# ISO/IEC JTC 1 SC 7 Working Group 24

# 10TH ANNIVERSARY

# OVERVIEW OF ACCOMPLISHMENTS

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## Executive Summary

Small and medium-sized enterprises (SMEs) are a very important source of employment and economic growth in the member countries of Organization for Economic Co-operation and Development (OECD). According to OECD, SMEs are the dominant form of business organization, accounting between 95% and 99% of all enterprises (OECD 2011). In Europe, for instance over 92% of enterprises, called micro-enterprises, have up to 9 employees and another 6.5% have between 10 and 49 employees (Moll, 2013).

From the various surveys and studies conducted, it was clear that systems and software engineering life cycle standards, such as ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207, did not address the needs of VSEs. Compliance with those standards was difficult, if not impossible, for them to achieve. Subsequently VSEs had no, or very limited ways to be recognized as entities that produce quality systems or software products in their domain and therefore they were cut off from some economic activities. Implementation of those engineering standards required expertise, cost and time.

In 2005, an ISO Working Group, ISO/IEC JTC 1/SC7 WG 24, has been mandated to rectify some of those difficulties by providing a set of standards and guides, such as management and engineering guides, developed specifically to meet the needs of VSEs. Australia, Belgium, Brazil, Canada, Finland, France, Germany, Ireland, Japan, Spain, the US, and Uruguay as well as many countries that hadn't previously participated in the development of ISO/IEC systems and software engineering standards—including Argentina, Colombia, the Czech Republic, India, Luxembourg, Mexico, Peru, and Thailand—decided to join WG 24.

WG24 took an innovative approach, using standardised profiles, to develop the set of ISO/IEC 29110 standards and guides. WG24 re-used elements of published engineering standards to develop a four-stage road map (Entry, Basic, Intermediate, and Advanced). The profiles are applicable to the vast majority of VSEs that don't develop critical systems or critical software.

ISO/IEC 29110 has been successfully implemented in many VSEs, including start-ups, around the world. Systems and software engineering ISO standards and guides are normally published only in English. The ISO/IEC 29110 management and engineering guides became so popular that they had been translated into Czech, French, German, Portuguese and Spanish. The fact that ISO/IEC 29110 management and engineering guides are easily understandable and freely available from ISO has greatly helped their adoption. Additionally, more than 15 countries are teaching it at the undergraduate and graduate levels.

As more countries are adopting ISO/IEC 29110 as their national standards and, VSEs around the world are using, in their daily development and maintenance activities, and obtaining increasingly formal recognition, we expect a very promising future for the family of standards and guides developed by WG24.

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## 1. Introduction

After 10 years of the establishment of the ISO working group, Working Group 24 (WG24), mandated to develop a set of ISO/IEC 29110 standards and technical reports (e.g. guides) for the benefits of Very Small Entities (VSEs) developing system and/or software, it was felt that it was a good time to present its history and its accomplishments.

This text is divided in 3 sections, in section 2 we present the history of WG24 since the activities in 2004 that led to its establishment in 2005, the activities and document produced by WG24 up to 2015. In section 3, we briefly present ISO/IEC 29110 (ISO 29110 hereon) activities conducted in different countries. In section 4, we present detailed descriptions of ISO 29110 activities in a few countries.

## 2. History of Working Group 24[1]

In this section, we describe the establishment of WG24, its activities as well as the ISO 29110 documents developed.

**May 2004 - Plenary Meeting of ISO/IEC JTC 1/SC7 – Australia**

At the Brisbane meeting of the SC7 in 2004, Canada's representatives raised the issue of small enterprises requiring standards adapted to their size and maturity level. The current software engineering standards target (or are perceived as targeting) large organizations. Australian's delegates supported Canada's representatives' position in this regard, and the two national bodies took action to investigate possible ways forward. A meeting of interested parties was held with delegates from five national bodies (Australia, Canada, the Czech Republic, South Africa and Thailand) at which a consensus was reached on the general objectives:

- To make the current software engineering standards more accessible to VSEs;
- To provide documentation requiring minimal tailoring and adaptation effort;
- To provide harmonized documentation integrating available standards:
    - Process standards
    - Work products and deliverables
    - Assessment and quality
    - Modelling and tools
- To align profiles, if desirable, with the notions of maturity levels presented in ISO/IEC 15504.

It was also decided that a special interest group (SIG) be created to explore these objectives, and to better articulate the priorities and the project plan. The participants felt that it would be possible, during 2004, to draw up:

- A set of requirements;

[1] By Jean Bérubé

- An outline of key deliverables, and the associated processes to create them (e.g. how to create profiles);
- A Terms of Reference document for the working group;
- An example of a simple profile.

**March 2005 - First Special Working Group Meeting – Thailand**

In March 2005, the Thailand Industrial Standards Institute (TISI) and the Thai Software promotion agency (SIPA) invited a Special Working Group (SWG) to advance the work items defined at the Brisbane meeting. The meeting was attended by delegates from the following countries: Australia, Belgium, Canada, the Czech Republic, Finland, South Africa, South Korea, the USA and Thailand.

Canada was instrumental in preparing the meeting, provided meeting management resources, and prepared the meeting report.

A key topic of discussion was to clearly define the size of VSE that would be targeted by the working group. The working group used a paper published by the Centre for Software Process Technologies of Ireland (McFall et al 2003) to help define the size of small organizations. McFall presented the various perceived priorities and areas of concern for different organization sizes.

As illustrated in Figure 1, the priorities and concerns of organizations with fewer than 20 employees are quite different from those of larger organizations. As an example, medium and large organizations rank process adherence higher than do small organizations. For the latter, managing risk is of great concern; while for larger organizations this ranks as priority number 8 only. Conversely, for small organizations, consistency across teams is less of a concern, while for larger organizations it is a top-priority issue.

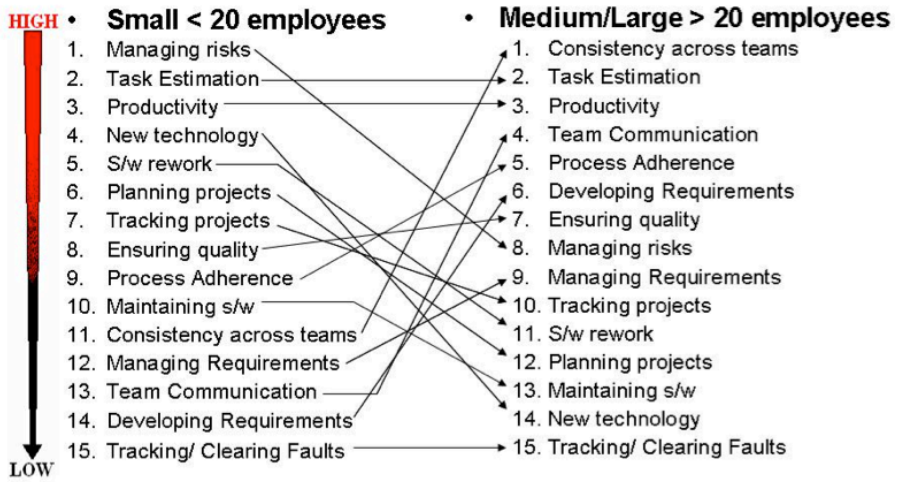


**Figure 1. Priority and concern differences based on size (McFall et al, 2003)**

A consensus was achieved by the members of the SWG on this study and a consensus was reached on defining our target VSE as IT services, organizations and projects with between 1 and 25 employees.

The major output of this one-week meeting was a draft list of New Work Items. A work schedule has also been developed for the new working group. Two streams of work were identified:

- The standard steps for the development and approval of an ISO standard.
- The actions that would need to be performed in parallel, in order to obtain a first committee draft (CD 1) by the end of 2007.

**May 2005 - Plenary Meeting of ISO/IEC JTC 1/SC7 - Finland**

The document developed in Thailand was reviewed during a meeting of one of the WGs at the 2005 SC7 plenary meeting in Helsinki. Canada edited the final NWIP. The document was sent for a letter ballot.

Balloting on this document was open until September 21, 2005. Over twelve countries voted in favour of the New Work Item Proposal (NWIP), and the following countries indicated a commitment to participate in the new working group: Belgium, Canada, the Czech Republic, Ireland, Italy, Japan, Korea, Luxemburg, South Africa, Thailand, the UK and the USA.

As a result of this vote, the Project was approved and the new working group, WG24, was established as follows:

- Mr Tanin Uthayanaka (Thailand) was appointed Convener.
- Mr Claude Y. Laporte (IEEE Computer Society) was appointed Project Editor.
- Mr Jean Bérubé (Canada) was appointed Secretary.

**September 2005 - Second Special Working Group meeting – Thailand**

In July 2005, the Thailand Industrial Standards Institute (TISI) sent out a second invitation to participate in the Special Working Group (SWG) held in September 2005 in Bangkok. The main objective of the meeting was to prepare material that would be presented to WG24 in order to facilitate the start-up of the working group.

Canada was instrumental in preparing the meeting, provided meeting management resources, and prepared the meeting report. The main outputs of the meeting were:

- Proposed requirements for Standard Profiles (SPs) based on Technical Report ISO/IEC TR10000-1;
- A proposed survey on VSE exposure and needs for software development life cycles;
- Proposed approaches to profile development and architecture;
- Proposed business models, that is, how organizations profit from software (Iberle, 2002), such as custom systems written on contract, custom systems written in-house, commercial products (mass-market) and consumer software;

- Proposed agenda for the first WG24 meeting;
- Proposed draft strategic plan for WG24.

**October 2005 - First WG24 Meeting – Italy**

In October 2005, Italy hosted ISO/IEC JTC1 SC7 Interim Meeting 2005. WG24, officially established at the SC7 plenary meeting in Helsinki, held its first working sessions there in order to:

1. Present the project to the official members of WG24;
2. Finalize project requirements to constitute the project baseline;
3. Gain consensus and commitment of WG members regarding the project;
4. Process the NWI comment disposition;
5. Liaise with other related working groups (i.e. WG7 and WG10);
6. Define the profile creation strategy;
7. Define situational factors, i.e. the attributes of a business model, such as the criticality of the software under development, that influence the selection of software practices (Iberle, 2002) and business models;
8. Build survey material in order to validate project requirements and collect missing information for the industry.

Discussion on the material presented in order to start building consensus led to the updating of some input documents and the validation of the project baseline. The New Work Item list was updated in order to take into account relevant comments received during balloting, and the first version of the WG24 requirements were validated and documented by WG24 members (Italy WG24 meeting, October 2005, BAR-005).

Furthermore, some VSE Business Models were identified (i.e. custom on contract, custom in-house, commercial products, mass-market software, firmware), as well as a strategy for creating profiles.

WG24 designed and conducted a survey, in 2006, to collect relevant information from VSEs around the world and to question them about their utilization of ISO/SC7 standards. WG24 also wanted to collect data to identify problems and potential solutions that would help them apply standards and become more competitive. This survey's responses appear in Table 1.

**Table 1. Number of responses per country**

| Country | Number of responses | Country | Number of responses |
|---|---|---|---|
| Argentina | 2 | Italy | 2 |
| Australia | 8 | Japan | 3 |
| Belgium | 10 | South Korea | 4 |
| Brazil | 68 | Mexico | 20 |
| Bulgaria | 3 | New Zealand | 1 |
| Canada | 8 | Peru | 4 |
| Chile | 1 | Russia | 4 |

| | | | |
|---|---|---|---|
| Colombia | 88 | South Africa | 10 |
| Czech Republic | 3 | Spain | 2 |
| Ecuador | 9 | Taiwan | 1 |
| Finland | 13 | Thailand | 52 |
| France | 3 | Turkey | 1 |
| India | 57 | United Kingdom | 2 |
| Ireland | 10 | United States | 3 |

From the beginning, WG24 drew up several working hypotheses regarding VSEs. The survey was intended to validate some of these hypotheses, including the following:

- The VSE context requires light and well-focused life-cycle profiles.
- Particular business contexts require particular profiles.
- There are significant differences in terms of available resources and infrastructure between a VSE employing 1 to 10 people and an IT department of the same size in a larger company.
- VSEs are limited in both time and resources, which leads to a lack of understanding about how they can use standards for their benefit.
- Benefits for VSEs might include recognition through assessment or audit by an accredited body.

WG24 developed and translated into nine languages a Web-based survey questionnaire to obtain responses from the following countries: England, France, Germany, Korea, Portugal, Thailand, Turkey, Russia, and Spain. The 392 respondents included 228 enterprises (58 percent) with 0 to 25 employees.

Since the survey was initiated through WG24 contacts without building a true random sample, the survey results might have been affected. The geographical distribution of answers provided the first observation about the respondent sample: Many responses were from Latin America (46 percent), mainly from Colombia (22 percent) and Brazil (17 percent).

At the same time, there were only a few responses from European countries, Japan, and the US. This might be either because the invitation to participate in the survey was not relayed to VSEs in some countries, or that most VSEs do not care about IT standardization, so only those aware of it or interested in this subject took the time to contribute.

More than 70 percent of VSEs that responded to the study are working on life- or mission-critical systems (40 percent) or in a regulated market (34 percent). This underscores our hypothesis concerning the awareness of the participating companies, as we assume that companies working in these particular contexts are prone to using standards for contractual reasons.

The survey found a marked difference in the percentage of certified companies with regard to company size: less than 18 percent of VSEs are certified, while 53 percent of larger companies (those with more than 25 employees) claim to be certified. Further,

among the 82 percent of VSE not certified only 25 percent claim to use standards. In larger companies using standards, two families of standards and models emerge from the list: ISO standards (55 percent) and models from the Software Engineering Institute (47 percent).

WG24 anticipated the weak use of standards by VSEs by asking questions designed to provide a better understanding of the reasons for this. Three reasons predominated: first, a lack of resources (28 percent); second, that standards are not required (24 percent); and third, the nature of standards themselves—15 percent of the respondents consider that the standards are difficult and bureaucratic and do not provide adequate guidance for use in a small business environment.

A three-quarters majority of VSEs feel it is important to be evaluated or certified against a standard - 40 percent of them request ISO certification. Of the 28 percent requesting official market recognition, only 4 percent are interested in a national certification. From the VSE perspective, the benefits that certification provides include increased competitiveness, greater customer confidence and satisfaction, greater software product quality, increased sponsorship for process improvement, decreased development risk, facilitation of marketing, and higher potential to export.

However, VSEs also express the need for assistance to adopt and implement standards. More than 62 percent would like more guidance with examples, and 55 percent asked for lightweight and easy-to-understand standards, complete with templates. Finally, the respondents indicated that it must be possible to implement standards with minimum cost, time, and resources.

Finally, twelve countries committed to participation in WG24: Belgium, Canada, the Czech Republic, Ireland, Italy, Japan, Korea, Luxemburg, South Africa, Thailand, the UK and the USA.

**May 2006 - Second WG24 Meeting – Thailand**

In the previous meetings, national delegates presented documents for discussion, which the members of WG24 reviewed and discussed. In May 2006, WG24 members met at the ISO/IEC JTC 1/SC7 Plenary meeting in Thailand. Two new countries, India and Mexico, sent delegates to WG24. The three main outputs of the meeting were:

1. Analysis of the survey responses
2. Evaluation of documents tabled by national delegations
3. Selection of the Mexican Standard (NMX-059-NYCE, 2005) as an input document for the development of profiles and guides.

## The WG 24 Approach for the Development of ISO/IEC 29110

WG24 used the concept of ISO standardized profiles (SP) to develop the new standard for VSEs. A profile is defined as "A set of one or more base standards and/or SPs, and, where applicable, the identification of chosen classes, conforming subsets, options and parameters of those base standards, or SPs necessary to accomplish a particular function." From a practical point of view, a profile is a kind of bill of material composed of parts of standards such as ISO/IEC/IEEE 12207 or ISO/IEC 15504.

To develop this new standard for VSE, WG24 followed an overall approach consisting of three steps:

- Target low-capability VSEs,
- Select the ISO/IEC12207 process subset applicable to VSEs of less than 10 employees,
- Tailor the subset to fit VSE needs, and
- Develop guidelines.

WG24 began by looking for existing standards or models that could be tailored to suit VMEs. At the 2006 SC7 Plenary meeting in Thailand two new countries, India and Mexico, sent delegates to WG24.

At that meeting, the group selected MoProsoft, a Mexican standard developed to assist Mexican small and medium enterprises (SMEs), to achieve this objective. MoProsoft uses ISO/IEC 12207 as a general framework. It borrows practices mainly from ISO 9001, the Capability Maturity Model Integration (CMMI®), and the Project Management Body of Knowledge (PMBOK®). The Mexican standard (NMX-059-NYCE, 2005) is divided into four parts: Part 1: Definition of Concepts and Products; Part 2: Process Requirements (MoProSoft); Part 3: Guidelines for Process Implementation; and Part 4: Guidelines for Process Assessment (EvalProSoft).

The first profile contains basic tasks coming from project-management and software-development-related processes. The idea was to concentrate on core activities that a low-capability VSE should perform.

**October 2006 - Third Meeting of WG24 - Luxembourg**

Mexico provided as input the English translation of a Mexican standard that was developed at the request of the Ministry of the Economy. It provides the software industry there with a model based on international practices and on the following characteristics:

- It is easy to understand;
- It is easy to apply;
- Adopting it is economical;
- It provides the basis on which to achieve successful evaluations with other standards or models, such as ISO 9000:2000 or CMMI®.

A few members of WG24 felt that MoProsoft addressed the needs of organizations larger than targeted VSEs. Therefore, as a second step, WG24 decided to tailor MoProsoft to address key characteristics of low-capability VSEs. As a starting point, the tailoring approach led to the development of incremental profile targeting of low-capability VSEs of fewer than 10 employees and, in a second phase, those with 10 to 25 employees.

