A Framework to Compare Software Process Assessment Methods Dedicated to Small and Very Small Organizations

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Abstract

It is a challenge for small and very small organizations to adopt software process improvement models and the associated assessment methods to improve their software process. A number of customized assessment methods based on SPI models, such as CMM/CMMI and ISO 15504, have been proposed to fit the needs of such organizations. To help them select an assessment method relevant to their needs, this paper presents a framework to compare SPI methods dedicated to small and very small organizations?.

1. Introduction

Software products are the result of a development process; hence, software product quality is directly affected by that process. Based on the relationship between product quality and process quality, several model-based software process improvement (SPI) approaches (e.g. CMMI, ISO 15504 and ISO 9001) have been designed. The initiatives associated with these approaches all begin with an assessment of the organization's current processes. The results of this assessment provide data on the strengths and weaknesses of the organization's processes and provide guidelines with respect to which processes require improvement.

In medium-sized and large organizations, the division of activities and tasks among employees with distinct responsibilities is much more visible than in small organizations, which have only a few people to carry out the full process. Most of the initial SPI models have therefore been developed instead based on observing and analyzing processes, which are more visible in these larger organizations. The SPI models are therefore easier to use in medium-sized and large organizations than in small and very small organizations with their highly uncoupled processes.

To adapt these models to fit the informal processes of small and very small organizations, a number of tailored SPI models have been proposed [1] [2] [3] [4] [5] [6] [7].

Small organizations fighting to survive and provide their customers with a working version of their products must address daily challenges, which leave them with little flexibility with respect to long-term planning: they must be highly agile and reactive, and they have little control over longer lead times. Therefore, any process assessment they conduct and any improvement process

they implement must also be agile, quick and inexpensive.

When an organization decides to initiate an assessment process (either on their own or by hiring an external assessor), they must first figure out which of a number of different SPI assessment frameworks is the most relevant to them.

The available SPI models are comprehensive and contain detailed descriptions, and so it is a challenge to compare them. Halverson [8] has observed that "many people who work in the SPI domain have chosen one SPI framework as their favourite. This choice is mostly subjective and seldom based on objective evidence of appropriateness. A reason for this is that SPI frameworks are difficult to compare due to their comprehensiveness." A consequence of this is that comparing SPA assessment methods, which are themselves built based on these SPI frameworks, is also a difficult process.

Such a comparison can be achieved from different points of view:

- The author's point of view: The author of a new assessment method would like to compare his method with other methods to determine the differences and similarities, as well as the way in which his method is aligned with other methods.
- The organization's point of view: Organizations with little SPI knowledge planning to conduct a self-assessment process to evaluate the capability levels of their processes need to compare the various SPA methods currently available and choose one of them.

Moreover, some organizations may already be involved in an SPI process, but wish to use another SPA method. In such cases, a comparison of the available methods would be useful. This paper investigates previous work on comparing SPI models and assessment methods, and proposes a framework for comparing assessment methods dedicated to small and very small organizations.

Section 2 presents related work, including the Halvorsen taxonomy to compare different SPI methods and the comparison approach proposed by Anacleto *et al*. Section 3 presents our proposed comparison framework, and applies it to seven different assessment methods. Section 4 provides the conclusion of this work.

2. Related Work
2.1 Overview

A number of comparisons of several well-known SPI models, such as CMM, ISO 15504 and ISO 9000, have already been performed. For instance:

- Tingey's [9] detailed comparison of the CMM, ISO 9000 and the Malcolm Baldrige National Quality Award (MBA);
- El-Emam *et al.* [10] textual comparison of SPICE and ISO 9000 to show their differences also provides a mapping of the two standards;
- Paulk's [11] comparison of ISO 9000 and the CMM;
- Analetco *et al.*'s [7] comparison of several lightweight process assessment methods for small companies; and
- McCaffrey *et al.*'s [12] comparison of his proposed assessment method dedicated to small organizations to other lightweight assessment methods.

Most of the methods compared in such articles are not dedicated to small organizations, however, which need

brief and quick comparisons providing sufficient information to enable a choice to be made among available SPA methods to start their SPI initiative.

In the next two sections, we discuss two main comparison attempts; the first is the Halvorsen taxonomy to compare SPI frameworks [8], and the other is Analetco *et al.*'s [7] trial to define the characteristics they deem necessary to compare different SPA methods for small organizations.

2.2 Halvorsen taxonomy

Halvorsen recognized four different classes of methods for comparing SPI frameworks; "From our review of other comparison work we have recognized four main classes of comparison methods" [8], which are:

1. *Characteristics comparison method.*
   The comparison in this method is based on a set of predefined characteristics listed in tabular form. It gives a compact and high-level comparison method with few details.

