

# Process Assessment In Very Small Entities

## An ISO/IEC 29110 based method

Timo Varkoi

Tampere University of Technology

Pori, Finland

timo.varkoi@tut.fi

**Abstract**— Very small software producing entities will soon have their own software process model. A new standard describes the basic processes for software projects. The new standard should also support conformance assessments and process assessments. This paper presents a process assessment method that consists of an assessment process and a process assessment model including assessment indicators. The method is applicable for process improvement purposes, but has limitations regarding formal process capability determination.

**Keywords**— process assessment; 29110; very small entities

### I. INTRODUCTION

A new standard, ISO/IEC 29110 Software Engineering — Lifecycle Profiles for Very Small Entities (VSEs), has been developed to help small software organizations in achieving international recognition of their process capability. The purpose and content of the standard has been described in various papers, e.g. [9, 10]. The set of 29110 standards is expected to be published in the end of 2010. At the first stage, the 29110 standard consists of five parts as shown in Fig. 1 [4] and contains one VSE Profile and one Management and Engineering Guide, also referred to as the Basic VSE Profile.

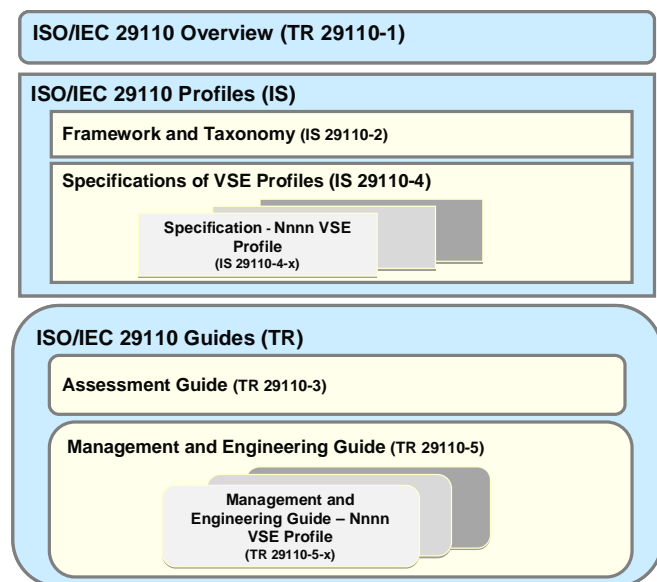


Figure 1. ISO/IEC 29110 Set of Documents [4].

The ISO/IEC 29110 standard aims to present a process life cycle model for software producing small organizations, or very small entities (VSEs). In this context, a VSE denotes an organization (enterprise, organization, department or project) of up to 25 people. The presented life cycle model (i.e. the processes) is most appropriate for a team that produces software as a contracted project.

The 29110 relies on existing standards, like ISO/IEC 12207, 15289, 15504, and ISO 9000. The original idea was to produce VSE Profiles, which "are defined to formally package references to other documents and/or parts of other documents in order to adapt them to a VSE needs and characteristics." [4] The motivation for this work was that VSEs are not willing to use large standards, like 12207 or 15504, due to their complexity and lack of support. The 29110 standards try to clarify the source standards for VSEs and make their application easier by providing more detailed information to establish the processes. One noteworthy point is that several countries are interested to translate the standards and supporting material to better serve their local software industry.

Part 5 Management and Engineering Guide [8] is intended for VSEs. Part 4 Specifications of VSE Profiles [7] provides the mapping to the source standards and is useful for method developers and assessors. Part 3 Assessment Guide [6] defines process assessment guidelines applicable for VSE Profiles. Part 2 Framework and Taxonomy [5] presents the concepts needed to understand Part 4.

This paper aims to present the development of a process assessment method that utilizes the 29110 set of standards. In this case the development includes identification of a process reference model, creation of a process assessment model and integration of the assessment procedures into a method.

We consider method development to be a case where design science approach is applicable. Hevner et al. [1] present design science in the context of information systems research, and we apply the presented guidelines to software engineering research [11]. The models and method presented here can be considered as artifacts that provide new solutions to relevant business problems, i.e. process assessment in VSEs.

Target audience of this paper is process assessment method and tool developers and VSE assessors. Also the developers of the 29110 standards could acquire ideas to improve consistency of the standards.

Next section describes the goals for the process assessment method. The third section presents an assessment process. Section four describes the assessment related models including an analysis of the VSE process model as a process reference model. Section five summarizes the developed process assessment method. Section six concludes the paper.