**2007-2011 - Preparation and publication of the first set of documents**

During that period, the working group prepared the Overview and the Framework document, a Capability Assessment Guide, and for the first profile, the Basic Profile, the Profile Specification and the Management and Engineering Guide.

**November 2010 - Start of the first revision of the Profile Specification**
Given that the first version of the profile specification proved to be difficult to use by auditors in a conformity assessment context, a simplification project was initiated. Canada is a key contributor for the preparation of profile specifications, and the methodology to prepare them.

**June 2011 - Addition of Systems Engineering to the scope of WG24 project**
Following the recommendation of a Study Group, Canada provided a NWIP (which was later approved) to add a new domain, Systems Engineering, to the scope of the project, and produce new profiles specification and new guides.

The objective which establish a common framework for describing assessable system engineering life cycle profiles for VSEs that do not develop critical systems, and associated guidance.

**June 2012 - Addition of Organizational Management to the scope of WG24 project**
Mexico proposed to add a new domain, Organizational Management, to the scope of the project, and produce a new profile specification and a new guide. Organizational Management is defined as:

> *The organizational standard processes (Basic profile) the VSE needs to define, deploy and improve to achieve similar good results in all projects.*

**June 2012 – June 2016 Document Production**
Revision and publication of core documents:

- ISO 29110-1 Ed2 (2016) - Overview
- ISO 29110-2-1 Ed2 (2015) - Framework and Taxonomy
- ISO 29110-3-1 (2015) - Process Assessment Guide

Preparation and publication of additional guides

- ISO 29110-5-6-1 (2015) - Systems Engineering Entry Profile
- ISO 29110-5-6-2 (2014) - Systems Engineering Basic Profile
- ISO 29110-5-2-1 (2016) - Organizational Management Profile Guide

Addition of conformity assessment documents

- ISO 29110-3-2 (2015) - Conformity Certification Scheme
- ISO 29110-3-3 (2015) - Process Assessment Conformity

Addition of support documents

- ISO 29110-2-2 (2016) - Domain Specific Guide
- ISO 29110-3-4 (2015) - Autonomy-based Improvement Method

Translation of Documents:

- ISO French Translations
  - Software Entry and Basic profiles translated by Canada
  - Systems engineering Basic profile translated by France (AFIS)
- National Translations
  - Czech
  - German
  - Japanese
  - Portuguese
- Spanish Translation (in progress)
  - Spanish Translation Task Force (STTF)
  - Translation of Part 1, 2, 3, 4, 5 by Peru/Uruguay

**February 2015 - Addition of Service Delivery to the scope of WG24**
Following the recommendation of a Study Group, Canada provided a NWIP (which was later approved) to add a new domain to VSEs, i.e. Service Delivery, to the scope of WG24. WG24 will produce a new profile specification (29110-4-3) and a new guide (29110-5-3). Service Delivery is defined as:

> *A set of services provided to customers (internal or external) after the system or software development phase. These life cycle processes are generally identified as transition, Operation, Support, and Maintenance.*

## 3. Overview of ISO 29110

There is a wide spectrum of development approaches for organizations developing software and multiple factors influencing the software development process. Figure 2 illustrates the spectrum of approaches on 2 axes. On the horizontal axis, from left to right, is illustrated the level of ceremony, from a low ceremony approach with little documentation (e.g. agile approach) to a high ceremony approach with a comprehensive documentation (e.g. plan driven CMMI® approach). On the vertical axes are illustrated the approaches based on the level of risk. The top axis illustrates a low risk linear approach using a waterfall approach while the lower part of the axis illustrates a risk-driven project using an iterative approach. As illustrated in figure 2, ISO 29110 is located at about the centre of both axes.

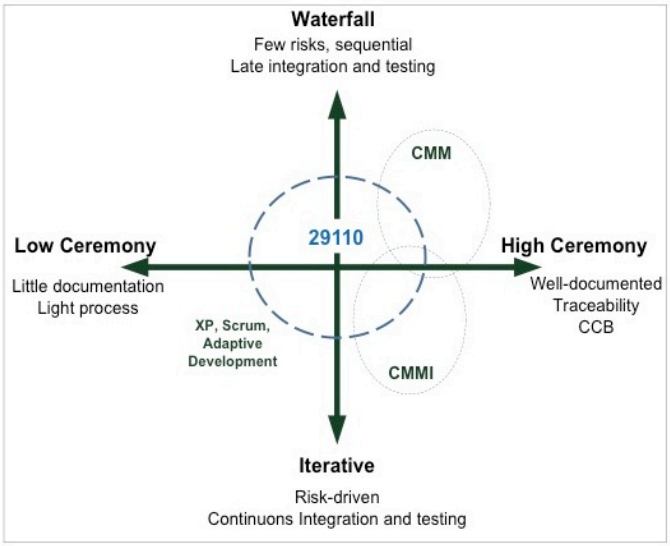


**Figure 2. Positioning of the ISO 29110 (Adapted from Kroll and Kruchten 2003)**

## Profile Groups

Profile Groups are a collection of profiles. The Generic Profile Group has been defined as applicable to a vast majority of VSEs that do not develop critical systems or critical software. This Profile Group is a collection of four profiles (Entry, Basic, Intermediate, Advanced) providing a progressive approach to satisfying a vast majority of VSEs. VSEs targeted by the Entry Profile are VSEs working on small projects (e.g. at most six person-months effort) and for start-up VSEs. The Basic Profile describes software development practices of a single application by a single project team of a VSE. The Intermediate Profile is targeted at VSEs developing multiple projects within the organizational context taking advantage of it. The Advanced Profile is target to VSEs that want to sustain and grow as a competitive software development business. Table 2 illustrates this profile group as a collection of four profiles, providing a progressive approach to satisfying the requirements of a profile group, where each profile graduates and builds upon the tasks and activities of earlier profiles.

**Table 2. Graduated profiles of the Generic profile group**

| Generic Profile Group | | | |
|---|---|---|---|
| Entry | Basic | Intermediate | Advanced |
| | | | |
| | | | |
| | | | |
| | | | |

The approach's third step consisted of defining guidelines explaining in more detail the processes defined in the profile. These guidelines will be published as ISO technical reports and should be freely accessible to VSEs. The guidelines integrate a series of

deployment packages that provide a set of artefacts developed to facilitate and accelerate the implementation of a set of practices for the selected framework in a VSE.

WG24 developed a four-stage roadmap, called profiles (Entry, Basic, Intermediate, Advanced) providing a progressive approach to satisfying a vast majority of VSEs involved in the development of software. VSEs targeted by the Entry Profile are VSEs working on small projects (e.g. at most six person-months effort) and for start-up VSEs. The Basic Profile describes software development practices of a single application by a single project team of a VSE. The Intermediate Profile is targeted at VSEs developing multiple projects within the organizational context taking advantage of it. The Advanced Profile is target to VSEs that want to sustain and grow as a competitive software development business.

The purpose of the Basic Profile is to define Software Implementation and Project Management processes from a subset of ISO/IEC/IEEE 12207 and ISO/IEC/IEEE 15289 appropriate for VSEs. The main reason to include project management is that the core business of VSEs is software development and their financial success depends on successful project completion within schedule and on budget, as well as on making a profit (Clarke and O'Connor, 2011). The high-level view and the relationships between the Software Implementation Process and the Project Management processes are illustrated in Figure 3.

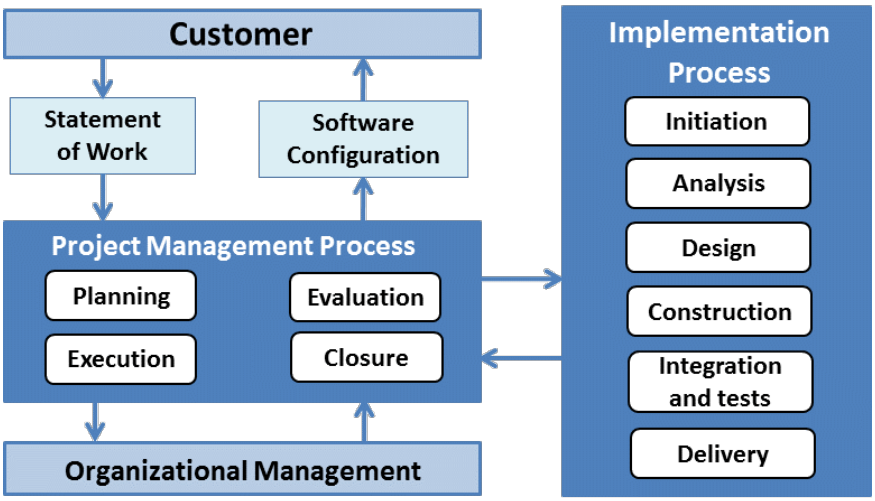


**Figure 3. Software engineering Basic profile processes and activities (Laporte et al. 2014)**

As illustrated in figure 3, the customer's statement of work is used to initiate the PM process. The project plan will be used to guide the execution of the software requirements analysis, software architectural and detailed design, software construction, and software integration and test, and product delivery activities. The PM process closure activity will deliver the Software Configuration (i.e. a set of software products such as documentation, code and tests) and will obtain the customer's acceptance to formalize the end of the project.

For illustration purposes, two tasks of the Project Planning activity are listed in Table 3. On the left side of the table are listed the roles involved in a task. The project manager (PM) and the customer (CUS) are involved in these 2 tasks. The customer is involved, during the execution of the project, when he submits change requests, during project review meetings, for the validation and approval of the requirements specifications and for the acceptance of the deliverables.

**Table 3. Example of 2 tasks of the Project Planning Activity**

| Role | Task list | Inputs | Outputs |
|---|---|---|---|
| PM<br>CUS | PM.1.2 Define with the Customer the *Delivery Instructions* of each one of the *Deliverables* specified in the *Statement of Work.* | *Statement of Work [reviewed]* | *Project Plan*<br>*Delivery Instructions* |
| PM<br>CUS | PM.1.14 Review and accept the *Project Plan.* Customer reviews and accepts the *Project Plan*, making sure that the *Project Plan* elements match with the *Statement of Work.* | *Project Plan [verified]* | *Meeting Record*<br>*Project Plan [accepted]* |

The set of ISO 29110 documents has been translated in Portuguese by Brazil and adopted as a Brazilian national standard. The set of documents has been translated in Spanish by Uruguay and adopted as a national standard. Japan has translated and adopted ISO 29110 as a Japanese national standard. The Management and Engineering guide of the Entry profile has been published in English, in French and in Spanish.

## Deployment Packages

A novel approach was taken to assist VSEs with the deployment of ISO 29110 and to provide guidance on the actual implementation this standard. A set of Deployment Packages (DPs) has been developed to define guidelines and explain in more detail the processes defined in the ISO 29110. The elements of a typical DP are: description of processes, activities, tasks, steps, roles, products, templates, checklists, examples, references and mapping to standards and models, and a list of tools. The mappings show that a deployment package has explicit links to standards, such as ISO/IEC/IEEE 12207, or models, such as the CMMI for Development. By implementing a DP, a VSE can see its concrete step to achieve or demonstrate coverage.

DPs were designed, by the members of WG24, such that a VSE can implement its content, without having to implement the complete ISO 29110 framework, i.e. all the management and engineering activities, at the same time. A set of nine DPs has been developed to date and is freely available[2]. Figure 4 illustrates the set of DPs developed to support the Basic Profile. The set of DPs has been translated in Spanish and was used by students when implementing ISO 29110 in Latin America (Garcia et al. 2015).

[1] ISO/IEC JCT1/SC7 Working Group 24 Deployment Packages repository, available from: http://profs.logti.etsmtl.ca/claporte/English/VSE/index.html

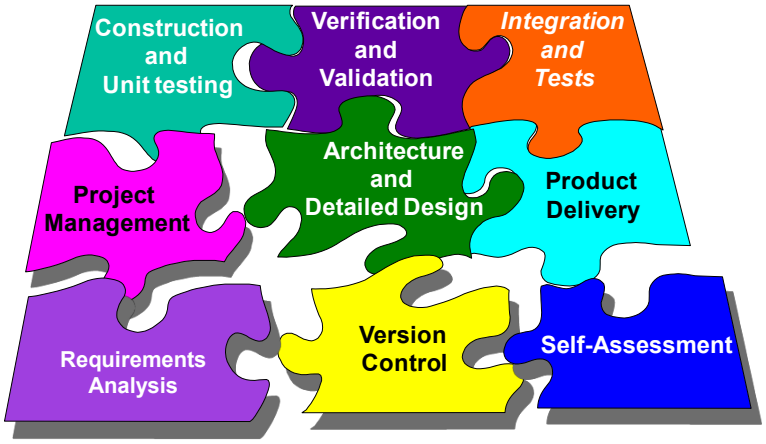


**Figure 4. DPs for Software Basic Profile**

A first commercial software solution using the Deployment Packages has been developed to facilitate the implementation of the Basic profile. The tool, which is based on the well-known Atlassian tool suite, facilitates the role of the project manager and enhances team collaboration. It has the following characteristics:[3]

- Project artefacts are shared in one place;
- Project documentation is managed;
- A project progress dashboard can be generated;
- Integrated with model-based solutions.

## 4. Activities Around the World

ISO 29110 related activities of countries, listed in alphabetical order, are briefly presented.

### Activities in Brazil[4]

Brazil has developed and piloted an ISO 29110 certification process to give VSEs the opportunity to achieve market recognition as producers of quality software products. The Brazilian certification process aims to:

- Operate according to the main principles of conformity assessment using the ISO/IEC 17000 suite of standards, mainly ISO/IEC 17065:2012, Conformity assessment – Requirements for bodies certifying products, processes and services, developed by the ISO Committee on conformity assessment
- Promote international acceptance of the ISO 29110 certification in many countries
- Enable easy and quick implementation by the national body certification schemes established in these countries Brazil's Requirements for conformity assessment programs for VSE's software development life-cycle processes is aimed at certification bodies, accreditation bodies and auditors.

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[3] http://nuumsolutions.com/?location=29110&lang=en

[4] Extracted from: Laporte, C.Y., Séguin, N., Villas Boas, G., *Seizing the benefits of software and systems engineering standards*, ISO Focus+, International Organization for Standardization, February 2013, pp. 32-36.

Brazilian auditors receive 40 hours of training. This approach shows that an ideal ISO 29110 auditor should be competent in auditing techniques, and have expertise in ISO 29110 concepts and experience in software development.

The certification process has been successfully applied during audit training in five VSEs, which plan to request formal certification as soon as it is officially available in early 2013.

Two Brazilian certification bodies have submitted their applications to conduct ISO 29110 audits to Inmetro, the accreditation body in Brazil, which is affiliated with the International Accreditation Forum (IAF). Once these applications are approved, audits can be conducted in any country that has signed the IAF agreement.

## Activities in Belgium

ISO 29110 activities in Belgium are presented in Annex A (in French).

## Activities in Canada

ISO 29110 activities in Canada are presented in Annex B.

An ISO 29110 game titled ISOPOLY©, modelled on the popular Monopoly Game, has been developed. The ISOPOLY© board is illustrated in figure 5. A Peruvian VSE, as described below, has developed an electronic version of the game.


**Figure 5. ISOPOLY© Board Game**

## Activities in Czech Republic[5]

In contrast to such countries like Brazil, Mexico or Thailand where there is a government support aiming at improved process quality in systems and software development in small companies, the Czech Republic lacks such a government support. Moreover, the government does not even require a certain level of these processes e.g. in government contracts. Therefore, activities for promoting the ISO 29110 standard are of high importance.

The ISO 29110 standard has been introduced in university courses at the Prague University of Economics on the undergraduate as well as graduate level. With the assistance of students taking a graduate course, parts of the ISO 29110 have been translated in Czech and made available free of charge. All Deployment Packages have been translated, updated and published on a website[6].

One pilot project focused on implementing the Testing Deployment Package (DP) has been conducted. The pilot project has been conducted in a VSE of 4 employees involved in the development of client-server applications. An evaluation of the Testing DP has also been conducted and documented.

Entry and Basic profiles have been implemented in Czech language in Eclipse Process Framework Composer and are available in the form of web application.

Besides university courses a public course about the ISO 29110 standard was introduced. Since September 2015, promotion activities of ISO 29110 in companies are being performed.

Professor Alena Buchalcevocá, from the Department of Information Technologies, Prague University of Economics, Prague, has published a book chapter titled 'Software Process Improvement in Small Companies as a Path to Enterprise Architecture' (Buchalcevová 2013).

## Activities in Finland

In some domains the plan-driven process models such as waterfall or RUP-based approaches can hardly be used, because the product design or required features cannot be identified or designed comprehensively beforehand (e.g. when a project starts). In these domains the development process often requires a functional prototype, proof-of-concept design or other form of user input to validate the requirements, and it is also expected that the product design and final features will change and mature during the development process.

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[5] By Alena Buchalcevová

[6] Web site (in Czech language): http://spicenter.vse.cz/metodiky/iso-29110/

A Deployment Package (DP), titled 'Highly Iterative Software Process Deployment Package' [7], has been developed to complement the Software Entry Profile. This DP has been developed by Jussi Kasurinen[8] of the Lappeenranta University of Technology (LUT).

This DP is designed to assist these types of VSEs in implementing the following features to principles of the Management and engineering guide of the Entry Profile:

- Design which is not finalized before the implementation.
- Starting the development work with varying amounts of details in the initial design.
- Changes in the product are allowed in any part of the project besides acceptance testing.
- Support for highly iterative approaches to the design-develop-test-cycle.
- Support the design phase with a separate development process that produces the proof-of-concept prototype.
- Divide the main software implementation process to three main phases: predesign (preproduction), development (production) and delivery (post-production).