2. *Framework mapping comparison method.*
   This is the process of creating a map from the statements or concepts of one framework to those of another. It is useful when an organization employs two or more different SPI frameworks, as corresponding statements can be identified and redundancy reduced. Thus, the extra effort needed to employ more than one framework is minimized.

3. *Bilateral comparison method.*
   In a bilateral comparison, two frameworks are compared textually. The difference between this

comparison method and the two previous ones is its textual nature.

4. *Needs mapping comparison method*
   Needs mapping does not constitute a direct comparison of frameworks. Instead, it considers the organizational and environmental needs that must be considered when selecting which SPI framework to adopt.

Halvorsen's proposed taxonomy falls into the "Characteristics comparison method" grouping described above. In his taxonomy, 25 different characteristics are defined to compare SPI frameworks. Within the taxonomy, the characteristics are grouped into 5 categories, as shown in Table 1.

Halvorsen used his taxonomy to compare six SPI frameworks: TQM, CMM v1.1, ISO9000, ISO/IEC 15504 (SPICE), GQM and SPIQ. For more details on the characteristics and comparison results, refer to [8].

Halvorsen's taxonomy includes a long list of characteristics for comparing different SPA methods which are built based on the SPI frameworks. We have used this taxonomy to compare SPA methods dedicated to small and very small organizations; but we found that several characteristics have the same value, which is inherited directly from the philosophy of most of these methods and is based on tailoring some other common frameworks. These redundant values did not add new knowledge to that of those performing the comparison. Therefore, in our proposed comparison framework, these characteristics have been removed.

General	Process	Organization	Quality	Result
Geographic origin/spread Scientific origin Development/stability Popularity Software specifc Prescriptive/descriptive Adaptive	Assessment Assessor Proc. improvement method Improvement Initiation Focus Analysis Techniques	Actors/roles/stakeholders Organization size Coherence	Quality perspective Progression Causal relation Comparative	Goal Process artifacts Certification Cost of implementation Validation

Table 1: Categorization of characteristics in Halvorsen taxonomy

2.3 Anacleto *et al.*

Anacleto *et al.* [7] have proposed a tabular comparison of five different assessment methods for small organizations (RAPID, SPINI, FAME and TOPS, and their new method, MARES). Their comparison is based on the following criteria:

1. Low cost.
2. Reliable results
3. Detailed description of the assessment process.
4. Guidance for process selection.
5. Detailed definition of the assessment method.
6. Support for identification of risks and suggestions for improvement.
7. Support for high-level process modeling.
8. Conformity with ISO/IEC 15504.
9. No specific software engineering knowledge required from the company representative.
10. Tool support.
11. Integrated into the assessment methodology
12. Public availability.

Based on the Halvorsen classification, this comparison method also falls into the "Characteristics comparison method" grouping.

Anacleto *et al.* did not aim to define a comparison framework; they rather documented their own criteria for comparing several assessment methods to verify to what extent their proposed MARES assessment method is similar to other methods. For instance, they found that their method is most similar to the SPINI method. Moreover, the values assigned to the above characteristics are less informative, being of the form: satisfy, do not satisfy, more or less satisfy and no information available. Although these criteria are relevant for comparison, we believe that other criteria can be added to these light-weight assessment methods to convey more informative and more useful data.

3. Improved comparison framework
3.1 Overview

Our main effort is focused on creating a comparison framework that is useful mainly for comparing SPA methods for small and very small organizations. According to the Halvorsen classification of comparison methods, our method will also belong to the "Characteristics comparison method" grouping.

It includes several characteristics from both the Halverson and Anacleto *et al.* comparison frameworks, making them convenient for use by small and very small organizations. Several characteristics that do not have strong informative value or that are common to SPA methods have been excluded, since we are more interested in presenting characteristics that show the differences between the methods, and so can help in making the decision as to which one to use. To achieve this, we have added some other criteria involving useful and informative data about the methods compared, e.g. it is useful to know how long the assessment should take, the number of assessed processes and what

are they, as well as which of them are to be improved.

Halvorsen Characteristics	Anacleto *et al.* Characteristics	New Characteristics
-Geographic origin/spread -Scientific origin -Development/stability -popularity -Analysis techniques	-Cost -Guidance for process selection -Support for identification of risk and improvement suggestions -Need for specific SE knowledge from the company representative -Tool support -Public availability	-Number of assessed processes -Assessed processes. -Number of processes to be improved -Assessment duration

Table 2: List of characteristics for the improved comparison framework

3.2 Characteristics description

Geographic Origin/Spread: Where did the framework originate and where is it used now?

