Performing ISO/IEC 15504 Conformant Software Process Assessments in Small Software Companies

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Small software companies face similar issues regarding software quality improvement and process assessments as larger companies. The main difference is that smaller companies seldom have specialized or competent resources to solve the problems. Therefore, the development of assessment methods also from the viewpoint of small companies can support the software industry. Based on experiences applying ISO/IEC 15504 in small software companies in Finland and Brazil, we present a flexible approach to efficient process assessments. Flexibility requires a continuous assessment model, so that the scope of process improvement and assessment can be defined based on the prioritized needs of an organization. Our experiences show that 15504 can also be applied with success in small software organizations. The paper presents how the assessments were run and lessons learned on applying 15504 in this kind of organization.

Keywords

ISO/IEC 15504, Software Process Improvement, Software Process Assessment, Small Organizations

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1 Introduction

Today, in many countries small companies (SC)[1] are important for the economy and employ a great share of people (for example, in Brazil they represent about 70% of the total number of organizations in the software sector [10]). Typically, this type of company faces similar problems as any type of company, e.g., regarding the quality of their products, although, in general, SCs normally face these problems to an extreme due to the informality of their processes and lack of resources. These characteristics can harm SCs in relation to their quality, productivity and competitiveness, or even their survival on the market. Therefore, the identification of problem areas and the systematic establishment of improvement actions are vital for their long-term success.

However, it seems that small software companies still find it difficult to run process assessments [2,8,9]. One reason is that many small companies are simply unaware of the existence of such methodologies [2,10]. Often there is also the perception that software process assessments conformant to these models/standards can be expensive and time consuming [11]. There is also often the perception that assessment models and standards are more targeted towards large organizations [2,8,11], including, e.g., practices for documentation and process formalization [9], which have been criticized to be inappropriate in the context of small companies [8,11].

In this context various initiatives have been started focusing specifically on software process improvement and assessment in the context of small software companies. Two examples are the project 15504MPE [1] in Brazil and the SataSPIN project [17] in Finland. The projects focus on the development of an assessment method customized to small software companies in order to enable effective software process assessments in conformance with the standard IS/IEC 15504 directed to their needs at low cost. Both methods, which were developed independently, are going in the same direction being similarly structured and based on ISO/IEC 15504 allowing a flexible adaptation of the process assessment in accordance with an organization's specific characteristics and goals.

In the context, also first experiences of both projects have been gathered. The 15504MPE project started in February 2003 and so far 7 trials have been performed in Brazilian small software companies. The SataSPIN project was organized in two phases; the first phase started in August 1998 and the second phase in June 2001. The project was ended in May 2003. Altogether 20 small and medium sized software companies took part in the projects, which resulted in an established software process improvement network.

In this paper, we present a unified view on the assessment methods developed and present a summarized overview on our experiences on the applicability of the international standard ISO/IEC 15504 with small organizations. We discuss the effectiveness and efficiency of the process assessment method as well as its effects on software process improvement.

2 Software Process Assessment Models and Methods

Software process models aim at continuous improvement. Small organizations require special guidance to be able to benefit from the models and to be successful in the process improvement. Process assessments provide lots of information as the basis for improvement activity planning. Today, the two most prominent software process improvement and assessment approaches are the CMMI framework [3] and the international standard ISO/IEC 15504 [6]. In general, both frameworks are directed to any type of company and being based on a continuous representation both offer flexible approach adaptable also to small software companies [14,15]. An advantage of the standard ISO/IEC 15504 specifically in the context of small software companies is its broad scope of, not only, technical processes. However, as the standard itself defines only a minimal set of generic requirements for an assessment, it does not provide in itself sufficient support for its ready application in a small software company.

[1] A common definition used classifies small companies with less than 50 employees.

In order to effectively and efficiently support process improvement in the context of small software companies, considering their specific characteristics and limitations, various ISO/IEC 15504 conformant assessment methods have been developed, such as, for example, RAPID [13], FAME [4], SPINI [9], MARES [1], SPIRE [14], and TOPS [2] among others.