Figure 6 illustrates the 3 phases of the Highly Iterative Software Process with the added activities.

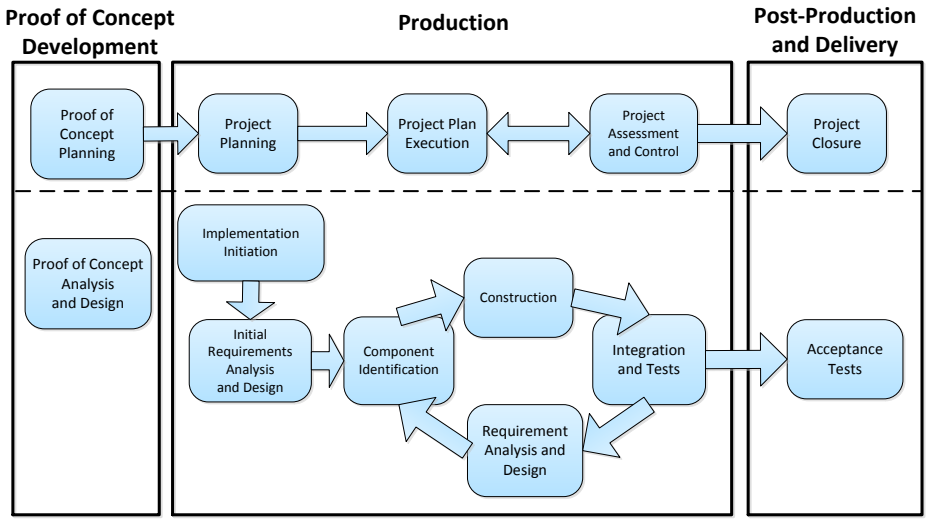


**Figure 6. Project Management and Software Implementation Processes and how they line up during development process (Kasurinen 2015)**

[7] http://profs.etsmtl.ca/claporte/English/VSE/Deploy-Pack/Highly%20Itetrative_DP_V_1_0.docx

[8] jussi.kasurinen@lut.fi

## Activities in France

The French systems engineering association, AFIS (*Association Française d'Ingénierie Système)*[9], has organized conferences and workshops. As an example, the Toulouse chapter organized a presentation about ISO 29110 on October 6th, 2015 and AFIS is collaboration with EMEA (Europe, Middle East, Africa) of INCOSE (International Council on Systems Engineering) organized a 3-day workshop in Paris in October 2015.[10]

AFIS has contributed to the development of the ISO 29110 systems engineering profiles. AFIS has also translated in French the ISO 29110 systems engineering Basic profile guide (ISO 2014).

## Activities in Germany[11]

The German chapter of INCOSE GfSE (Gesellschaft für Systems Engineering e.V.)[12] has sponsored the translation of the systems engineering Basic profile and the German standard organization DIN (Deutsches Institut für Normung)[13] will publish in 2017 the systems engineering Basic profile in its catalogue (DIN 2017).

## Activities in Haiti [14, 15]

A graduate, of the joint graduate software engineering program of Université du Québec and ÉTS, has done his graduate project on the implementation of the Basic profile of ISO 29110 in two VSEs of Haiti. After completing his master degree, he returned to Haiti as a software engineering professor at INUKA (Institut Universitaire Quisqueya-Amérique)[16].

A few webinars have been held between ÉTS and INUKA to present and discuss the set of ISO 29110 standards and technical reports to students of a software quality assurance course of INUKA.

In 2104, over 14 software VSEs of Haiti have been evaluated against ISO 29110 as part of a software quality assurance taught course. Fourteen teams of students made these evaluations. For the summer session of 2014, over 80 students have evaluated the development processes of other VSEs using the ISO 29110 standard. At the centre of research and development in information technology of INUKA, three applications, using the minimum activities of the standard, have been developed using ISO 29110.

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[9] https://www.afis.fr/pages/accueil.aspx

[10] http://www.afisemea2015.irt-systemx.fr/program/

[11] By Martin Geisreiter

[12] http://www.gfse.de

[13] http://www.din.de/en

[14] By Bruel Gerançon

[15] Adapted from: Laporte, C.Y., O'Connor, R., Garcia Paucar, L.H., Gerançon, B., *An Innovative Approach in Developing Standard Professionals by Involving Software Engineering Students in Implementing and Improving International Standards*, International Cooperation for Education about Standardization Conference, August 14th 2014, Ottawa, Canada.

[16] http://www.inuka.edu.ht/

The ISO 29110 has been taught during the winter session of 2015 at INUKA to about 132 undergraduate students in the software quality assurance course taught by Professor Gerançon. In this course, students debated the difficulty of producing quality software, and showed how the using of minimum activities suggested by the ISO 29110 standard can improve the development processes of VSEs in information technology. Hereafter, we presented to the students the project management processes and software implementation of ISO 29110, by explaining the main activities of each of the processes and tasks of each activity. To help students to know well the ISO 29110 standard, and to encourage, motivate and sensitize them to apply the activities of the standard in their professional life, we organized a final exam on the ISO 29110.

Since we have already evaluated almost every Haitian VSEs involved in software development, therefore, there had been no student project interventions in VSEs in 2015.

In addition, from 2014 to 2015, the centre of research and development in information technology of INUKA developed a new software application using the activities and tasks of ISO 29110. This is a mobile and web-oriented application, a broadcast system results allowing students to access their grades online from a mobile phone or computer. Also, the centre of research is developing another application to the university INUKA, in using the project management processes and software implementation of ISO 29110.

According to a survey we conducted among 18 VSEs in Haiti, it was noted that the majority of these organizations have between 2-10 developers[17] (Gerançon 2014).

As an outlook, we planned to organize conferences for current project managers, IT department managers and developers operating in the production of software in Haiti. The Haitian state, with the aim to computerize Haitian public institutions, invests heavily in software projects developed by Haitian companies. Therefore, it is necessary to help these firms to build quality into the software that they develop, teaching them to use the minimum management and engineering activities and tasks described of ISO 29110.

It is true that students can, in the medium or long-term, motivate and help their employers to standardize their software development process. However, if we want VSEs to improve their software development process, it is urgent to organize trainings or conferences for analysts, designers, programmers, project managers and IT department managers working currently in the software development industry.

## Activities in Ireland[18]

Ultimately the goal of educating the next generation of standards professionals to embrace standards initiatives, such as ISO 29110, in an industry setting will be strongly influenced by the attitudes, opinions and sentiment that exist in VSEs. A series of ISO 29110 public industry briefing seminars were conducted in Dublin, Ireland among local

[17] Gerançon, Bruel, Enquête dans les firmes de développement en Haïti, Université INUKA, 2014.

[18] By Rory V. O'Connor

software product VSEs, none of who were currently utilizing ISO standards. Following from this, a detailed qualitative study was conducted in ten software product VSEs, all of which were in start-up phase or recently formed (< 24 months). Participating in this was individuals holding job titles such as founder, Chief Technical Officer (CTO), project manager, or owner or co-owner of the VSE. All of the subjects were educated to graduate level and were aged between 27 and 32 years old. A semi-structured interview approach consisting of both open-ended and specific questions was used in this study in order to discuss the topics in depth and to get respondents' candid discussion on the topic.

In terms of *acceptance of standards* among VSEs, none of the VSEs currently had plans to adopt any particular standard in their software development process. Furthermore, all of the respondents reported that they had never been exposed to ISO standards as part of their formal university education and accordingly felt ill equipped to navigate the domain of international standards and relied mostly on hearsay and/or second hand information regarding standards and the potential applicability in their companies.

The interview data analysis identified several interesting phenomena such as *Low Acceptance* and *Low Priority*. Low acceptance issues were predominately due the perception that process standards are overly complicated, lacking in detailed implementation guidance and would require additional [unavailable] resources. Participants of the interview also believed that the processes, as generally described in software standards, are not easy to actually tailor and implement in their VSEs. In addition, the analysis also indicates that the lack of requirement from the market in general and their customer in particular has contributed to low acceptance of such standards. The interview analysis indicated that a software lifecycle standard is a low priority issue for multiple reasons including: low to no demand for standards compliance from clients; the view of standards as a 'sales tool' only; and the perception that the software lifecycle standards are designed for the big companies rather than for VSEs.

Two related major categories are the level of interest in standards and awareness of standards. These explain VSEs level of interest and awareness regarding software lifecycle standards and ISO 29110 in particular. Even though VSEs have shown low acceptance and priority level regarding standards, our analysis has also shown that there is an indicator that VSEs are interested and are aware about software process and quality standards and the potential benefits from having a quality standard, and in particular ISO accreditation. Leading to a quality product, creating consistency, improving company image, creating consistency in development work, improving work process and 'good for business' are the main points that the interviewees gave about the potential benefits of standards compliance.

The data suggests that a potentially significant way to develop standards professionals is by having professional graduate students involved in the application and improvement of international standards in VSEs. Further we suggest that such initiatives, as described in this paper, may address the negative sentiment expressed above.

## Activities in Japan

Since 2007, Japanese delegates participated to WG24. Japan decided to translate one ISO 29110 standard: Part 2. It has been published in 2013. A Japanese guide to implement ISO 29110 has been published in 2014 by the Japan Information Technology Services Industry Association (JISA), [19]. Figure 7 shows the cover page of the guide.

The Keio University, one of leading university of Japan, has organized the VSE centre to study and deploy ISO/IEC 29110 to the industry[20]. The VSE Centre was established in February 2011 to promote process improvement in system development in VSEs, such as small and medium-sized enterprises (SMEs) and small departments and projects within large enterprises. With the aim of assisting improvement of development sites through industry-academia-government collaboration, it is already producing successful outcomes. The VSE Centre has carried out activities described below with these two aims:

1) To enhance IT companies' financial stability and global competitiveness
2) To establish manufacturing processes, which are one of Japan's strengths, to secure superior global positioning


**Figure 7. A Guide to Implement the VSE Standard**

Motoko Takeuchi won the Best Paper Award at Euro SPI Conference. The paper was titled: Report on an assessment experience based on ISO/IEC 29110[21]. Additional ISO 29110 activities in Japan are presented in Annex C[22].

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[19] JISA (Japan Information Technology Services Industry Association), A Guide to Implement the VSE Standard, IAG Inc (Tokyo), ISBN: 978-4-905161-09-7, 2014.

[20] http://www.sdm.keio.ac.jp/en/

[21] Takeuchi, M., Kohtake, N., Shirasaka, S., Koishi, Y., Shioya, K.: Report on an assessment experience based on ISO/IEC 29110. In: 18th EuroSPI Industrial Proceedings. DELTA, Denmark (2011)

[22] Satoshi Fushimi and Kazunori Shioya, *ISO/IEC 29110 Standard for Very Small Entities and the Japanese Software Industry*

## Activities in Mexico

Mexico has adopted ISO 29110 as one of the Quality Standards that have the recognition of the government and industry. Also, the Mexican government offers support to organizations by paying 25% of the cost of implementation and certification.

Other ISO 29110 activities of Mexico are presented in Annex D.

## Activities in Peru[23]

The ISO 29110 standards and translated in Spanish the set of Deployment Packages developed to support the Basic profile. Figure 8 illustrates the set of DPs translated in Spanish, by the Universitad Peruana de Ciencas Aplicadas (UPC), for the Basic profile.

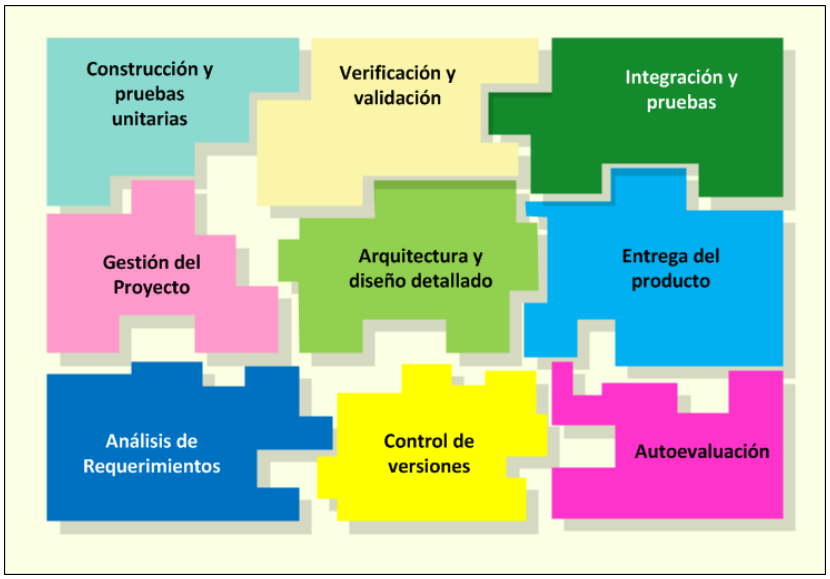


**Figure 8. Set of Deployment Packages translated by students of Peru[24]**

The set of DPs has been used in a Peruvian VSE. Recently, that VSE was granted an ISO 29110 certificate of conformity[25]. Graduate students also developed, as part of the Architecture DP, a procedure to support the analysis, design and documentation of the architecture in VSEs. The requirements DP was also updated, by the Peruvian students, to better define the non-functional requirements (i.e. the quality attributes) of a software product.

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[23] By Luis Hernán García Paucar

[24] http://profs.etsmtl.ca/claporte/English/VSE/indexS.html

[25] Garcia, L., Laporte, C.Y., Arteaga, J., Bruggmann, M., *Implementation and Certification of ISO/IEC 29110 in an IT Startup in Peru*, Software Quality Professional Journal, ASQ, vol. 17, no. 2, 2015.

A case study titled *'Factors driving the adoption of ISO/IEC 29110: a case study of a small software enterprise'* was performed in a Peruvian VSE. Abstract of the paper (Dávila & Pessoa 2015)[26]:

> Peruvian software industry is mainly composed of micro and small enterprises and presents several problems on quality, schedule and costs. Since 2012 government supports the development of innovative software products using standards in order to improve quality. Quality improvement is affected by several factors, some contributing positively and others, negatively. The objective of this study is to identify which factors have influence on the practices adoption. The research method used is unique case study and a survey to collect complementary data. The studied company presented variations in the assessments results and during interviews, six most influential factors were identified. The company improved their software processes with the use of some practices in a project funded by government and lost some practices after that project. The factors that positively influences were: Experience in information technology and Top management support. The negative factors were: Competitive pressure, Perceived usefulness, Perceived ease of use and User training.

A young Peruvian VSE, BITPERFECT Solutions[27], have developed an electronic version of the ISOPOLY© game as illustrated in figure 9 [28].


**Figure 9. An electronic version of the ISOPOLY© game**

[26] Dávila, A., Pessoa, M., *Factors driving the adoption of ISO / IEC 29110: a case study of a small software enterprise,* XLI Latin American Computing Conference (CLEI), Arequipa, Peru, Oct 19-23, 2015. DOI: 10.1109/CLEI.2015.7360042, Available at: http://eventos.spc.org.pe/clei2015/pdfs/144527.pdf
[27] http://bitperfect.pe
[28] https://drive.google.com/folderview?id=0B-azdmmE6QgnOG5yZ0tqMHhIR2s&usp=sharing

Additional ISO 29110 activities in Peru are presented in Annex E.

## Activities in Spain[29]

Tecnalia ICT-European Software Institute division, formerly known as European Software Institute (ESI), is committed with IT process optimization and has been working with organizations of any size[30]. Concerning VSEs in Spain, there is a scarce of initiatives related to IT process improvement. From the ISO 29110 point of view, organizations are still on the awareness raising process of the ISO 29110. Tecnalia has its own approach, which has been applied in several countries including Spain[31]. In order to push forward and to improve VSEs, there is a need to launch improvement programs supported by national, international or regional initiatives. Clusters can help this kind of organizations on their approximation to the improvement path.

## Activities in Thailand

The Software Industry Promotion Agency (Public Organization) (SIPA) and the Federation of Thai Industries (FTI) by Information Technology Club (IT club) have continued co-project relating to software process improvement programs. This is the third year of running project for Collaboration between Government support – SIPA and Representative industries delegate – FTI.

The activities in last 3 years are:

- ISO/IEC 29110 Consulting and Certification program having at least 150 VSEs certified by 2 CBs involved in the project.
- ISO/IEC 15504/33000 Auditor Training for ISO/IEC 29110 Assessment.
- Network collaboration in Thailand between Education sector, Government sector and Private sector to support software development and the use of software products (built by certified VSEs) in various industries.
- Educational Link for Knowledge Transfer and Curriculum Improvement among >10 universities.
- Criteria/regulations driven approach for software development procurement in government sectors, contractor qualification having certified software standard.
- International Network collaboration for ISO/IEC 29110 promotion and training (Myanmar: UMFCCI and Vietnam: HCA).

The results aim to create Competitive Advantage in Digital Economy in Thailand by using Standard as a backbone to develop and create linage criteria for collaboration exchange and investment in AEC (ASEAN Economic Community).

Additional ISO 29110 activities in Thailand are presented in articles in Annex F and G.

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[29] By Xabier Larrucea Uriarte, Xabier and Izaskun Santamaria

[30] http://www.tecnalia.com/images/stories/Catalogos/Catalogo-Servicios-ICT-ESI-EN.pdf

[31] For more information: http://it-mark.eu/wordpress/?page_id=64

## 5. Celebration of the 10th Anniversary of WG 24

At the November 2015 WG24 meeting held in Tokyo, our Japanese hosts, Satoshi Fushimi and Kazunori Shioya, organized on behalf of the VSE Study Group of JISA (Japan Information Technology Services Industry Association), a special event to celebrate the 10th anniversary of WG24.