## II. GOALS FOR A PROCESS ASSESSMENT METHOD

Process assessment methods have typically been developed by consultants, who need these methods and tools to efficiently provide services that include process assessment, for example to support customer's process improvement initiative. Methods vary in scope and content. Methods are often supported by tools that help in collecting assessment data and reporting the assessment results. For VSEs process assessments provide objective information for process improvement and are necessary if a VSE wants to claim conformance to the 29110 standards.

In the 29110 context, one precondition was that the processes should be assessed using ISO/IEC 15504 [3] compliant approach. Requirements for process assessment are described in detail in 15504. Therefore, we try to develop a method that also satisfies the 15504 requirements.

The strict requirements for performing an assessment are written in ISO/IEC 15504-2 [3]. It says that: "*The assessment shall be conducted according to a documented assessment process that is capable of meeting the assessment purpose.*" The required assessment activities are also listed:

- a) *Planning*
- b) *Data Collection*
- c) *Data Validation*
- d) *Process Attribute Rating*
- e) *Reporting*

The 15504-2 standard also sets requirements for the assessment input and output, measurement framework and models for process assessment. Additionally, ISO/IEC 15504-3 [3] gives detailed guidance on performing a process capability assessment, which helps in developing a process assessment method.

An essential part of a 15504 conformant process assessment is the use of a Process Assessment Model (PAM) in the assessment. A PAM describes the set of processes defined in a Process Reference Model (PRM), and mapping to the Measurement Framework of 15504.

In addition to the 15504 based strict requirements, the method should meet the 29110 requirements. Requirements relevant in an assessment are presented in 29110-4-1 [7] and guidance on performing 15504 conformant assessments is presented in 29110-3 [6]. Considering the VSEs as the target group for the assessments, the method should also encourage self-assessments and therefore be simple to use.

In short, the main goals for our process assessment method are:

- it describes the process used in the assessment;
- it contains a Process Assessment Model

Next, we open up the goals to enable method development.

## III. ASSESSMENT PROCESS

In the assessment process we apply the five assessment activities defined in 15504-2. The method is supported by an assessment tool that documents the process.

### A. *Planning*

A plan for the assessment includes the assessment input (sponsor, purpose, scope, approach, constraints, PAM, assessors, participants), activities to be performed, resources and schedule, responsibilities of the participants, verification criteria, and assessment outputs. The plan is documented. The plan should take into account the availability of the resources of the VSE. In self-assessments the planning phase is typically less formal.

### B. *Data Collection*

The means to collect the data are planned. When documentation or other material is used as evidence in the assessment, it is identified and associated to the processes. In VSEs it is common to collect data by interviewing the experts performing the process.

### C. *Data Validation*

The assessor ensures that the data collected is sufficient and consistent to cover the scope of the assessment.

### D. *Process Attribute Rating*

Rating is based on the validated data and provides the assessment result in the form of process profiles (process attribute ratings for a process). In this method also the practices within the process attributes are rated using the NPLF-scale as described in 15504-2. The attribute rating is usually an average of the ratings, but assessor's judgment is necessary. The existence of work products is noted and may affect the assessor's judgment. The achieved capability level is derived from the process attribute ratings.

### E. *Reporting*

The assessment results are reported to the assessment sponsor. Often the management of the VSE and all the participants of the assessment join the feedback session. The feedback session may be used to commit the VSE to the improvements.

## IV. PROCESS ASSESSMENT MODEL FOR VSEs

We have modeled the standard's structure in our earlier work [10] and presented a process assessment model in [11]. This section summarizes those results.

Process assessment models are instrumental for reliable and repeatable process assessments. A Process Assessment Model is related to one or more Process Reference Models [3]. In addition, a PAM requires a Measurement Framework to characterize process capability.

The first thing in building a VSE PAM is to discover a suitable PRM. Next section discusses the available VSE process descriptions and their applicability as a PRM.

### A. VSE Process Model

Specifications of VSE Profiles (29110-4) provide profiles based on subsets of other standards [5]. The first developed profile for VSEs, 29110-4-1, is named Basic VSE Profile and it contains project management and software development processes. The processes and related activities are summarized in their context in Fig. 2 [11].

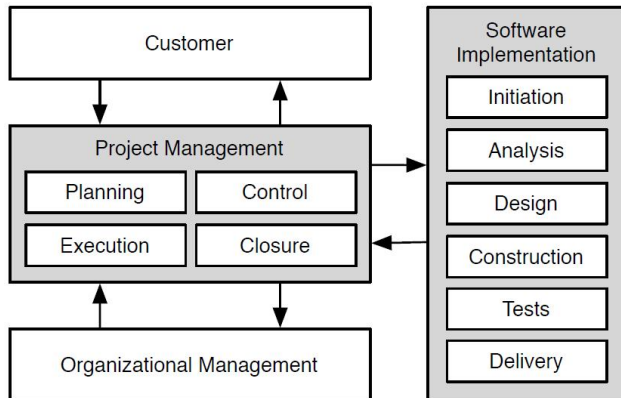


Figure 2. 29110-4-1 Basic VSE Profile processes. [11]

The Basic VSE Profile elements include processes, process objectives, work products, activities and tasks. Work products are defined as inputs or outputs for activities. For 29110 conformity assessment purposes, all processes, objectives, activities and work products are defined as mandatory. Additionally, output work products are mandatory for activities.