In the context of our research, we developed the tailored assessment methods:

- SPINI: The assessment method has been developed during the SataSPIN project/Finland as part of a SPI Initiation Framework (SPINI). The framework is based on the ideas of IDEAL and SPICE, and the experience acquired when implementing software process improvement in small organizations. The framework expresses the essential activities that were found useful in starting up SPI using external support.
- MARES: The method has been developed as result of the research project 15504MPE/Brazil based on our experiences applying 15504 in small software companies focusing on continuous improvement based on the CenPRA approach for SPI [1] based on IDEAL.

In this section we provide a general overview and comparison of both methods. The methods are basically composed of a process assessment model and an assessment process.

2.1 Process Assessment Model

The process assessment models used by both methods are based on the exemplar assessment model of Part 5 of ISO/IEC 15504 [5,7]. The capability dimension is adopted as-is from capability level 0 up to level 3. Capability level 4 and 5 are not considered due to the, generally, low level of capability encountered in small software companies.

The process dimension has also been developed based on ISO/IEC 15504-5. However, due to the characteristics of small software companies, some processes of the exemplar model have been disregarded as being irrelevant in most cases in the process assessment model used by the MARES method. For example, as most small companies do not have subcontractors, processes related to the Acquisition Process Group have not been considered. However, if any of these turns out to be an important process in a specific context, it can easily be re-integrated based on ISO/IEC 15504-5. In addition, some processes (e.g., Project Management and Risk Management) have been re-grouped into one process.

Assessments during the SataSPIN project were performed according to the prioritized needs of the participating companies. As most of them were in the very beginning of process improvement, the selection of processes for the assessments consists mainly of engineering processes together with project management. Detailed distribution of the assessed processes is presented in Table 3.

2.2 Process Assessment Process

Both methods are based on the requirements for performing an assessment as defined in ISO/IEC 15504-2. In addition, a phase in the beginning of the assessment is added in order to characterize the company, to obtain a general understanding on the complete software process and to systematically support the selection of the processes to be assessed. In both methods, the assessments are performed similarly, but the assessment planning related activities are organized in a different way (Table 1). The MARES method pays more attention to the control and feedback of the assessments.

Table 1. Comparing the basic phases and activities of both methods

SPINI		**MARES**	
Phase	*Activity*	*Phase*	*Activity*
Needs analysis	Alignment General assessment Scope definition	Planning	
		Contextualization	Data collection Data analysis

Process assessment	Assessment planning Data gathering Assessment reporting	Process assessment	Preparation Data collection Consolidation of observations Validation Process attribute ratings and general results Reporting
			Monitoring & Control
			Post-mortem

Planning: During the planning phase, the assessment is organized and planned, including the definition of the purpose(s) for performing the assessment, its scope, available resources, constraints, schedule and the required output. In addition, participants and their responsibilities are identified. In general, the assessment is performed by an assessment team, composed of a competent lead assessor and a support assessor. Participants from the organization are the sponsor of the assessment and representatives involved in the software process.

Needs Analysis/Contextualization: The activities in the first step are alignment, general assessment and scope definition. The alignment provides a common understanding within the organization of process thinking and related concepts. A general assessment is used to study the overall situation of the organization's business and improvement goals and its software processes. As results of this phase, target profiles are defined, indicating high-priority processes and their capability level to be achieved in order to meet the organization's goals. Organization's needs and present situation are considered, and the assessment strategy and scope is defined including the processes that will be investigated in detail. All results of the contextualization phase are documented and revised. Based on the results of the needs analysis/contextualization phase, the assessment plan is updated and completed determining schedule, participants, source material and restrictions to the assessment.