After the opening session, as illustrated in figure 10, presented by our host, a series of presentations have been done.


**Figure 10. WG24 10th Anniversary Opening Presentation**

The first presentation, by the Project Editor – Claude Y Laporte, was titled 'International Standards and Guides for Very Small Entities - Historical Perspective and a Look Ahead'. It was followed by a presentation of Rory O'Connor from Ireland titled 'Understanding VSE Management Perspective and Sentiment Towards the Adoption of the ISO/IEC 29110 Standard'. Then Gisele of Brazil made a presentation titled 'ISO/IEC 29110 Series - Helping SME in Becoming more Competitive' that was followed by a presentation of Jean Bérubé and Claude Y Laporte from Canada, illustrated in figure 11, titled 'Implementations of ISO/IEC 29110 in Canada'.


**Figure 11. Presentation of Canadian ISO 29110 activities[32]**

Prakit Sangpar from Thailand, made a presentation, as illustrated in figure 12, titled 'Thailand Flagship : ISO 29110 drives Digital Economy'.

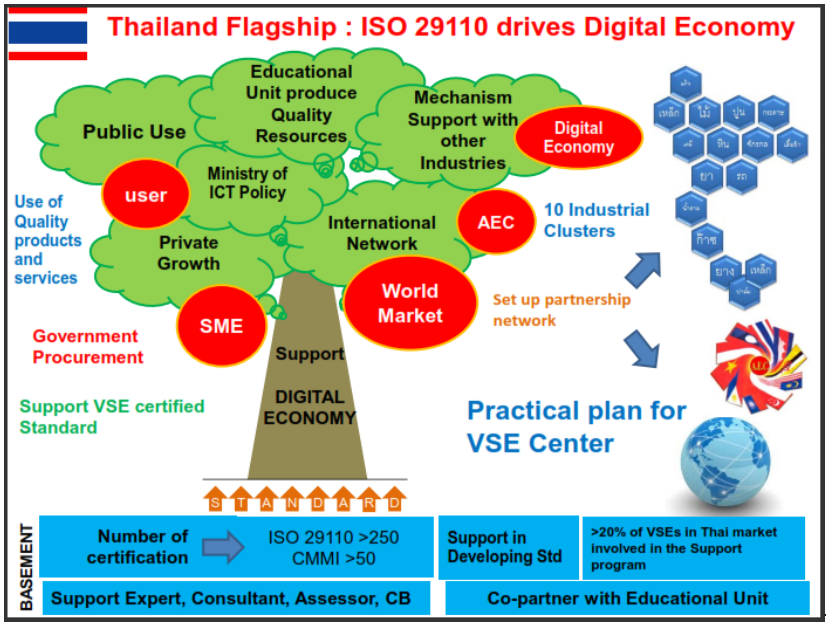


**Figure 12. Roadmap of Thailand to drive industries using ISO 29110**

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[32] Laporte, C.Y., Bérubé, J., Implementations of ISO/IEC 29110 in Canada, Past and Future of Small Software/System Developers, 10th anniversary symposium for the WG24 project, Novembre 13th, 2015, Japan Information Technology Services Industry Association, Tokyo, Japan (Presentation in Japanese), (Presentation in English).

The closing presentation by Satoshi Fushimi and Kazunori Shioya was titled 'ISO/IEC 29110 Standard for Very Small Entities and the Japanese Software Industry'.

## 6. INCOSE VSE Working Group

An INCOSE (International Council on Systems Engineering) Working Group has been established in 2009. The WG has about 150 members.

The mandate of the "SE for VSEs" working group (Systems Engineering for Very Small Entities) is to assist in the application of systems engineering for product development in very small/micro enterprises or small projects.

Systems engineering concepts have been adopted and adapted by most industries in various domains (Aeronautics, Defence, Space, Transportation, Telecom, Information Systems, Bio Medical, etc.) for development of product and services.

In the context of very small and micro enterprises and small projects (VSEs), these concepts can be used or tailored to improve:

- Product development efficiency (including costs and delays)
- Product Quality

The goals of the working group are:

1) To improve and make product development within VSEs more efficient by using Systems Engineering concepts
2) Elaborate tailored guidance for VSMEs to apply, in the context of either a prime or subcontractor role
3) Elaborate tailored guidance to apply to small projects
4) To contribute to standardization in the context of Systems Engineering

At the 2009 INCOSE International Workshop, held in Phoenix USA, the ISO project editor of standards and guides for VSEs developing software, proposed an approach similar to that of WG24: conduct a survey, establish a set of requirements, create profiles (e.g., roadmaps), develop deployment packages to facilitate implementation of the standards and guides, and conduct pilot projects. The members of the working group agreed with this proposition. The initial goals of the working group were as follows:

- Improve product development by using systems engineering methodology;
- Establish tailored practical guidance to apply to VSEs in the context of the prime contractor or subcontractor of commercial products;
- Contribute to standardization.

In November 2011, WG24 met in Ireland to launch the official development of the systems engineering International Standards (ISs) and Technical Reports (TRs) for VSEs. Delegates from Brazil, Canada, France, Japan, Thailand, the United States and INCOSE participated in the first meeting. A first draft of the Basic Profile was sent for a round of review within ISO in January 2012. Seven countries submitted more than 450 comments.

A new version was sent for a second round of review in December 2012, and fewer than 150 comments were submitted. The Basic profile has been published by ISO, as a freely available document, in August 2014.

The ISO 29110 standards and guides for systems engineering has been designed to work hand-in-hand with the ones for software engineering. Figure 13 illustrated the processes and activities of the systems engineering Basic profile.

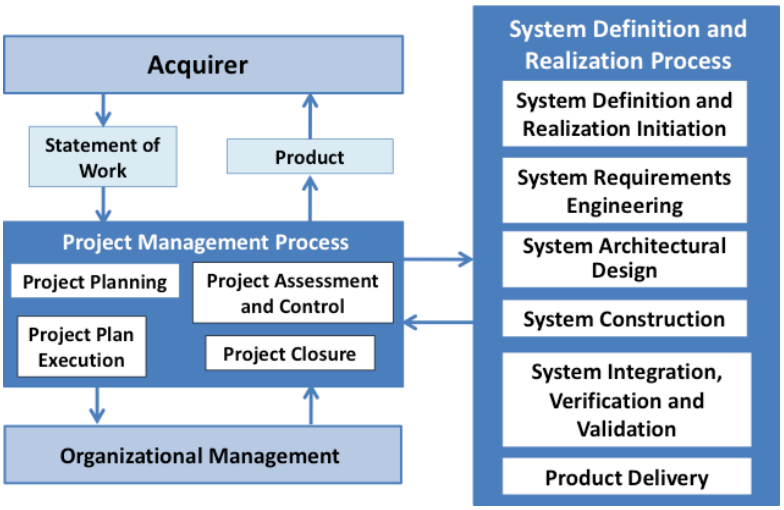


**Figure 13. Processes and activities of the Systems Engineering Basic Profile**

The INCOSE VSE Working Group defined a set of guidelines explaining in more detail the processes defined in the Basic profile. These guidelines are freely accessible to VSEs on the Internet as a collection of Deployment Packages (DPs). A DP is a set of artefacts developed to facilitate the implementation of a set of practices for the selected framework in a VSE. Since the INCOSE handbook is a 'how to' document, it was used to develop the set of DPs. DPs are designed such that a VSE can implement its content without having to implement the complete Basic profile at the same time.

Figure 14 illustrates the set of SE DPs for the Basic profile, which is available on the Internet and on the INCOSE VSE page.

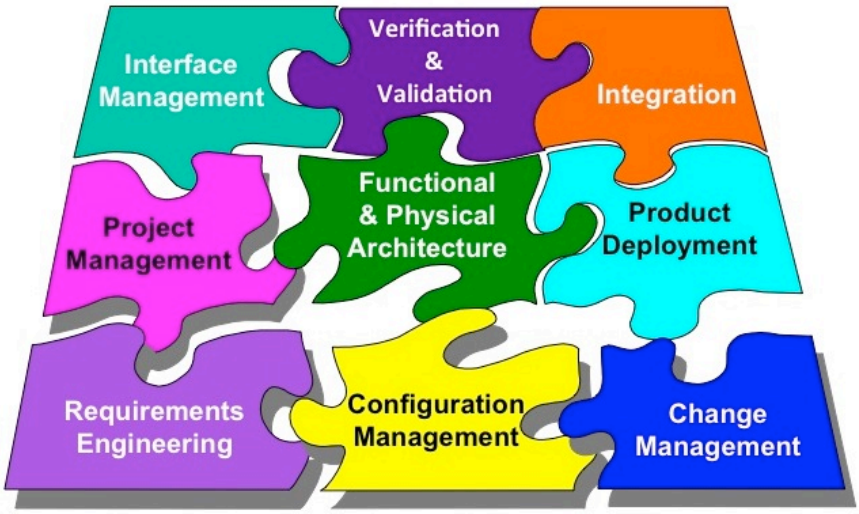


**Figure 14. Deployment Packages for the Systems Engineering Basic profile**

A section about ISO 29110 has been included in the 2015 version of the INCOSE Systems engineering Handbook[33].

## 7. Educational Activities

At the Hyderabad (India) meeting of Working Group 24 in May 2009, it was proposed to establish an informal interest group about education. Its main objective is to develop a set of courses for software undergraduate and graduate students such that students learn about the ISO standards for Very Small Entities (VSEs) before they graduate.

The course modules developed are, for academia, similar to the development packages for VSEs[34]. In this case, the objective is to facilitate the teaching of the new standards by academia by providing them with readily usable course plans, teaching material such as presentation material, exercises, case studies and reading material.

Figure 15 lists the 15 countries teaching ISO 29110 and the undergraduate or graduate level.

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[33] Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities, 4th Edition, ISBN: 978-1-118-99940-0, 304 pages, 2015

[34] http://profs.etsmtl.ca/claporte/English/VSE/VSE-Education.html

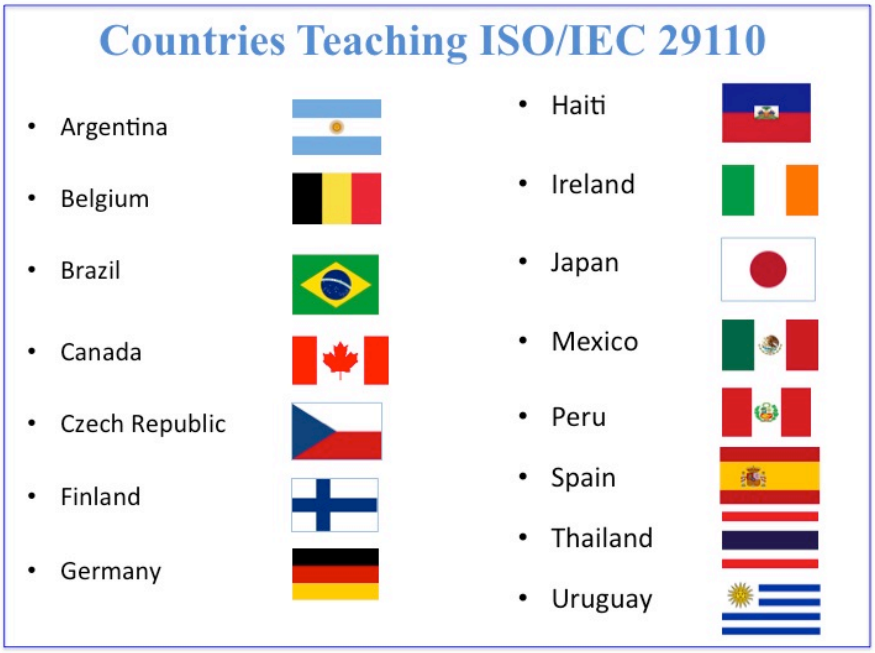


**Figure 15. Countries Teaching ISO 29110**

## 8. Ideas for the Future

Once the mandates of WG24 are completed, e.g. the Entry-Basic–Intermediate-Advanced documents of the systems engineering and software engineering Generic Profile Group are published, WG24 will be in a position to develop additional material to help VSEs and to accelerate the diffusion and implementation of ISO 29110. Examples of future projects are:

1. Combine Management and Engineering Guides
   - all SW Generic Profile Guides in one document
   - all SE Generic Profile Guides in one document
2. Get large organizations to do business with VSEs that have implemented ISO 29110
3. Get large organizations to request ISO 29110 evaluation/audit certification from their suppliers
4. Develop a Guide to help VSEs in obtaining/negotiating with large organizations
5. Get Universities and technical colleges to teach ISO 29110 at the undergraduate and graduate levels
6. Develop ISO 29110 Guides/Profiles for specific domains
   - e.g. medical device developers
7. Develop a Guide, adapted for each SE or SW profile, for VSEs involved in domains where security is important
   - e.g. using ISO 27000 series
8. Develop Alliances with Professional Associations
   - Example of an Alliance/collaboration with INCOSE
     - Member of WG24 since 2005
       - INCOSE VSE WG established in 2009

- ISO 29110 presented at International Workshops, symposia and local chapters
- ISO 29110 Systems engineering set of DPs
- Webinar for INCOSE members – e.g. Nov 18th 2015
- ISO 29110 in Systems Engineering Body of Knowledge
- VSE WG and Healthcare WG alliance
    - e.g. Develop a DP based on the SE Basic Profile, a Guide based on the SE Basic profile, a Profile Specification, a certification

9. Develop Alliances with Professional Associations and Communities
    - 'Broadcast' ISO 29110 to other communities
        - e.g. Eclipse/Polarsys
            - Embedded Word Exhibition and Conference, Germany (February 23-25, 2016)
    - e.g. Agile Events, Chambers of Commerce
    - SPICE and International Registration Scheme for Assessors
    - Project Management Institute (PMI)
10. Develop Workshop Material
    - Example: AFIS/EMEA Workshop conducted in October 2015
        - VSE workshop attended by 30 people
            - Mainly from large organization (e.g. Airbus)
        - Ideas discussed
            - Propose ISO 29110 to subcontractors
            - ISO 29110 can be used as an inspiration for tailoring large corporate processes
    - Develop Case study material (documentation, code, etc.)
        - An example using all Deployment Packages
            - e.g. PolarSys Robot
11. Collaborate with tool developers to enable support for ISO 29110
    - e.g. project management, repository management, requirement management
12. Explore ways to work with Living labs to introduce ISO 29110 in product development.
    - « A living lab is a user-centered, open-innovation ecosystem, often operating in a territorial context (e.g. city, agglomeration, region), integrating concurrent research and innovation processes within a public-private-people partnership. »[35]

## 9. Detailed ISO 29110 Activities in a few Countries

In the following annexes, we present, in alphabetical order, detailed ISO 29110 activities in the following countries: Belgium, Canada, Japan, Mexico, Peru and Thailand.

Annex H presents a summary of the VSE workshop held in Paris in 2015.

[35] https://en.wikipedia.org/wiki/Living_lab

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Basri, S. and O'Connor, R., Organizational Commitment Towards Software Process Improvement An Irish Software VSEs Case Study, 4th International Symposium on Information Technology 2010 (ITSim 2010), Kuala Lumpur, Malaysia, June 2010.

Buchalcevova, A., Software Process Improvement in Small Companies as a Path to Enterprise Architecture. In R. Pooley et al. (eds.), Information Systems Development: Reflections, Challenges and New Directions, Springer Science+Business Media New York 2013 DOI 10.1007/978-1-4614-4951-5_20

Dávila, A., Pessoa, M., Factors driving the adoption of ISO / IEC 29110: a case study of a small software enterprise, XLI Latin American Computing Conference (CLEI), Arequipa, Peru, Oct 19-23, 2015. DOI: 10.1109/CLEI.2015.7360042, Available at: http://eventos.spc.org.pe/clei2015/pdfs/144527.pdf

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# Annex A

## Activities in Belgium

By Annick Majchrowski and Jean-Christophe Deprez

# Déjà 10 ans d'existence pour la norme ISO 29110

**Annick Majchrowski et Jean-Christophe Deprez**
**Centre d'Excellence en Technologies de l'Information et de la Communication (CETIC)[1]**

L'ISO 29110, le guide indispensable au service de nos PMEs wallonnes actives dans le développement logiciel.

Le CETIC, en tant que représentant belge du JTC1-SC7 sur l'ingénierie de système et de logiciel de l'ISO, a participé à l'élaboration de la norme ISO29110, depuis la création du groupe de travail 24 en 2005. Cette norme a été conçue sur mesure pour les petites et moyennes entreprises (PMEs) pour définir leurs processus de développement logiciel et de gestion de projet. Depuis plus de 7 ans, nous exploitons son guide outillé dans le monde industriel en menant des missions d'accompagnement pour évaluer et améliorer les pratiques logicielles des PMEs en Wallonie. Elle se trouve également mise à l'honneur dans de nombreux travaux de recherche. Le CETIC a d'ailleurs mené récemment une enquête sur la maturité des PMEs en se basant sur les processus et les activités de l'ISO 29110 dont les résultats ont été récemment publiés à la conférence EuroAsiaSpi et a obtenu le prix du meilleur papier industriel en 2015.

En participant à la conception de la norme ISO 29110, le CETIC a ainsi pu faire valoir les intérêts spécifiques de nos PMEs wallonnes et favoriser l'intégration du contexte wallon, notamment, en collaboration avec le Canada et l'Irlande, la Belgique a élaborer un niveau d'entrée à la norme 29110 afin de promouvoir les bonnes pratiques liées au développement de logiciel lors de la création de start-up ou spin-off. Fort de son expertise en ingénierie logicielle et de ses missions d'accompagnement, le CETIC connaît bien les enjeux et les défis auxquels les PMEs doivent faire face au quotidien. Bon nombre de PMEs ont déjà compris que pour relever ces défis, elles doivent adopter continuellement une démarche d'amélioration de leur fonctionnement pour être plus efficaces, plus innovantes et plus séduisantes, quel que soit le secteur pour lequel elles travaillent.