In 29110-4-1 there is a normative annex (Annex A: Process Reference Model for Basic VSE Profile Assessment) that states: "For the purpose of capability assessments as defined in ISO/IEC 15504, process objectives specifications shall be used as the process reference models, using 29110 objectives as 15504 outcomes." Unfortunately, the content of the annex is misleading, since it does not describe a PRM as the title indicates.

There are several issues related to the 29110-4-1 process descriptions when compared to the PRM requirements of 15504-2. First, 29110-4-1 does not describe the processes in terms of process purpose and outcomes. Second, the processes contain aspects beyond process performance requirements, e.g. quality assurance objective in project management process, validation activities in software implementation process, and measurement in general. Third, the process objectives do not meet the requirements for process outcomes as they describe process goals. Therefore, the 29110-4-1 cannot be considered as a PRM. [11]

### B. Generating a VSE PRM

As concluded in the previous section, the 29110-4-1 is not applicable as a process reference model. On the other hand, the mapping provided can be used to identify a plausible PRM. Based on the identified PRM, a PAM could then be constructed. [11]

First we need to identify process purposes and outcomes. Even though the process purposes are not defined in 29110-4-1, they are included in 29110-5-1. The process purposes are [8]:

- *The purpose of the Project Management process is to establish and carry out in a systematic way the tasks of the software implementation project, which allows complying with the project's objectives in the expected quality, time and costs.*
- *The purpose of the Software Implementation process is the systematic performance of the analysis, design, construction, integration and tests activities for new or modified software products according to the specified requirements.*

Process objectives are described for both processes and in the 29110-4-1 mapping, most of the process objectives are linked to 12207 process outcomes. As a result of the mapping, the 29110 processes, Project Management and Software Implementation, cover partially a set of 12207 processes. The selected outcomes may be satisfied with the 29110 activities, but the 12207 process purposes are of course not.

The 12207 process outcomes meet the requirements for outcomes set in 15504-2. If we accept a subset of outcomes from various 12207 processes for the 29110-4-1 processes, we can then constitute a PRM for the VSEs. [11] Though, this PRM would not cover all the aspects of 29110-4-1, which consequently will limit its usability in the VSE assessments.

In addition, the 29110 adds aspects beyond the 12207 process concept and VSE Profiles do not directly correspond to 12207 processes. This should be noted also when applying this PRM.

### C. Assessment indicators

Assessment indicators are needed to provide objective evidence to support the assessors in rating process attributes. [3] Assessment indicators are an essential element of a Process Assessment Model. Indicators represent the characteristics of processes and work products. E.g. in the 15504-5 the process performance indicators are Base Practices and Work Products.

By selecting the 12207 process outcomes as the basis for the PRM, we can now create the VSE PAM based on a subset of assessment indicators in the 15504-5 (An exemplar Process Assessment Model). The 15504-5 PAM utilizes the 12207 process purposes and outcomes, and provides Base Practices and Work Products as assessment indicators for capability level 1. The 15504-5 PAM includes mapping of the Base Practices to 12207 process outcomes. Using this mapping, we can create a corresponding subset of Base Practices for the VSE PAM.

For the moment, the Basic VSE Profile describes mainly activities related to process performance and the base practices are adequate. If needed in the future, the 15504-5 generic practices for process attributes on capability levels 2-5, can be utilized.

The last issue in creating a PAM is the Work Products. The 29110-4-1 draft standard specifies work products as mandatory elements for conformance. The work products are explicitly mapped to ISO/IEC 15289.

The 15504-5 PAM considers work products as 'objective guidance for potential inputs and outputs' [3]. Using this more permissive interpretation, we can include the 29110 Work Products as assessment indicators in the VSE PAM. The work products are grouped under processes and the input/output division is obtained through the activities. [11]

Next, an exemplar VSE PAM is described. It includes base practices and work products as assessment indicators.