Process Assessment: The second step concentrates on a planned, detailed assessment of the selected processes. Therefore, the data collection is prepared, including the refinement of the strategy and techniques to be used for collection and analysis, as well as the definition of process attribute indicators. Data gathering consists of studying the source material and interviewing process performers in assessment sessions. The collected evidence is then analyzed by the assessors mapping the data to the indicators of the process assessment model. This is explicitly documented by stating the consolidated observations and briefly indicating the level of achievement of the indicators in order to facilitate later on the rating for the process attributes. The observations are then validated by representatives of the organization during a feedback session in order to ensure that they accurately represent the assessed process(es). In addition, the assessors validate them in order to ensure their objectivity, consistency and sufficiency with respect to the scope of the assessment. Then, the capability of each process is rated unanimously by the assessors resulting in the definition of a set of assessed process profiles based on the validated evidence. By comparing the assessed process profiles to the target profiles and considering the results of the contextualization phase, strengths, weaknesses are identified. In addition, potential risks and improvement suggestions are identified by analyzing the gaps between the target and the assessed process profiles. The assessment report records the findings and process ratings and profiles in a detailed manner and is presented to the SPI stakeholders. It gives precise input for improvement actions.

Monitoring and control: All activities during the assessment are monitored and controlled with respect to the assessment plan. If necessary, corrective actions are initiated and the plan is updated accordingly.

Post-mortem: Once the assessment is finished, the assessors hold a brief post-mortem session in order to discuss the performance of the assessment as a basis for the continuous improvement of the assessment method. Further feedback on the execution of the assessment, its results and benefits is also provided through a questionnaire to be answered by the assessment sponsor.

3 Performing Assessments in Small Software Companies

Focusing on software process improvement in small software companies, we have run eight software process assessments in small companies in Brazil in the context of the project 15504MPE during

2002-2004, and thirteen in small software companies in SataSPIN project in Finland during 1999-2001. The companies varied from recently founded ones (partly associated to incubators) to companies founded 15 years ago, representing different growth stages. Their size varied from 2 to 56 people. One trial was run in a rapidly growing company with about 56 employees at the moment of the assessment, which strictly seen, would be considered a medium organization. However, as the company only recently before the assessment employed several people, the results are still considered relevant. Some of the recently founded companies were very small with only 2 to 5 employees.

Most of the companies developed their own software products. The types of products and services ranged from the development of individual applications, development and/or customization of standard products, or services requiring the development of software systems. Application domains include e.g. commercial and industrial applications, enterprise information systems, distance learning support, logistics and telecommunications. Only two of the companies were primarily subcontractors.

The assessments have been performed in accordance with ISO/IEC 15504 using either the SPINI or MARES method. Summary of the assessments analyzed in this paper is presented in Table 2.

Table 2. Summary of assessments

	SataSPIN	15504MPE	TOTAL
Companies	8	8	16
Assessments	13	8	21
Projects	22	12	34
Participants	61	37	98
Process instances	77	27	104

Due to the time frame in which the assessments took place, different versions of 15504-5 have been used (ISO/IEC TR 15504-5:1999 and ISO/IEC CD 15504-5:2003), as this part of the standard is still under development. In each assessment, different processes have been assessed up to different levels of capability depending on the company's specific characteristics and goals. Table 3 presents an overview on the number of process instances assessed with respect to the processes of 15504-5.

Table 3. Overview on the number of instances assessed per process

Process	Version	15504MPE	SataSPIN	Total
Supply	TR	4	1	5
Supplier Tendering	CD	1	0	1
Contract agreement	CD	1	0	1
Software release	CD	1	0	1
Software acceptance support	CD	1	0	1
Requirement elicitation	TR / CD	2	16	18
Customer Support	TR / CD	2	2	4
System requirements analysis and design	TR	0	6	6
Software requirements analysis	TR	0	14	14
Software design	TR	0	10	10
Software construction	TR / CD	3	3	6
Software integration	TR / CD	1	2	3
Software testing	TR	1	2	3
System integration and testing	TR	0	1	1
Software installation	CD	2	0	2
System and SW maintenance	TR	0	1	1
Documentation	TR	0	3	3
Configuration management	TR	0	1	1
Change request management	CD	1	0	1
Project management	TR / CD	6	13	19
Risk management	TR	0	2	2

Measurement	TR	1	0	1

Here we can observe a strong focus on project management, requirements elicitation and analysis, as well as design. Comparing the processes assessed in both projects, we can observe a stronger focus on the engineering process in SataSPIN, with exception of the software installation process which did not exist in the TR version and was exclusively assessed in the 15504MPE project. Projects also show some emphasis on the supply process, as well as in the case of 15504MPE on the customer support process covering specifically early and final phases of the software process. As typical for companies just starting SPI, most assessments resulted in either capability level 0 or 1 in the first assessment.