Une enquête récente fut menée par le CETIC, l'Infôpole et l'AdN fin 2014 sur la maturité des pratiques logicielles au sein des PMEs wallonnes. Basée sur les processus et activités exigés par le standard ISO 29110, l'enquête a permis de préciser les problèmes les plus souvent rencontrés mais surtout de proposer des actions concrètes pour améliorer les déficiences des PMEs participantes. Les résultats de l'enquête ont été publiés et présentés récemment lors de la conférence EuroAsiaSPI 2015 à Ankara ce 30 septembre et pour lequel le CETIC a reçu le prix du meilleur papier industriel. La présentation des résultats avaient également fait l'objet d'un groupe de discussion mené par le CETIC ce 12 mai dernier.

Outre l'intérêt suscité par le monde de la recherche appliquée sur les résultats publiés de notre enquête, l'intérêt d'utiliser la norme ISO 29110 comme référentiel outillé pour aider les PMEs n'est plus à prouver.

[1] https://www.cetic.be

Même avant la parution officielle de la norme, le CETIC a évalué les pratiques logicielles de diverses PMEs travaillant dans des domaines d'expertise assez variés, tels que le secteur de la santé, la pharmacie, l'IT, le bancaire, etc. Les objectifs des missions d'évaluation furent aussi assez diversifiés tels que la préparation à une prochaine certification, l'adoption d'une rigueur méthodologique dans un contexte agile de développement, la conception d'une documentation structurée et commune ou tout simplement l'amélioration des pratiques existantes.

# Annex B

# Activities in Canada

# By Claude Y Laporte

# Implementation Activities in Canada using ISO/IEC 29110 Systems Engineering and Software Engineering Standards and Guides Developed Specifically for Very Small Entities

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**ISO/IEC 29110 Project Editor**

**Professor – École de technologie supérieure, Canada**

## Abstract

Very small entities, organizations with up to 25 people, are very important to the Canadian economy. However it has been established that such organizations often do not utilize existing best practice standards and frameworks. To address the needs of Very Small Entities (VSEs), a set of international standards and guides, known as ISO/IEC 29110, has been developed. In this paper we describe 9 implementations of ISO 29110 in Canada: in 2 IT start-ups, in a division of a large engineering firm, in an automotive enterprise, in a large IT consulting firm, in a young transportation enterprise, in a medical research organisation, in a large public utility organisation and in a large financial organization. We also present an ISO 29110 board game titled ISOPOLY and the implementation of the ISO/IEC 29110 management and engineering guides in undergraduate and graduate courses in a 10,000-student engineering school, École de technologie supérieure, of Montréal as well as the use of ISO 29110 in educational activities in two technical colleges.

## Keywords

ISO/IEC 29110 • Very Small Entity (VSE) • Canada • Software development • Deployment Package • École de technologie supérieure • ÉTS

# Introduction

In this article, we present what has been done in Canada, mainly in Québec, since the early 1990s to help organizations in producing better, faster and cheaper software products and systems. First, we present the establishment of a software engineering centre as well as the process assessments conducted by the centre. Then we present the application of ISO/IEC 29110 in 9 organizations: in start-ups, in a division of a large engineering firm, in an automotive enterprise, in a large IT enterprise, in a young transportation enterprise, in a VSE of a large financial organization, in a large utility provider and in a medical research organisation. Finally, we present how ISO 29110 has been implemented in the undergraduate and graduate courses at École de technologie supérieure (ÉTS), an engineering school of 10,000 students.

## *Software Process Improvement Activities in Canada in the 1990s*

In the 1990s, a software engineering centre was created in Montréal, the Applied Software Engineering Centre (ASEC). Federal and provincial governments, to serve the needs of all Canadian provinces, established the ASEC. The Software Capability Maturity Model, the CMM® (Paulk 1993), developed by the Software Engineering Institute (SEI) and the Capability Model Integration CMMI® (SEI 2010) were selected by ASEC as the main frameworks for process improvement and assessment of Canadian organizations. Its mission was to provide access to and training in the best software engineering managerial and technical solutions to help the Canadian software community raise its competence in software engineering. The target clients of ASEC comprised companies and agencies that rely on information technology to improve their productivity and the quality of their services and products, and that use complex software for critical applications, especially enterprises in the defence and aerospace sectors. ASEC offered its members four main categories of services: software engineering process assessment, training, awareness of new technologies and interest groups, as well as all relevant support (Laporte 1995).

Since most of Canadian software is developed in small or medium business. It was felt that these organizations could not afford the resources of performing a SEI SPA or CBA/IPI and set aside resources needed to address the findings of the assessment. ASEC, in collaboration with industrial partners developed a risk evaluation method based essentially on the CMM key process areas. The method, called S:PRIME (Software: Process Risk Identification Mapping and Evaluation), identifies areas of priorities and facilitates the development of a focused action plan (Poulin 1997).

Table 1 lists a few Canadian organizations that were actively involved in software process engineering activities. Most assessments were performed, by large organizations, using the SEI's approach.

Table 1. Process Activities in Canada (adapted from Laporte 1995)

| Organization | Sector | Year | Activity[1] |
|---|---|---|---|
| Bombardier - Canadair | Defence | 1991 | SEI - SPA |
| Paramax Systems Canada | Defence | 1991 | SEI - SPA |
| Hydro-Québec | Utility | 1993 | Internal assessment using SEI - CMM |
| Oerlikon Aerospace | Defence | 1993 | SEI – SPA |
| Montréal-Trust | Finance | 1993 | SEI - SPA |
| Hydro-Québec – IREQ (Research Centre) | Utility - (Research) | 1994 | Internal assessment using SEI - CMM |
| CAE Electronics | Energy Management | 1993 | SEI - SPA |
| Bombardier- Canadair | Defence | 1994 | SEI - CBA/IPI |
| Canadian Marconi | Commercial and Defence | 1994 | SEI - CBA/IPI |
| CRIM | Research and Development | 1995 | S:PRIME |
| Hydro-Québec | Utility | 1995 | SPICE Trial |
| IST | Information Systems | 1995 | S:PRIME |
| M3i | Electricity Distribution | 1994 | S:PRIME |
| Oerlikon Aerospace | Defence | 1997 | SEI – CBA-IPI |
| Bombardier Transportation | Transportation | 2001 | SCE SCAMPI (Laporte 2012) |

Unfortunately, since the early 2000s, the use of CMMI in Canada has slowly decreased. Only a few organizations, such as defence and aerospace firms and banking institutions, have pursued their improvement initiatives with the CMMI. The CMMI, even if it was available in French and English at no cost from the SEI, was perceived by many organizations as too demanding and too expensive to implement. Also, many process improvement initiatives failed partially or totally. Between January 2007 and June 2015, only 91 CMMI-DEV assessments have been reported by the CMMI Institute (CMMI 2015).

The S:PRIME method typically takes about 100 person-hours to perform the assessment of an organization, compared to the 1500 person-hours required for a SEI assessment (i.e., assessment team training, on-site assessment, report preparation and presentations). After an assessment, an action plan is prepared to

[1] Legend: Software Engineering Institute (SEI), Software Process Assessment (SPA), CMM Based Assessment - Internal Process Improvement (CBA-IPI), Standard CMMI Appraisal Method for Process Improvement (SCAMPI), Software Capability Evaluation (SCE)

address the risks identified. About 60 S:PRIME assessments have been conducted in Canada (Poulin 2014).

A report by Poulin (Poulin 2014) presented the data collected through 30 assessments conducted in Canadian organizations involved in software engineering and IT. The report indicated that only 60% of the CMM level 2 and 3 key practices plus 2 non-CMM process areas, organizational culture[2] and customer service[3], had been implemented.

A survey of the software development companies was made in 2004 in order to obtain a picture of this industry in the Montréal area. As illustrated in Table 2, it was found that close to 80% of software development companies have fewer than 25 employees. In addition, over 50% has fewer than 10 employees.

Table 2: Size of software development companies in the Montreal area (Gauthier, 2004)

| **Size (Number of employees)** | **Software Companies** | | **Total Number of Jobs** | |
|---|---|---|---|---|
| | Number | % | Number | % |
| 1 to 25 | 540 | 78% | 5,105 | 29% |
| 26 to 100 | 127 | 18% | 6,221 | 36% |
| over 100 | 26 | 4% | 6,056 | 35% |
| **TOTAL** | **693** | **100%** | **17,382** | **100%** |

Since a large percentage of organizations are small, the emphasis on the use of the CMMI framework was gradually reduced to switch to the set of ISO/IEC 29110 standards and guides developed specifically for enterprises, organizations, departments and projects having up to 25 people.

# 4. Experiences with the implementation of ISO 29110 in Canada

In this section we present the implementation of ISO/IEC 29110 (ISO 29110 hereon) in three start-ups, in a division of a large engineering firm, in an automotive enterprise, in a young transportation enterprise and in a VSE of a large financial organization.

[2] The purpose of this area consists in establishing a set of collective values that will evolve with time and that may be harnessed to sustain changes introduced in the project or in the organization.

[3] The purpose of this area consists in providing quality products and services to the customers and end-users in the course of the development and maintenance effort, along with the support they need to operate the delivered system.

## *4.1 Implementation in an IT start-up of 2 developers*

An implementation project has been conducted in an IT start-up VSE by a team of two (part-time) developers (Laporte et al., 2014c)[4]. Their web application allows users to collaborate, share and plan their trips simply and accessible to all. The use of the Basic profile of ISO 29110 has guided the start-up to develop an application of high quality while using proven practices of ISO 29110. The total effort of this project was nearly 1000 hours. The two members of the team were assigned roles and activities of ISO 29110.

During the software development, a traceability matrix was developed between the software requirements, defined in the requirements specification document, and the software components. Since, in most projects requirements, defined in the requirements activity, are never finalized at the end of this activity, a traceability matrix is very useful. One advantage of such a matrix is the possibility of rapidly identifying the impacted software components when modifications, additions, deletions, of software requirements are done during a project.

Verification tasks, such as peer reviews, were performed on documents such as the requirement specifications and the architecture. The team used the desk-check to review their documents that is inexpensive and easy to implement in any organization and can be used to detect anomalies, omissions, improve a document or present and discuss alternative solutions.

As defined in ISO 29110, the software integration and tests activity ensures that the integrated Software Components satisfy the software requirements. This activity provides (ISO 2011c):

- Work team review of the project plan to determine task assignment.
- Understanding of test cases and procedures and the integration environment.
- Integrated software components, corrected defects and documented results.
- Traceability of requirements and design to the integrated software product.
- Documented and verified operational and software user documentation.
- Verified software baseline.

To manage the defects detected, a tracking tool was used. Such software allowed the team to do an inventory of problems found during the integration and testing activity, to track problems and to classify them, and to determine a priority for each defect found. In this project, the open source Bugzilla software tool had been used to manage the defects.

The test report presents the results of tests carried out using the test plan. These results are used to illustrate the number of problems found and the progress of the resolution of anomalies. The test plan includes 112 cases which have been successfully completed with the exception test cases connected to one type of defect:

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[4] Laporte, C.Y., Hébert, C., Mineau, C., *Development of a Social Network Website Using the New ISO/IEC 29110 Standard Developed Specifically for Very Small Entities*, Software Quality Professional Journal, ASQ, vol. 16, no. 4.

the validation of the date format when manually entered by a user. Since this defect was classified as "minor", it was decided not to correct their instances during the first cycle of development. Table 3 illustrates the percentage of defects detected during the execution of the tests for each category of defects.

Table 3: Number and types of defects detected through testing and corrected (Laporte et al. 2014c)

| Seriousness | No. of defects detected | No. of defects corrected | % of defects corrected |
|---|---|---|---|
| Blocker | 3 | 3 | 100% |
| Critical | 22 | 22 | 100% |
| Major | 11 | 11 | 100% |
| Normal | 12 | 12 | 100% |
| Minor | 19 | 6 | 32% |

The defects classified by severity using the following defect classification:

- Blocker: prevents function from being used, no work-around, blocking progress on multiple fronts
- Critical: prevents function from being used, no work-around
- Major: prevents function from being used, but a work-around is possible
- Normal: a problem making a function difficult to use but no special work-around is required
- Minor: a problem not affecting the actual function, but the behaviour is not natural

The members of the start-up have recorded the effort, in person-hours, spent on tasks of the project to the nearest 30 minutes. Table 4 shows, for each major task, the effort to execute the task, the effort required to review a document, such as the software specification document, in order to detect errors and, the effort required to correct the errors (i.e. the rework). As an example, for the development of the software architecture document, it took 42.5 hours to develop, an additional 1.5-hour to conduct a review and an additional 3.5 hours to correct the errors.

As illustrated in table 4 for this start-up project, about 8.9% (i.e. 89 hours/990.5 hours) of the total project effort has been spent in prevention tasks such as the installation of the server, the workstations and the software tools; and only 12.6% has been spent on rework (i.e. 125 hours/990.5 hours). This indicates that the use of appropriate standards, in this case for a start-up company, can guide all the phases of the development of a product such that the wasted effort (i.e. rework) is about the same as a more mature organization (i.e. about level 3 of CMM).

In most start-ups, the wasted effort, for a project similar to this one, would have added about 90 hours (i.e. 30% of 716 or 215 hours – 125 hours). This also implies that for a net effort of about 6 hours per member per day (if we subtract from an 8-hour day interruptions (e.g. phone call), answering emails, discussions in corridors, etc.), the product would have been ready for delivery to a customer about 15 days, of 6 hours, later than with a project with only 12.6% of waste.

Table 4: Effort to execute, detect and correct errors by the 2-member team (Laporte et al. 2014c)

| Title of task | Prevention (hours) | Execution (Hours) | Review (Hours) | Rework (Hours) |
|---|---|---|---|---|
| Environment installation | 89 | | | |
| Project plan development | | 35 | 3 | 4 |
| Project plan execution and project assessment & control | | 47 | | |
| Specification & prototype development | | 199.5 | 7 | 18 |
| Architecture development | | 42.5 | 1.5 | 3.5 |
| Test plan development | | 12.5 | 1 | 2 |
| Code development and testing | | 361 | 47 | 96.5 |
| Develop user guide & maintenance document | | 8 | 1 | 1 |
| Web site deployment | | 8.5 | | |
| Project closure | | 2 | | |
| **Total (Hours)** | **89** | **716** | **60.5** | **125** |

These two projects have demonstrated that, by using ISO 29110, it was possible to properly plan the project and develop the software product using proven software practices documented in standards as well as not interfering with the creativity during the development of their web site.

## *4.2 Development and Deployment of project management processes in an engineering firm*

The Transmission & Distribution of electricity division, of about 400 employees, of a large American engineering firm has implemented a program to define and implement project management processes for their small-scale and medium-scale projects[5]. The firm already had a robust and proven process to manage their large-scale projects. Their projects are classified into three categories as illustrated in Table 5.

Table 5: Classification of projects by the engineering firm (Laporte & Chevalier, 2015)

| | Small project | Medium project | Large project |
|---|---|---|---|
| **Duration** | < 2 months | > 2 and < 8 months | > 8 months |
| **Team size** | <= 4 people | 4-8 people | > 8 people |
| **No. of engineering specialties** | 1 | >1 | Many |
| **Engineering fees** | $5,000 - $70,000 | $50,000 - $350,000 | > $350,000 |
| **Percentage of projects** | 70% | 25% | 5% |

As illustrated in Table 5, over 95% of the projects of this division fall in the small- and medium-scale categories.

[5] Laporte, C.Y., Chevalier, F., *An Innovative Approach to the Development of Project Management Processes for Small-scale Projects in a large Engineering Company*, 25th Annual International Symposium of INCOSE (International Council on Systems Engineering), Seattle, US, July 13-16, 2015.

The goal-problem approach (Potter, 2002) was used to set the improvement program's priorities and to ensure that the goals set by the program addressed tangible problems that the company hoped to solve. This approach includes the following steps:

- Determine the business goals (see table 6) and the problems that the company hopes to solve
- Group goals and problems
- Prioritize problems
- Develop and implement an action plan

Table 6. Division's business goals

| Objective Identification | Description |
|---|---|
| O-1 | Facilitate the integration of new project managers. |
| O-2 | Achieve a global customer satisfaction level of 80 %. |
| O-3 | Meet the deadlines and costs planned for the projects, within a margin of 5 %. |
| O-4 | Reduce resources overload by 10 %. |
| O-5 | Reduce time delays to one week and cost overruns to 5 % of the initial budget. |
| O-6 | Reduce corrective work during the quality control phase by 10 %. |
| O-7 | Reduce non-chargeable time for resources by 10 %. |

Sponsors of this project evaluated 5 frameworks (i.e. CMMI-DEV, CMMI-SVC, PMBOK®, PRINCE2, ISO 29110) using the weighted selection criteria. Table 7 illustrates the evaluation of the frameworks selected. The final score for each framework is obtained by multiplying each individual score by the weight of each criterion and the by adding the individual scores. As illustrated in table 7, the PMBOK® Guide and the ISO 29110 obtained the highest overall score.