#### D. Exemplar VSE PAM

We have constructed an exemplar VSE PAM in [11] that corresponds to the Basic Profile defined in 29110-4-1. It is based on the following principles, also depicted in Fig. 3:

- Processes are from 29110-4-1
- Process purposes are from 29110-5-1
- Process outcomes are from 12207 based on the mapping in 29110-4-1
- Base Practices are from 15504-5 and based on the mapping to 12207 outcomes
- Work product input/output lists are based on the 29110-4-1 profile specification

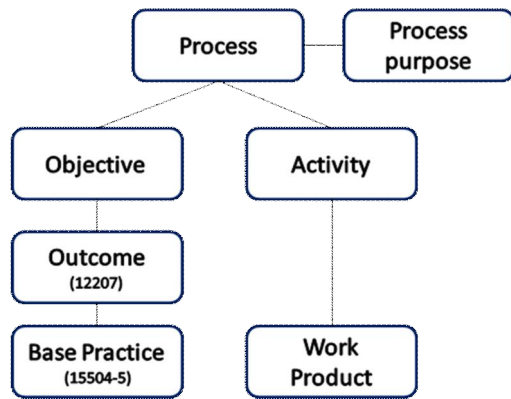


Figure 3. Derived process indicators of VSE PAM. [11]

For instance, to exhibit the VSE PAM, one objective of the Project Management process is:

- PM.O5. Risks are identified as they develop and during the conduct of the project.

This objective is mapped to one outcome of 12207 6.3.4 Risk Management Process: c) risks are identified as they develop and during the conduct of the project; and one outcome of 12207 7.2.6 Software Review Process: e) risks and problems are identified and recorded.

The Base Practices can be associated with the 12207 process outcomes, in this example from two processes. From the 15504-5 we can find the two related base practices:

- PM.O5.BP1: Identify risks. Identify risks to the project both initially within the project strategy and as they develop during the conduct of the project. {Outcome: 6.3.4c}
  - Examples of risks include cost, schedule, effort, resource, and technical risks.
- PM.O5.BP2: Determine actions for review results. Analyze review report; identify and record the

problems; propose resolution(s) for the review results; determine priority for actions. {Outcome: 7.2.6e}

Similarly, we can infer the relevant Base Practices for both of the 29110 processes.

The work products are related to processes. These work products can be used as process performance indicators instead of the 15504-5 Work Products. E.g. the Project Management process output work products are:

- Acceptance Record
- Change Request
- Correction Register
- Meeting Record
- Progress Status Record
- Project Plan
- Project Repository
- Project Repository Backup

The exemplar VSE PAM is composed of the two type of process performance indicators: base practices and work products. This PAM is adequate to be used for process improvement purposes and, with restrictions, determining the capability of the VSE processes. Therefore it is usable as part of the VSE process assessment method.

#### V. A VSE PROCESS ASSESSMENT METHOD

This VSE assessment method combines a 15504-2 compliant assessment process and a VSE PAM that has been derived using the information provided in the 29110 drafts. The method support continuous process improvement where needs analysis is followed by process assessment. Assessment provides the input for actual improvement actions. Follow-up of the effects of the improvements is further input for the needs analysis.

The practical application of the method can be described in steps (Table I). The assessment process sets requirements for the output of the steps, while the assessment model ensures systematic input gathering.

TABLE I. VSE PROCESS ASSESSMENT METHOD STEPS

Input	Step	Output
Management needs	Assessment planning	Assessment purpose, scope, responsibilities
Documentation	Pilot study	Preliminary findings
Participants	Assessment interviews	Findings, improvement ideas
Collected material	Validation	Validated findings
Validated findings	Rating	Process capability, assessment results
Plan, findings, results	Reporting (includes assessment feedback session)	Assessment report, improvement proposals

Assessment planning, interview and feedback sessions are typically face-to-face meetings conducted in the assessed organization. Studying the collected material and process attribute rating are typically conducted by the assessor(s). Data validation might require additional input from the assessed organization, too. The method does not present any

requirements for the assessors' competency, but the general rules in 15504 are applicable.

## VI. DISCUSSION

The presented assessment process and the exemplar VSE PAM compose a process assessment method that can be used in the VSE context. Certain complexity is derived from the 29110 standards as they do not support process assessment sufficiently. Therefore it is uncertain whether the method serves the self-assessment needs of VSEs. On the other hand, neither does the 29110 standard: the future 29110-4-1 standard should include appropriate elements for PRMs.

For experienced SPICE assessors use of this method should be easy because of the similarity to 15504-5. Tools to support the method are under development, and they will further increase the efficiency of the assessment data collection and reporting.

This presented method cannot be used for 29110 conformance assessments. The main reason is that the VSE PAM does not cover the 29110 activities which have been defined as mandatory elements.

The purpose of the 29110 standard is worthy of support. Even the smallest software companies can benefit of the international standards and the power of process improvement. Hopefully future releases of the standard are better integrated to established more solid process assessment models that can also be used in conformance assessments. This would also help in gaining wider support for standard.

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