We also can observe that only some of the processes identified as high-priority for SPI in the small companies confer to process areas focused, e.g., by the CMM-SW/staged framework on maturity level 2 [12]. Others, such as Supplier Agreement Management, Measurement and Analysis, Process and Product Quality Assurance, and Configuration Management, were not or considered only in one assessment. This may indicate the importance of the flexibility of the assessment method enabling the selection of the processes to be assessed in accordance with the specific characteristics and business goals of an organization.

Effects of the assessments on software process improvement

In general, all participating companies considered the assessment as very beneficial and have already begun to implement improvement actions. Based on surveys after the assessments, the companies agreed on that the assessment contributed to a better understanding of their software process. As result of the assessment, strengths and weaknesses were identified that only partially had been recognized before the assessment, and which were confirmed by the companies. Especially, the explicit indication of improvement suggestions was considered helpful.

The key business benefits of SPI were reported to be: 1) Improved control of outcomes, 2) Development of knowledge and skills, and 3) Improved manageability of the operations [16].

However, an interesting tendency, we observed, is that the very small companies with less than 5 employees (including in some cases only 1 or 2 full-time employees), and which had only been recently founded, started improvement actions (e.g., developed tools), but did not effectively established them, as they considered them only to be useful once the size of the company increases.

Methods were created as a part of national projects to support SPI and are therefore intended to be used in a larger framework. Both methods are similar in their assessment approach and produce the desired outcomes. Methods can be developed further by integrating the experiences gathered during their use. The ISO/IEC 15504 can efficiently and effectively be applied also in the context of small companies.

4 Lessons Learned

Our experiences indicate the applicability of the standard ISO/IEC 15504 for software process assessment also in the context of small companies. The process assessment models based on the exemplar process assessment model defined in 15504-5, as well, as the assessment processes were considered adequate providing findings that were confirmed by all participating companies.

Some lessons learned:

- **Flexibility of assessment model** based on a continuous representation has shown to be important in order to support the adaptation to this kind of organization and each company. However, most assessments methods based on continuous models do not yet provide detailed support for the identification of target process profiles and the selection of processes to be investigated in detail.
- **Focus on the principal high-priority processes** in alignment with the company's business goals, characteristics and resources available for SPI. This is important to keep the assessment focused on the most relevant processes to be targeted for improvement, as well as to keep the assessment cost as low as possible with maximum coverage of relevant processes.

- **Coverage of the process reference model** has shown to be important, especially as in the context of small companies, processes in direct contact with the customer (such as supply, software installation, customer support or change request management) have turned out of high priority.
- **Data collection** based on group interviews has turned out to be another activity critical to the success and costs of an assessment. The interviews were performed in an open style, not using any kind of questionnaire or checklist, based only on an interview plan, which lists all issues to be elicited during the interview. This was considered very adequate enabling a valid data collection, as the companies' representatives could freely describe how the processes are executed, leaving the mapping to the processes from the process assessment model to the assessors. This was considered especially important, in those cases where we observed a low level of Software Engineering knowledge among the companies' representatives and, therefore, their incapability to do this kind of mapping on their own.
- **Identification of risks and improvement opportunities**. As the objective of the assessments was on process improvement, we observed that besides the minimum requirements regarding the assessment output, principally including the process profiles, it is necessary to point out also the principal strengths and weaknesses related to the assessed processes, as well, as risks and improvement suggestions in order to provide initial support for the planning of improvement actions.
- **Availability of documents templates and tool support.** Based on our experiences, the assessment effort can be considerable reduced when templates for the documents to be produced during an assessment are available (in the respective native language, if needed). Further cost reduction could be achieved by the usage of tool support for the management of documents during all assessment activities and identified possibilities enabling the partial semi-automatization of the handling of information as a basis for the creation of initial versions of some documents to be produced.

Overall, systematic process assessments support management of small software companies and provide valuable information for their process improvement. As small software organizations are in the beginning depending on external support for SPI, the main issue is to convince them on the expected business benefits.

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