Table 7. Evaluation of the frameworks selected

| | Evaluation criteria | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Adapted for the management of small projects | | Known to the management of the organization | | Recognized by the company's customers | | Tools to facilitate the use of standards are available | |
| Framework | Weight assigned to each criteria | Evaluation of framework using criteria | Weight assigned to each criteria | Evaluation of framework using criteria | Weight assigned to each criteria | Evaluation of framework using criteria | Weight assigned to each criteria | Evaluation of framework using criteria |
| CMMI-DEV, version 1.3 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 2 |
| CMMI-SVC, version 1.3 | 3 | 1 | 2 | 0 | 2 | 0 | 2 | 2 |
| PMBOK Guide (PMI) | 3 | 1 | 2 | 3 | 2 | 3 | 2 | 2 |
| PRINCE2 2009 Edition | 3 | 1 | 2 | 0 | 2 | 0 | 2 | 2 |
| ISO/IEC 29110 | 3 | 3 | 2 | 0 | 2 | 0 | 2 | 3 |

| | Evaluation criteria | | | | | | |
|---|---|---|---|---|---|---|---|
| | Ease of integration with existing organizational processes | | Accreditation/Certification available | | Ease of access to documents | | |
| Framework | Weight assigned to each criteria | Evaluation of framework using criteria | Weight assigned to each criteria | Evaluation of framework using criteria | Weight assigned to each criteria | Evaluation of framework using criteria | Total Score |
| CMMI-DEV, version 1.3 | 3 | 1 | 1 | 3 | 1 | 3 | **18** |
| CMMI-SVC, version 1.3 | 3 | 1 | 1 | 3 | 1 | 3 | **16** |
| PMBOK Guide (PMI) | 3 | 3 | 1 | 0 | 1 | 3 | **31** |
| PRINCE2 2009 Edition | 3 | 1 | 1 | 2 | 1 | 1 | **13** |
| ISO/IEC 29110 | 3 | 3 | 1 | 2 | 1 | 3 | **29** |

The PMBOK® was selected to complement the project management process of large projects while the ISO 29110 Entry profile was selected to document the small-scale project management process and the Basic profile was selected for the medium-scale project management process.

Then, the project management practices used by the engineering division's project managers were assessed against the ISO 29110 Entry and Basic profiles by interviewing project managers.

Figure 1 shows the overall results of the assessment of the activities of the PM process of the Basic profile. The figure displays the percentage of the tasks performed for each of the following activities of the ISO 29110 management and engineering guide (ISO 2011):

- Project planning (15 tasks)
- Project plan execution (6 tasks)
- Project assessment and control (3 tasks)
- Project closure (2 tasks)

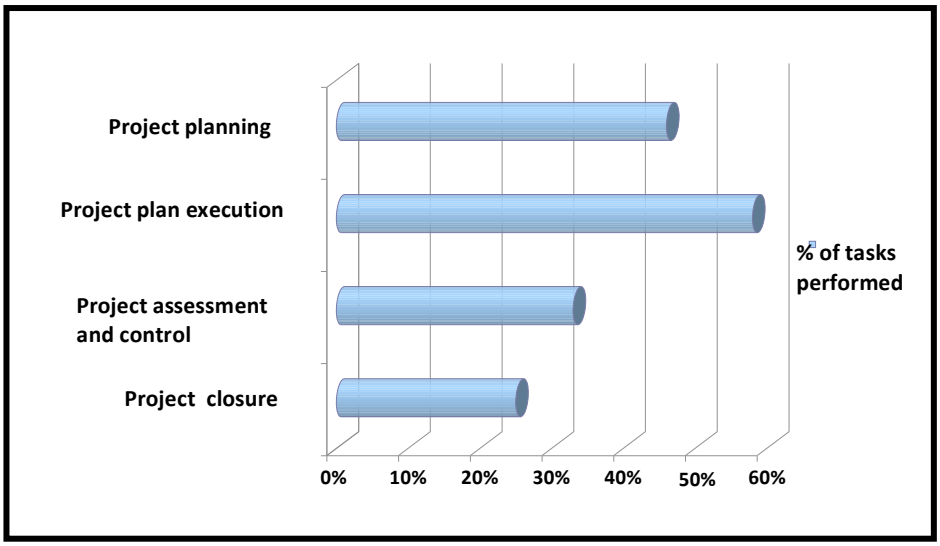


Figure 1. Performance assessment of the Basic Profile of ISO 29110

We note that a low level of the implementation of ISO 29110 activities was achieved, for medium-scale projects, within the engineering company at the beginning of the improvement program. Also, during the interview with managers, it was noted the PM tasks were not performed systematically. In addition, the assessment revealed that PM practices varied from project manager to project manager and that no guideline had been defined for a few tasks. A similar assessment, against the Entry profile, was also carried out for the small-scale projects.

An ISO methodology was used to estimate the anticipated costs and benefits over a period of three years. The improvement program project sponsors made an estimate of anticipated costs and benefits over a period of three years. Table 8 shows the results for the first three years of this cost/benefit estimation.

Table 8. Costs (in $CAD) and benefits estimations from implementing ISO 29110 (Laporte & Chevalier, 2016)[6]

| | Year 1 | Year 2 | Year 3 | Total |
|---|---|---|---|---|
| Cost to implement & maintain | 59,600 | 50 100 | 50,100 | 159,800 |
| Net benefits | 255,500 | 265,000 | 265,000 | 785,500 |

Since the utilization of ISO 29110 was very successful in the development of their project management processes, the recently published systems engineering ISO 29110 Entry and Basic profiles (ISO 2014, ISO 2015) will be used to redefine and improve the existing engineering process. This process will address the activities required from engineering requirements identification to final product delivery. Figure 2 illustrates the Poster developed.

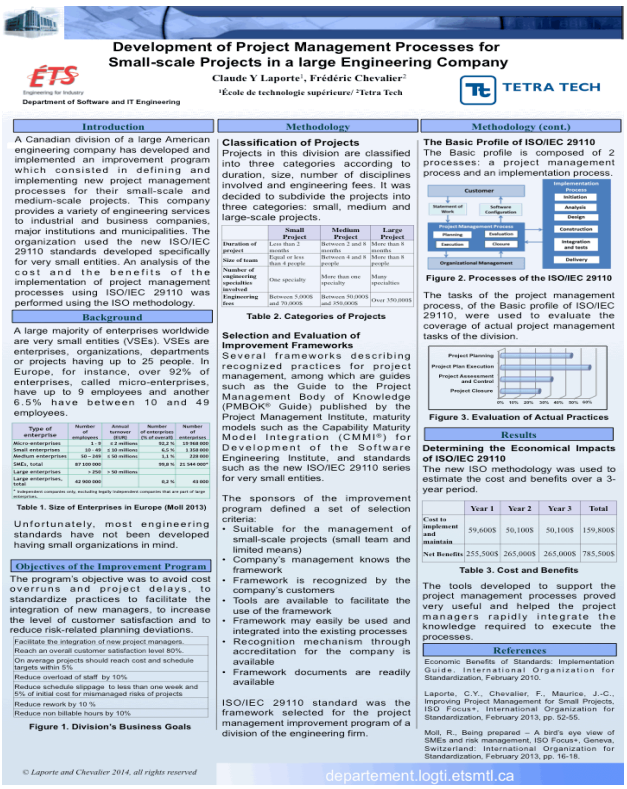


Figure 2. Poster developed about the industrial implementation in an engineering firm (Laporte and Chevalier, 2015[7])

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[6] Laporte, C. Y., Chevalier, F. (2016). An Innovative Approach to the Development of Project Management Processes for Small-Scale Projects in a Large Engineering Company. In K. Jakobs (Ed.), *Effective Standardization Management in Corporate Settings* (pp. 123-160). Hershey, PA: Business Science Reference. (Copyright 2016, IGI Global, www.igi-global.com. Posted by permission of the publisher.)

## 4.3 Implementation in a Canadian/Tunisian IT Start-up

Metam is a company founded in 2013 by a software engineering graduate student of ÉTS (Jeljeli 2016). The company has one site in Canada and one site in Tunisia. Its business domains are software development services, web solutions, mobile applications as well as consulting services to implement ERP solutions. The Basic profile of ISO 29110 was used as the framework for the company's software processes. It was also used as a foundation to implement CMMI® DEV level 2 practices because it was requested by some military contracts of Metam. In 2016, the VSE had 20 employees.

## 4.4 Implementation in a Large IT Consulting Firm

A business division of a large consulting firm of about 1,000 employees with 7 offices in Canada and one office in France implemented the Basic profile. The company specializes in the design, implementation, integration, and support of management and accounting solutions, and in the development of e-business operations. Once a decision has been made to implement the Basic profile in a division, an informal assessment of the practices in used against the Basic profile was performed. Figure 3 illustrates the score of the project management process.

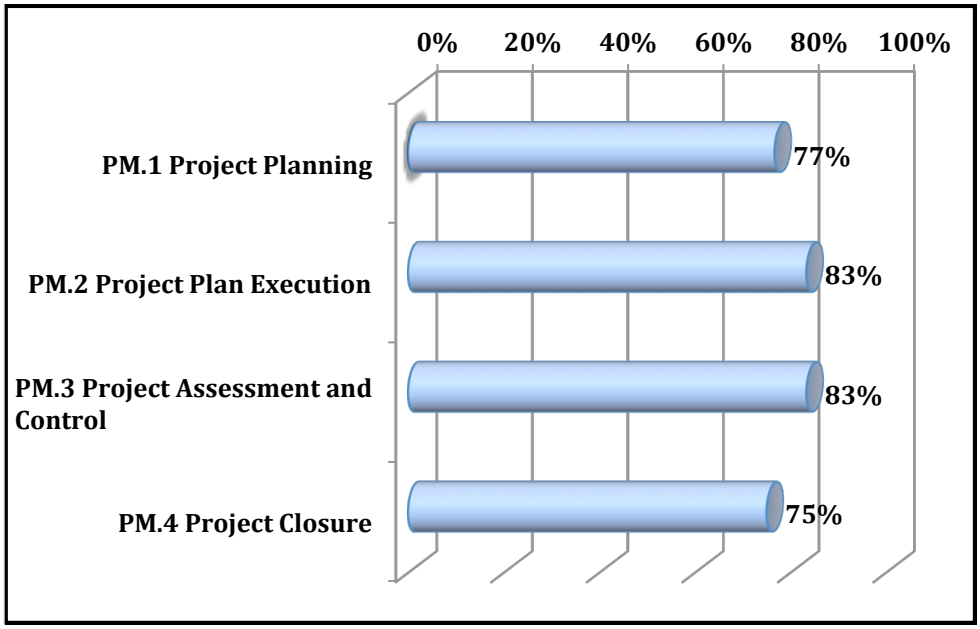


Figure 3. Evaluation of the Project Management Tasks of the large organisation (Translated from Jeljeli 2015)

The project management process, as illustrated in figure 2, was quite acceptable to management. Figure 4 illustrates the score for the software implementation process. This process was not judged acceptable to management.

[7] http://profs.etsmtl.ca/claporte/English/VSE/BPR_Poster.gif

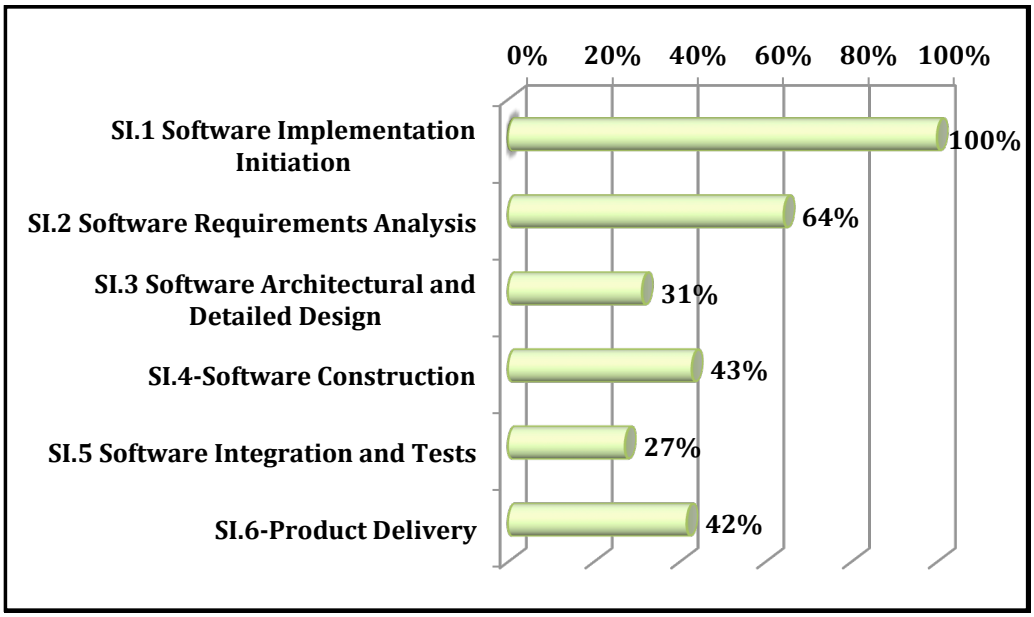


Figure 4. Evaluation of the Software Implementation Tasks of the large organisation (Translated from Jeljeli 2015)

The division decided to focus its efforts in the software implementation process the Basic profile of ISO 29110. On a part-time basis, a few employees developed and implemented a series of templates and tools using mainly Jira and Sharepoint. It took about 180 hours of effort, on a part-time basis, over a period of 8 months to develop and deploy the updated processes. The new tasks have been implemented gradually over a period of 3 months. Since January 2015, all employees of the division must use the updated processes. The division is also looking to obtain an ISO 29110 certification.

## *4.5 Implementation of Systems and Software Engineering processes in a Transportation Enterprise*[8]

A project was created to define and implement project management and systems engineering processes at CSinTrans Inc. (CSiT)[9], a Canadian company, established in 2011[10]. The company specializes in the integration of interactive systems, communication and security in the field of public transport such as trains, subways and buses and railway stations, and stations bus stops. Some customers in this domain are requiring from their suppliers to be assessed at CMMI® Level 2. Implementing the practices of CMMI® Level 2 was too demanding for a start-up.

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[8] Tremblay, N., Menaceur, J., Poliquin, D., Laporte, C.Y., Mise en place de processus de gestion de projets et d'ingénierie système chez CSiT, une entreprise canadienne dans le domaine du transport collectif, Revue Génie Logiciel, Numéro 114, Septembre 2015, pp 11- 27.

[9] http://csit.co

[10] Laporte, C.Y., Tremblay, N., Menaceur, J., Poliquin, D., Houde, R., Developing and implementing systems engineering and project management processes at CSIT - A small Canadian company in public transportation. Submitted to: 26th Annual International Symposium of INCOSE (International Council on Systems Engineering), Edinburgh, UK, July 16-21, 2016.

Instead, ISO 29110 standards and guides for systems engineering have been used as the main reference for the development of the processes of CSiT.

To avoid additional process and produce too many documents, participants gave themselves the 2 sets of guidelines:

- Regarding processes, the guideline was to add tasks not described in the Basic profile only if they add value to the context and projects of the company or provided an alignment with CMMI level 2.
- For the document templates, the guidelines were:
  - Group different documents into one where this is possible;
  - Each section of a template must be relevant and applicable. If a section does not provide added value, it is not included.

The standard has helped raise the maturity of this young organization by implementing proven practices and developing uniform work products. ISO 29110 was a good starting point to align processes with selected level 2 and 3 practices of the CMMI® model. Compliance with the ISO standard allowed CSiT to be recognized as producing quality products. ISO 29110 has also helped in developing lightweight processes allowing the small company to remain flexible as well as its ability to react quickly to its customers. CSiT performed an external audit of the management and engineering processes, mainly based on ISO 29110.

It was decided to develop three process groups (light, standard, full), each adapted to meet the needs of a specific project such as the size of a project. Table 9 shows the three process groups and the frameworks to be used as requirements.

Table 9. Classification of CSiT processes

| | **Light Process** | **Standard Process** | **Full Process** |
|---|---|---|---|
| **Type of Project** | Proof of Concept, Prototype<br><br>Product Testing or Product Deployment at Customer Site<br><br>Small Project | Typical Project<br><br>Product Deployment at Customer Site<br><br>Medium Project | Project when CMMI level 2 is required by a Customer<br><br>Product Testing or Product Deployment at Customer Site<br><br>Large Project |
| **Framework to be used** | ISO/IEC TR 29110-5-6-1 (Entry Profile)<br>+<br>CMMI - Supplier Agreement Management | ISO/IEC TR 29110-5-6-2 (Basic Profile)<br>+<br>CMMI - Supplier Agreement Management | CMMI (Level 2) |

The Entry profile is the main framework for the light process, the Basic profile for the standard process and the CMM-DEV for the full process.

In 2012, CSiT was composed of 4 people; in 2016 there are 10 people.

### *4.6 Implementation of Agile Processes Based in a Large Financial Institution*

The Cash Management IT department, of a large Canadian financial institution, is responsible for the development and maintenance of software tools used by traders. The software team is composed of 6 people. Each year, the division is faced with an increase in the numbers of requests to add, correct or modify features related to supported applications. Before the implementation of the ISO 29110-agile process, customers had the following complaints:

- Very difficult to know the status of specific requests
- Very often, there is an incident when a change is put in production.
- There is a large number of faults detected by the quality assurance department
- The development process is painful and the documentation produced is not very useful.

In response to this problem, we evaluated our process by comparing the activities of the maintenance process to those of the Basic profile of the ISO 29110. Some shortcomings were found in the project management process and in the software implementation process. Figure 5 illustrates the coverage of the project management tasks to the Basic profile.