Scientific origin: What is the background on which this framework is based?

Development/Stability: Is it desirable to employ an evolved and relatively stable framework such as is achieved through experience feedback from real use over a number of years.

Popularity: Where is this method used?

Analysis techniques: Does the framework utilize any quantitative or qualitative analysis techniques, e.g. statistical process control or questionnaires?

Cost: What is the relative cost? Is it high, low or moderate?

Guidance for process selection: Does the compared method provide any guidance in selecting the processes to be assessed?

Support for identification of risk and improvement suggestions: Does the compared method provide a way to identify the possible risks and improvement suggestions?

Need for specific SE knowledge from the company representative: Does the company representative need to have any particular level of SE knowledge?

Tool support: What tools does the assessment method use to support the assessment process?

Public availability: Is the compared method available to the public?

Number of assessed process: What is the number of processes to be assessed by this framework?

Assessed process: What processes have been chosen for assessment?

Number of processes to be improved: Of the assessed processes, how many will need to undergo improvement?

Assessment duration: How long will it take to complete the assessment process?

3.2 Apply the comparison framework

The proposed comparison framework is applied to a set of seven different assessment methods, which are:
1. TOPS [1]: Toward Organized Process in SMEs.
2. Micro-Evaluation [2]: OWPL Micro Assessment Method.

3. MARES [3]: A methodology for software process assessment in small software companies.
4. SPM [4]: Software Process Matrix.
5. RAPID [5]: Rapid Assessment for Process Improvement for Software Development.
6. FAME [6]: Fraunhofer Assessment Method
7. EAP [12]: Express Process Appraisal Method.

The full comparison of these assessment methods is shown in Table 3.

7. Conclusion

In this paper, we have explored two attempts to compare SPI frameworks; one was devoted to defining taxonomy for comparing SPI frameworks, while the other provides a trial comparison of some assessment methods for small companies. We have discussed the suitability of these methods for comparing assessment methods for small and very small organizations, and found that mixing the characteristics of the two methods, while choosing suitable characteristics for VSE assessment methods and adding some others, would give us a more informative framework. We have applied the proposed framework to comparing seven different assessment methods and presented the results.

8. References

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Criteria	MARES	TOPS	FAME	RAPID	SPM	EAP	Micro-Evaluation
Geographic origin/Spread	Brazil	Italy	Germany	Australia	Ireland	Ireland	Belgium
Scientific origin	ISO 15504	ISO 15504	ISO 15504/ Bootstrap	ISO 15504	Quality Function Deployment	CMMI Compliant with the ARC 1.1	OWPL
Cost	Low	Low	NA	Low	Low	Low	Low
Development/ Stability	NA	NA	NA	Since 1999	Since 1999	Since 2003	Since 1998
Popularity	Regional	Regional	Regional	Regional	Regional	NA	Belgium/Quebec/France
Analysis techniques	Interview	Interview	Interview	Interview	Questionnaire	Interview	Short interview
Number of processes assessed	26	3	4	8	47 Process with 135 practices	6	6
Number of processes to be improved	2-3	3	4	8	Max. 10 practices	6	6
Assessed processes	Selected after identifying strengths and weakness based on SWOT analysis	ENG.2, ENG. 5, CUS. 4	ENG.2, ENG.3, ENG.4, ENG.5	CUS. 3, ENG.1, MAN.2, SUP.2, SUP.3, SUP.4, MAN.4, ORG2.1	Selected according to a prioritized list based on QFD calculations	1-Requirement Management 2-Configuration Management 3-Project Planning 4-Project Management 5-Project monitor & control 6-Process & Product QA	1. Quality Assurance 2. Customer Management 3. Supplier Management 4. Project Management 5. Product Management 6. Training and Human Resource Management
Tool support	NA	Paper forms	Data collection, analyses and rating tools	Paper forms	NA	Paper forms + data collection & analysis tools	Paper forms + Excel sheet

Assessment duration	1 day	Half a day	NA	1 day	NA	1 day	Half an hour
Public availability	Yes	Yes	No	No	NA	No	No
Guidance for process selection	Yes By using a contextualization phase	No	NA	No	NA	No	No
Support for identification of risk and improvement suggestions	Yes By using a risk management Phase	Partially supported	Partially supported	No	NA	Yes	Partially supported
Need for specific SE knowledge on the part of the company representative	No	Yes	Yes	Yes	NA	No	No

Table-3: The comparison framework applied to seven different assessment methods