practices obtained the lowest score because some of the best practices of agile were not performed, for example pair programming and collective code ownership. However, pair programming is very important as it can improve the quality of software design and code [25]. Similarly, collective code ownership is a prominent activity that can improve the quality [26].

Additionally, standards and procedure is important to assist the team in giving better understanding on the requirements, improve communication and facilitate maintenance of the software [27]. The team emphasized on the use of standards and procedure during requirement engineering, coding and testing. However, during software design, less emphasis was placed. Similarly, the usage of tools, methods and techniques were also given less importance during software design, especially in representing the design using a particular notation. Nevertheless, for requirement engineering, coding and testing, the usage of tools was emphasized.

5.2 Management process

All of the evaluation criteria for management practices achieved LEVEL IV. The change management activities were more correctly performed based on the agile principles, compared to the project management. In particular, the team gave less emphasis on few important activities in the project management as suggested by agile, for instance documenting project plan for solution-in-hand and monitoring customer and end-user involvement during software development. In spite of this, both management activities emphasized on the use of standards and procedures as well as tools and techniques. These can accelerate the project and enable traceability of the project.

5.3 Support process

The support process has been assessed based on the completeness of trainings, resource management, documentation and staff initiatives provided. Majority of them achieved LEVEL IV. The highest score was obtained for the resource management, which indicates that the organization allocated resources for the project as needed. On the other hand, the lowest score was achieved for the training (LEVEL II). This is because the top management gave less attention for the trainings provided to the staffs, either technical or

management trainings. On the other hand, the organization emphasized staff welfare by ensuring the working hours did not exceed 40 hours per week. The documentation practices also followed the agile best practices.

5.4 Technology

The assessment result shows that the organization emphasizes on the use of tools and technology in order to implement the software process effectively and efficiently. However, although the use of standard and procedure is important for ensuring the uniformity of the software process and work product, less emphasis was given by the top management to monitor its implementation among staffs.

5.5 People

The ESPAC Model assesses the software practitioners, organization and customers. Majority of the assessed criteria for the software practitioners achieved LEVEL IV. The team members were experienced, knowledgeable, very committed in the team and had high level of technical skills. However, they lacked the management skills, for example performing adaptive management style. Additionally, the organization's involvement is very crucial in agile environment. This organization ensures that agile is universally accepted in the organization, which is essential for a successful agile environment. Besides, the customers' commitment is very important for the team implementing agile. Basically the customers of this project were collaborative, able to give constant feedback, able to present on-site and can communicate well with the team.

5.6 Project constraint

The schedule of this project was planned and managed accurately, as it was finished within the estimated time. However, the budget was not assessed as the team did not involve in budgeting.

5.7 Environment

The organization emphasized on the safety and comfort provided to the staffs. However, the organization can improve the communication and network facilities to enable information sharing among team members.

6.0 CONCLUSIONS

The ESPAC Model has been validated by seven software practitioners through a focus group discussion. This paper discusses the results obtained from one of the projects. The results demonstrate the quality and certification levels of the project based on the defined Achievement Index. In a nutshell, the

project has been implemented systematically; however, there exist some practices with low performance, whereby majority of the evaluation criteria achieved Level III or IV. Furthermore, the practices that are effectively and efficiently implemented are highlighted besides than the practices that can be improved. By using these outcomes, organizations can reveal their current level of software process and utilize them to plan and improve their upcoming software processes. For our next step, a repository will be built to manage, organize and store the historical data related to the assessment and certification. This is aimed to ensure that the assessment data are kept safely and can be retrieved easier at any time.

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