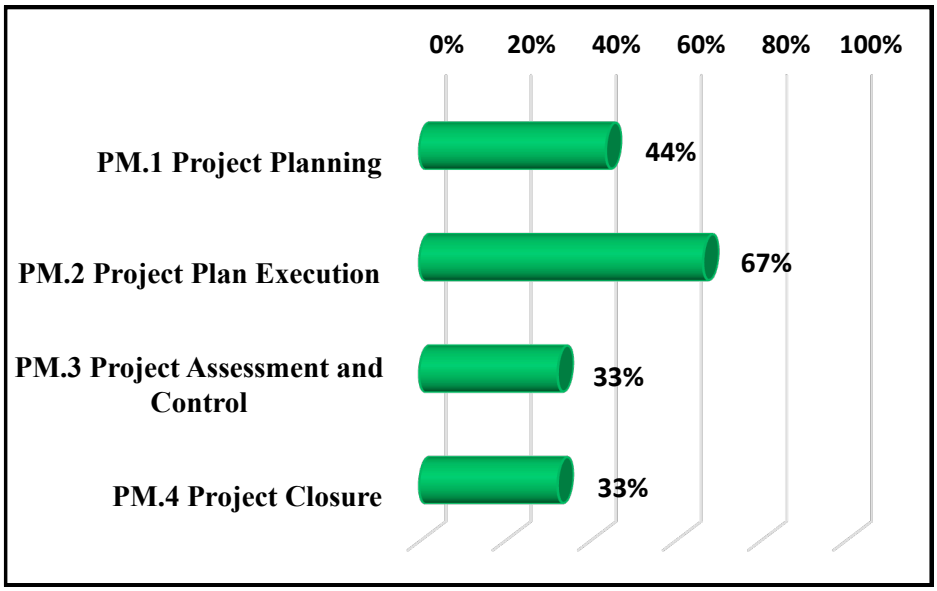



Figure 5. Coverage of initial project management tasks to the Basic profile (Translated from Plante 2015)

As illustrated in figure 6, the coverage of the PM activities by the maintenance process, beside the project plan execution activity, was quite low. Figure 5 illustrates the coverage of the software implementation tasks to the Basic profile.

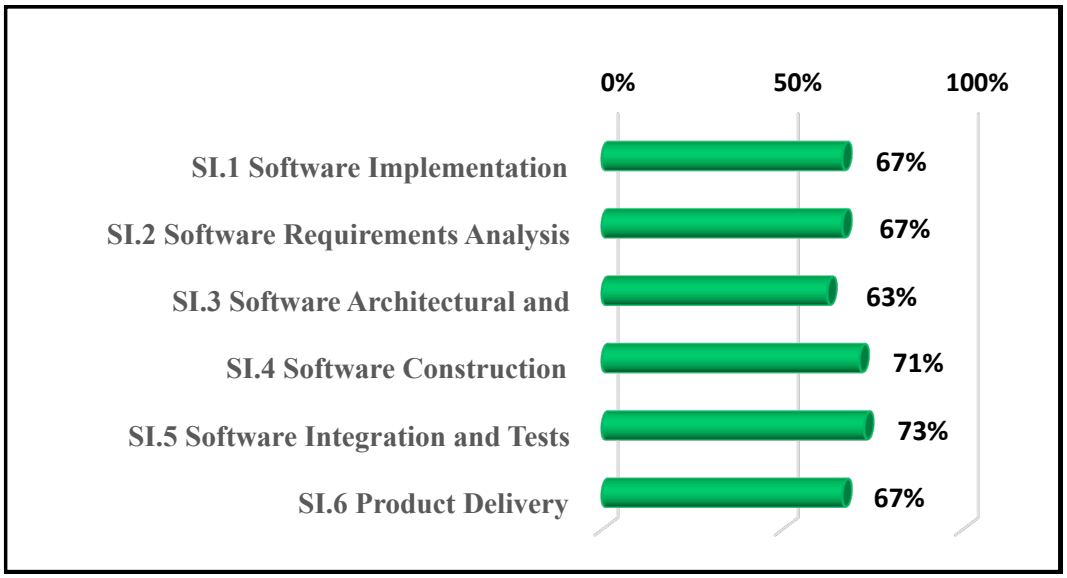



Figure 6. Coverage of the initial software implementation tasks to the Basic profile (Translated from Plante 2015)

As illustrated in figure 6, the coverage of the software implementation activities of the maintenance process was better than the PM activities.

The project management process has been adapted to the context of the division, by injecting a few tasks of the SCRUM methodology. The new agile process, using the Basic profile of the ISO 29110, has been tested on three pilot projects. The new process helped to significantly reduce the number of major incidents caused by changes to the tools of the traders. The users are delighted with the new agile planning and control approach, which allows them to better manage their priorities and to always know the status of their requests. The maintenance team was also very pleased to see an improvement in the quality of the change requests, resulting in a noticeable decrease in the number of defects when handed to traders.

In this organisation, an incident is classified as minor or major using a set of criteria such as the number of impacted systems, the severity, number of customers impacted and criticality of the impact. The criticality is evaluated on a 1 to 5 scale. Figure 7 illustrates the decrease in the numbers of systems impacted as well as in the total criticality level. In June, figure 7 illustrates that 5 systems were impacted and the criticality of those 5 incidents was of 17. About 9 months later, both the number of incidents and the criticality were very low (i.e. one incident and criticality of 1).

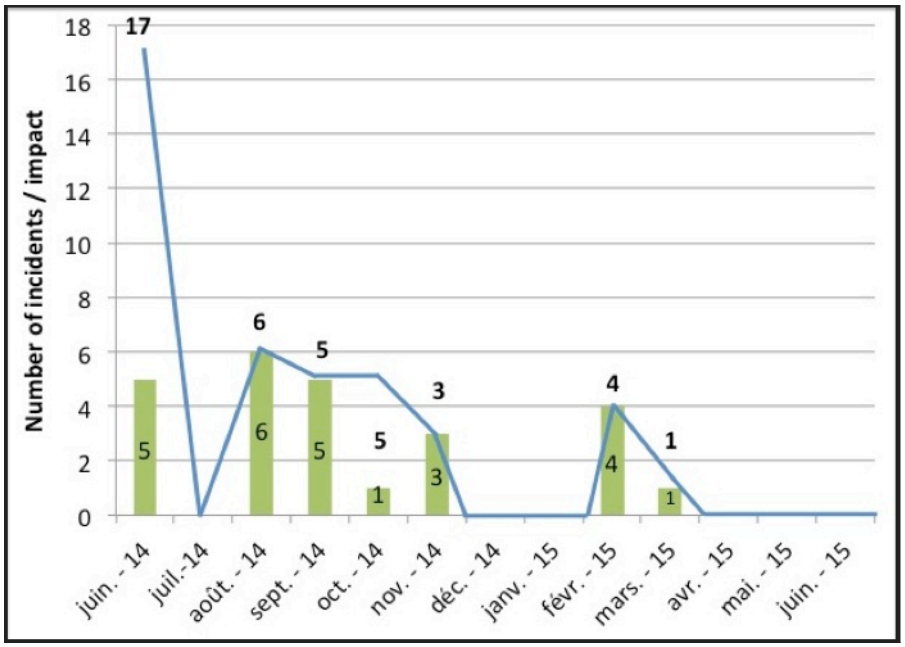


Figure 7. Monthly number of incidents and their impact (Translated from Plante 2015)

The adoption of this agile approach, however, requires a higher availability from the users. Initially, this new approach presented a challenge. In some cases, a few users appointed a representative to play the role of head of product backlog. But that person did not have adequate knowledge of the business domain. Also, the head of product backlog was not able to respond quickly to questions from developers about the requirements, and user stories were not sufficiently documented in advance to maintain the velocity of the team. Finally, representatives of the Project Office and the Audit Group required a few modifications to the new ISO 29110-agile process.

A survey has been conducted to measure the satisfaction level of traders after the deployment of the new process. The following ten questions were asked to traders (on a 0 to 10 scale):

1. How do you qualify the quality of our software upgrades (e.g. number of incidents recorded in production) ?
2. Are you well informed about the content of the next software upgrade ?
3. Is the frequency of delivery right for you ?
4. How do you trust the new process ?
5. How would you describe the ability of the new process to respond to your needs ?
6. How easy is it to consult the status of a change request ?
7. How much the new process prioritizes the added value for you as a trader ?
8. What is the quality level of upgrades ?
9. Are you satisfied with the productivity of the team in response to your needs ?
10. What is your overall level of satisfaction about the new process (e.g. quality, cost, return on investment)

Figure 8 illustrates the increase in satisfaction level between the old process in 2014 and the new ISO 29110-agile process in 2015.

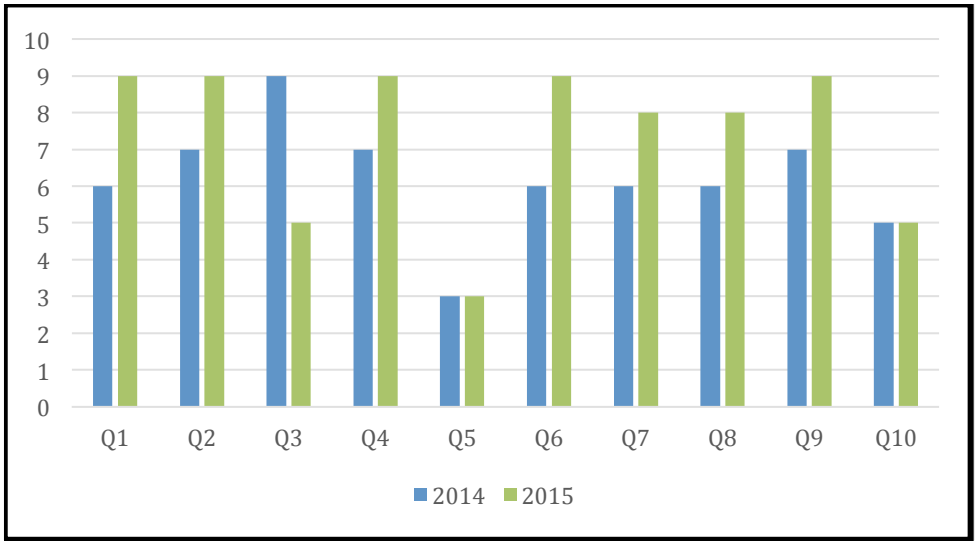



Figure 8. Satisfaction levels of traders (0 to 10 scale) before and after the implementation of the ISO 29110-agile process (Translated from Plante 2015).

The new ISO 29110-agile process has been tested on three pilot projects. The new process helped to significantly reduce the number of major incidents caused by changes to the tools of the traders. The users are delighted with the new agile planning and control approach, which allows them to better manage their priorities and to always know the status of their requests. The maintenance team was also very pleased to see an improvement in the quality of the change requests, resulting in a noticeable decrease in the number of defects in the software tools handed to traders.

### *4.7 Implementation in an Enterprise in the Automotive Field*

TM4 is a Canadian company of more than 140 people (14 software engineers), designs and sells electric powertrain systems in the automotive field. Their products are embedded software that controls the operation of engines in real time and software that controls the interactions between the components of a vehicle.

The company planned to increase its production systems in the coming years. Before this increase in production, and for the sake of improvement and compliance with standards, the company wanted to review and improve its software development processes.

ISO 29110 was used in this effort to improve its processes. A compliance study was conducted to establish the difference between the processes in place and those proposed by the ISO 29110. A pilot project has been successfully completed in May 2015. New projects will be done with the ISO 29110-based process.

An analysis of differences between ISO 29110 and ISO 26262[11], a standard for the automotive industry, was conducted and an economic impact assessment was conducted using the methodology developed by ISO.

## 4.8 Implementation in a large electricity provider

The IT division of a large Canadian electricity provider has 1950 employees that support more than 2,100 software applications. The organization had already implemented, as illustrated in Table 10, 12 process areas of the CMMI-DEV model (SEI 2010). Traditional lifecycles were used for the development of this division.

Table 10. CMMI-DEV Process Areas implemented by the IT Division (SEI 2010)

| | |
|---|---|
| Project Planning | Product Integration |
| Project Monitoring and Control | Verification |
| Supplier Agreement Management | Validation |
| Requirements Management | Measurement and Analysis |
| Requirements Development | Process and Product Quality Assurance |
| Technical Solution | Configuration Management |

A small department within the IT division, the Mobility and Georeferenced Solutions department, is composed of 6 developers and 3 analysts, an architect and a manager. Typical projects of the department are requests from internal customers to improve a few applications.

Due to the increased area of mobility, the small department was required to develop applications more quickly, and with very different technologies. Increasingly, the department had to develop proof of concepts. The problem was that the deliverables requested by the current methodology for typical projects of the IT division were too numerous, the level of documentation required was not suitable for small projects and small teams.

A project was launched within the small department to tailor ISO 29110 to their needs and adapted to a Scrum approach. A pilot project, involving the creation of a web application for property management, has been conducted. This application greatly facilitated geographic data consultation. This software process improvement project combined the advantages of ISO 29110, designed specifically for very small entities, with elements of the CMMI® model already in place.

Many challenges have been encountered during the realization of the pilot project, such as resistance to change of some people and the challenge of finding the right tools to achieve an agile approach. The results of this project have shown that it is

[11] ISO 26262-6:2011 Road vehicules – Functionnal safety- Product development at the software level.

possible to develop quality software that offers more features than expected and in a short lapse of time.

The use of ISO 29110 gave the team short and long-term benefits. The use of proven practices quickly improved the quality and quantity of the software application developed. By centralizing the data of geographical maps, their customers no longer have to update them. In addition, geographical information is more uniform across the enterprise.

The ISO 29110 pilot project allowed the small department to shine within the IT division, as it became a model for future small IT projects. For a large IT division, of close to 2000 people, the benefits of the ISO 29110 implementation are always welcomed for a public utility provider.

### *4.9 Implementation in a Medical R&D VSE*

A project has been conducted to develop and implement a quality management system for a medical R&D company of 15 employees. The VSE manufactures a family of neuronavigation products that are used in over 400 laboratories around the world in the fields of cognitive neuroscience, rehabilitation research and veterinary sciences.

This project improved the business processes and implemented a quality management system in accordance with the ISO 13485 medical standard (ISO 2003).

This project used the ISO 29110 systems engineering Basic profile to facilitate the implementation of ISO 13485. ISO 29110 has guided the VSE in the development of tools, guides and templates. During this project, totalling more than 1,000 hours of effort, the implementation of the quality system was planned; processes, guides and templates were defined in collaboration with key resources of the company. A pilot project was conducted to validate the adequacy of the established process.

The use of ISO 29110 systems engineering Basic profile facilitated the implementation and the adaptation of a standard such as ISO 13485 for very small business.

## *5. Other implementations in Canada*

Table 11 lists organizations involved in ISO 29110 implementation activities in Canada. The table lists completed ISO 29110 implementations.

Table 11. Additional ISO 29110 Implementations completed in Canada

| Description of organization | Project Description |
|---|---|
| A project conducted at ÉTS for a unit responsible to promote activities for graduates and to raise money for the financing of the ÉTS foundation. | • The software project developed a web portal using ISO/IEC 29110.<br>• The portal allowed graduates to register to activities, modify their personal information |

| | |
|---|---|
| An enterprise specialized in industrial process control. | • A department of 13 employees<br>• ISO/IEC 29110 Entry profile was used to assess practices in used<br>• The management of requirements was the focus of the project |
| An IT start-up involved in the development of web traffic surveillance. | • A start-up of 4 employees<br>• Documentation of the software development process using the Basic profile of ISO/IEC 29110 |
| A large civil engineering and construction firm. | • A department of 15 people<br>• Responsible for the development and maintenance of software for the other units of the company.<br>• After an analysis of current practices using ISO/IEC 29110, the improvement implemented a change request management process |

Ongoing ISO 29110 implementations in Canada are presented in a next section.

## *Open Source Systems Engineering Guides, Deployment Packages and Support Tools for Very Small Enterprises*[12]

Open Source software tools are emerging to complete "Big League" development life-cycle toolsets, which are often out-of-reach to VSEs. Finally, to make the deployment of the standard possible in the VSE, training packages, supported by relevant pilot projects help VSE personnel learn how to apply all of the above.

Two of the three pieces of the equation have been developed: the ISO 29110 and the Requirements Engineering DP provide the *Process* piece; an Open Source Framework, constructed around the Eclipse Requirements Management Framework, provides the *Tool* piece. *People* need to be brought into the equation. A survey of enterprises done in (Land 1997) identified very specific needs they have in order to achieve an acceptance of standards. Those needs include:

- User training course
- Examples of deliverables
- Deliverable templates
- CASE tool support for documentation generation
- On-line or phone support
- Educators resource/support

An inexpensive, publicly licensed (i.e. allowing a VSE to tailor and adapt to its needs with as few constraints as possible) and easily deployable training package was therefore needed to allow VSEs to deploy an effective Systems Engineering

[12] Adapted from: Laporte, C.Y., Houde, R., Open Source Systems Engineering Guides, Deployment Packages and Support Tools for Very Small Enterprises – A Case Study, 25th Annual International Symposium of INCOSE (International Council on Systems Engineering), Seattle, US, July 13-16, 2015.

life-cycle process. Such a Training Kit was developed by the Eclipse foundation[13], in collaboration with a team of practitioners from around the world.

Since requirements are the cornerstone of a requirement-centric development lifecycle, the Requirements Engineering (RE) DP was the first of the Systems Engineering DP selected for development. It will serve as the proving ground upon which the other Systems Engineering DPs will be developed under the "Systems Engineering for VSEs" INCOSE Working Group.

As a pilot project to use the DPs and tools, the RE DP Training Kit, has been constructed around a Case Study that can be extended to apply to all the Systems Engineering DPs and the entire lifecycle of a Systems Engineering effort (i.e. hardware, software, organizational processes, etc.). The Case Studies, used in the Training Kit, is the Autonomous Rover[14].

The Autonomous Rover case was selected for a pilot project because it represents a typical System development problem (i.e. includes both hardware and software elements). Also, it is sufficiently simple that a complete solution can be developed during the training period and allows students to become proficient with the application of the System Requirements Engineering Process for a VSE, the artefact templates and the RE Tool.

The RE DP Training Material has for objective to satisfy Goal 1 of Step 0 of the Autonomous Rover project, which is to gather the first set of requirements. The set, of which a sample is shown in Table 12, consists of functional, non-functional, hardware and safety requirements to be implemented in three (3) phases of the Autonomous Rover development project. Whereas the RE DP focuses on the management and engineering of textual requirements, the Case Study is designed from its inception to be extendable to Model-Base techniques, methodologies and tools.

Table 12. Sample of Autonomous Rover project requirements

| Identifier | Description | Target Version | Category | Comment |
|---|---|---|---|---|
| ROVER_FUNC_010 | The Rover must support various payloads (sensors/camera/robotic arm) thanks to a pluggable software architecture | 1.0 | Functional | |
| ROVER_HARD_010 | The Rover must be built with the Polulu Dagu Rover 5 platform | 1.0 | Hardware | |

[13] http://jastram.github.io/teaching/
[14] https://polarsys.org/wiki/PolarSys_Rover_Demo

| | | | | |
|---|---|---|---|---|
| ROVER_NFUNC_010 | Battery must provide an autonomy of at least 10mn | 1.0 | Non Functional | Will evolve to 30mn autonomy in V3.0 |
| ROVER_SAFE_010 | The Rover must avoid crash in obstacles | 2.0 | Safety | |

The Rover will be built with a low-cost Polulu Dagu Rover 5 platform[15] illustrated in Figure 9. The chassis includes a battery holder and two DC motors, with an independent drive train and a quadrature encoder for each tread. The outer dimensions of the chassis are approximately 24 cm (9.5") long, 23 cm (9") wide, and 8 cm (3") tall in its default, flattened configuration.


Figure 9. The Autonomous Rover

The training material has been collected in a GitHub project[16] and is available under the Apache 2.0 License, which allows VSEs to use the material as is, or tailor it to meet their own needs. We also expect educators and trainers will use and improve the training material over time[17].

## Development of a Public ISO 29110 site

A Process Asset Library (PAL) is an organized and downloadable repository of process assets that is easily accessible by everyone who needs processes and process-related assets, such as guidance documents (e.g. deployment packages), forms, checklists, templates, examples, lessons learned related Web links, or other process support materials, such as training material.

Since VSEs cannot afford the overhead to develop and maintain a PAL, the author has developed a public PAL where any VSE can access the assets that are not covered by restrictive copyright clauses, but by clauses typical of Open Source resources. Three versions of the PAL were developed, one in French, one in English and one in Spanish.

---

[15] https://www.pololu.com/product/1551

[16] https://github.com/jastram/teaching/

[17] Houde, R., Laporte, C.Y., ISO/IEC 29110 Deployment Packages and Case Study for Systems Engineering: The "Not-So-Secret" Ingredients That Power the Standard, 26th Annual International Symposium of INCOSE (International Council on Systems Engineering), Edinburgh, UK, July 18-21, 2016. http://profs.etsmtl.ca/claporte/Publications/Publications/INCOSE%202016_ISO_29110_Case_Study.pdf

The PAL is located on the ETS infrastructure at the following addresses:

- French: http://profs.logti.etsmtl.ca/claporte/VSE/index.html
- English: http://profs.logti.etsmtl.ca/claporte/English/VSE/index.html
- Spanish: http://profs.etsmtl.ca/claporte/English/VSE/indexS.html

**Architecture of the Process Asset Library**

The PAL is structured as follows:

- A home page with a table of contents and the following introduction: "Industry recognizes very small entities (i.e. those with up to 25 people) for their contribution of valuable products and services. As software quality increasingly becomes a subject of concern, and as process approaches are maturing and earning the confidence of companies, the use of ISO/IEC JTC1/SC7 international standards is spreading in organizations of all sizes. However, these standards were not written for VSEs and are consequently difficult to apply in such settings. A new ISO/IEC JTC1/SC7 Working Group has been established to address these difficulties by developing profiles and providing guidance for compliance with ISO software engineering standards. A survey was conducted among very small entities on their utilization of standards, as well as to collect data to identify problems and potential solutions to help very small enterprises apply them."
- A page listing the members of ISO working group 24. For each member, the following information is provided:
    - Name of the country represented by the delegate
    - Name and e-mail address
    - Picture of the member

  As an example, the following information is provided for the convenor of the working group:
    - Tanin Uthayanaka (taninu@mozart.inet.co.th) is the Chief Operating Officer of Siamguru Co. Ltd. (a VSE). He is SW-CMM (Software Capability Maturity® Model) lead assessor, candidate CMMI® (Capability Model Integration) lead appraiser, and a member of the Thai Industrial Standards Institute – Software and Systems Engineering Standard Group.
- A page presenting the survey done by WG24
- A page presenting the Network of Support Centres to support VSEs
- A page describing the documents of the Generic profile group
- A page describing and listing the deployment packages for each profile
- A page describing a few ISO 29110 implementations (pilot projects)
- A page describing ISO 29110 course and course material
- A page listing the publications and communications
- A page listing organizations that perform ISO 29110 evaluation/audit
- A page describing the service delivery profile

Figure 10 shows the home page of the English PAL located at the ÉTS.

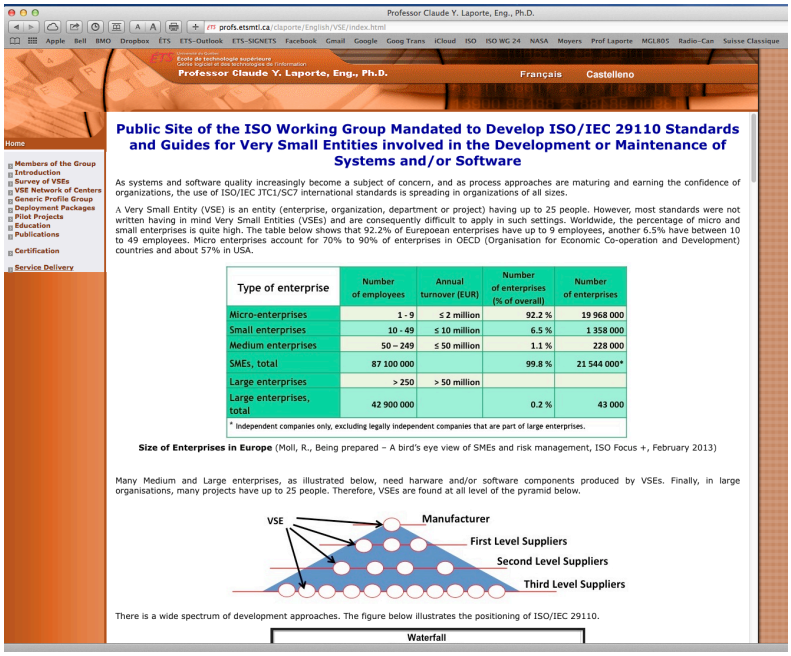


Figure 10. Home page of the ISO 29110 Public site

**Monitoring Access to the Process Asset Library**

The author has instrumented the French and English VSE Web sites with the code provided by Google[18], called Google Analytics, to capture information about access to the sites. The services provided by Google Analytics are free, easy to install, and easy to use.

The following information is monitored and captured on a monthly basis by the Webmaster:

- Number of visits
- Percentage of new visits
- Number of countries
- Number of pages visited
- Number of accesses to VSE pages

Figure 11 illustrates the Google Analytics home page for the VSE Web site for the September 20th to October 20th 2015 period.

[18] http://www.google.com/analytics/

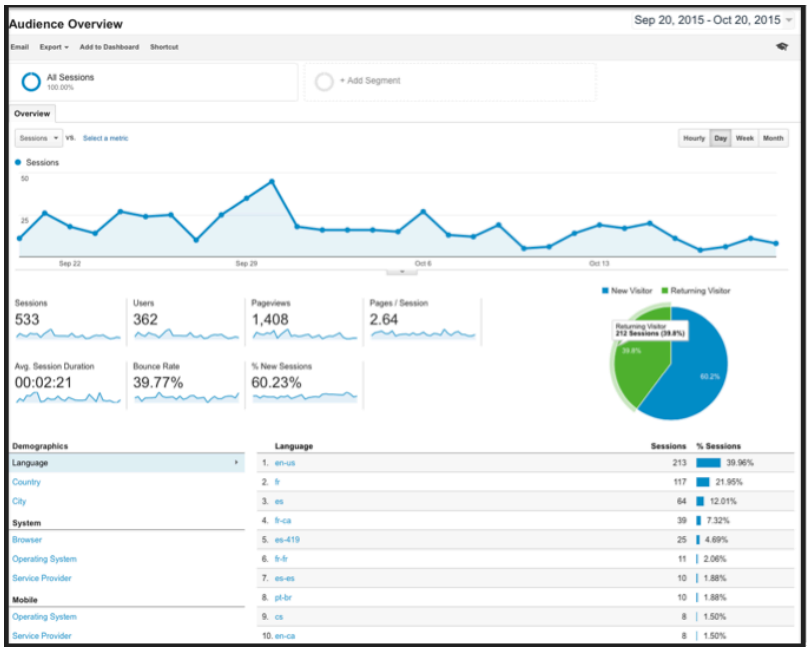


Figure 11. ISO 29110 Web site access data with Google Analytics

As illustrated in figure 10, in this one-month period, 362 users have conducted 533 sessions. Over 1,400 pages have been viewed during the one-month period.

## Other ISO 29110-Related Activities in Canada

In this section we present other ISO 29110 activities in Canada such as the development of a commercial tool, education, training, and workshop.

### *Development of a commercial Tool to support ISO 29110*

A first commercial software solution, using the deployment packages, has been developed to facilitate the implementation of the Basic Profile[19]. The tool, illustrated in figure 12, is based on the well-known Atlassian tool suite. The solution facilitates the role of the project manager and enhances team collaboration. It has the following characteristics:

- Project artefacts shared in one place
- Project documentation is managed
- Project progress dashboard can be generated
- Integrated with Model-based solutions

[19] http://www.gaiaforjira.com


Figure 12. ISO 29110 Commercial tool

The solution provides project artefacts and documentation templates. It enforces the project management process, the system definition, the realization process and it facilitates progress tracking. When using a model-based approach, project artefacts such as: requirements, tests, changes and model artefacts, can be integrated and traced. The solution is already available in different languages such as English, French and Spanish.

### *Software Quality Assurance Courses at ÉTS*

At the École de technologie supérieure (ÉTS), an engineering school of about 10,000 students, software quality assurance (SQA) is taught in lectures format in the undergraduate software engineering curriculum[20]. The SQA course covers the concepts of the business model and the cost of quality, to convince students of the importance of putting in place adequate prevention and evaluation practices, both to reduce the number of defects and to predict the extra effort needed to correct defects introduced as the work progresses.

The course includes a 10-week capstone project in which teams of 4 students apply the SQA practices taught in class in a software development assignment. The students collect measures throughout the 10-week period, and the performance of each team is analyzed. This analysis allows discussion to take place on the positive impact of SQA practices as a way to deliver quality software on time and within budget.

The laboratory sessions have been designed in such a way that teams of students can apply the SQA practices presented in the lectures to their SQA term projects.

Students attend twelve 2-hour laboratory sessions during a semester. After completing the first two sessions on the code of ethics and the business models, students embark on a project in teams of four for a period of ten weeks where they must apply the SQA practices presented in the course, using the ISO 29110 standard

[20] Adapted from: Laporte, C.Y., O'Connor, R., Garcia Paucar, L.H., Gerançon, B., *An Innovative Approach in Developing Standard Professionals by Involving Software Engineering Students in Implementing and Improving International Standards*, International Cooperation for Education about Standardization Conference, August 14th 2014, Ottawa, Canada.

as the framework for the project[21]. The teachers randomly create the teams, to simulate an industrial context where an employee doesn't usually choose his teammates.

At the start of the project, the teams receive a copy of the Statement of Work (SOW), which they use to develop the project plan. During the planning phase of the project, the four students in a team must share the following roles, as defined in ISO 29110: analyst, designer, programmer, technical lead, and project manager. Monitoring this process is the responsibility of the teacher or the lab supervisor, who plays the role of customer.

During the first week of the project, students are also required to select and install the tools they will use during the project. For example, they must choose and install a document repository, a version control tool, and an issue-tracking tool, among others.

Then, the four-member team must complete and sign a contract that specifies the roles of each participant, the team deliverables, the expectations of each participant, and the operating rules that they agree to respect. The course website lists the objectives and deliverables for each of the ten weeks of the project. The site also contains all the templates required to produce the deliverables. The templates list the content of the documents required by ISO 29110, such as the project plan and the specifications of the software. The site also includes descriptions of the various reviews they have to perform (e.g. desk check, walkthrough) and forms for registering any anomalies, e.g. defects, they find during the review process.

Teams must estimate the effort that will be needed by each member to carry out the activities and deliverables required by ISO 29110. These estimates are recorded on a spreadsheet, and every week members of the team must record the hours they have worked on defined project activities. Also, students must record their rework effort. Table 13 describes the laboratory components of the SQA course.

Table 13. Topics of the SQA laboratory sessions (adapted from Laporte & April 2013)

[21] Laporte, C.Y., International Software Engineering Standards Applied in Undergraduate and Graduate Software Quality Assurance Courses, IEEE Standards University, IEEE Standards Education E-Magazine, November 2015, http://www.standardsuniversity.org/issue/november-2015/

**Team Project - Part 1 - Project Planning and installation of the work environment**

Objectives

- Objective 1: Perform the project planning activity according to the basic profile of ISO/IEC 29110, perform a desk check of the project plan;
- Objective 2: Select tools and set up the working environment (e.g. a version control tool and an issue tracking tool);
- Objective 3: Customize the measurement spreadsheet for the measurement of effort and the cost of quality for the project.

Deliverables

1. Project plan:
    - Profile of freedoms/constraints
    - Identification of the criticality of the project
    - Roles and responsibilities of team members
    - Version control strategy
    - Delivery instructions
2. Work environment *[installed and tested]*
3. Contracts among team members
4. Defect registration form (desk check of the project plan)
5. Measurement spreadsheet tailored to this project. *[updated with current data]*

**Team Project - Part 2 - Analysis and Documentation of Requirements**

Objectives

- Objective 1: Perform the software requirements analysis activity of ISO 29110;
- Objective 2: Perform a walkthrough (review) to verify the specifications before they are submitted to the customer for approval.

Deliverables

1. Functional and non-functional requirement specifications *[verified and baselined]*
2. Audit results (audit performed by a professor)
3. Anomaly registration form
4. Validation results
5. Software user documentation *[preliminary]*
6. Measurement spreadsheet *[verified, baselined]*

**Team Project - Part 3 - Software architecture and detailed design**

Objectives

- Objective 1: Perform the Create the architecture and the detailed design activity of ISO 29110
- Objective 2: Perform a walkthrough to verify the architecture.

Deliverables

1. Software design *[verified, baselined]*
2. Verification results of the architecture document
7. Anomaly registration form
3. Traceability record *[verified, baselined]*
4. Test Procedures and test cases *[verified]*
5. Measurement spreadsheet *[verified, baselined]*

**Team Project - Part 4 - Software Construction**

Objectives

- Objective 1: Perform construction, implementation, and evaluation activities of ISO 29110;
- Objective 2: Perform a walkthrough to verify the components developed.

Deliverables

1. Software components *[corrected, baselined]*
2. Correction register (if necessary)
3. Anomaly registration form
4. Analysis of measures collected and recommendations

| |
|---|
| 5. Traceability record *[updated, baselined]*<br>6. Change request form *[ready to be signed by the client]*<br>7. Measurement spreadsheet [*verified, baselined]*<br>8. Progress status record *[evaluated]*<br>9. Analysis of measurements collected and recommendations<br>10. Analysis of the cost of the quality measures |
| **Team Project - Part 5 - Software Integration and Tests**<br>Objective<br>• Perform integration and testing, execution, and evaluation activities of ISO 29110<br><br>Deliverables<br>1. Test procedures and test cases (updated if necessary) *[baselined]*<br>2. Software (i.e. components developed in the previous activity have been integrated) *[tested, baselined]*<br>3. Traceability record *[updated, baselined]*<br>4. Test report *[baselined]*<br>5. Product operation guide *[verified, baselined]*<br>6. User documentation *[verified, baselined]*<br>7. Measurement spreadsheet *[verified, baselined]*<br>8. Progress status record *[evaluated]*<br>9. Correction register (if necessary) |
| **Team Project - Part 6 - Product Delivery and Project Completion**<br>Objectives<br>• Objective 1: Perform the product delivery activity;<br>• Objective 2: Conduct a post-mortem review of the project.<br><br>Deliverables<br>1. Maintenance documentation *[verified, baselined]*<br>2. Software configuration *[delivered]*<br>3. Correction register (if required)<br>4. Acceptance form *[signed by the client]*<br>5. Software configuration *[accepted]*<br>6. Measurement spreadsheet *[verified, baselined]*<br>7. Information repository [*updated]*<br>8. Report on lessons learned |

At the end of the project, teams conduct a session on lessons learned (post-mortem), where they analyze the data logged on their spreadsheets. We ask them to explain the differences between the initial estimates and the actual effort expended, including the cost-of-quality components (e.g. rework effort), and ask them to generate findings and develop recommendations for a future project[22].

### *Software Process Improvement Course at ÉTS*

The graduate Software Process Improvement (SPI) course of ÉTS is taught in the lecture format within the Software Engineering curriculum[23]. The objective of the graduate software engineering program is to train professionals already active in the

[22] See also IEEE eZine: http://standardsmagazine.ieee-elearning.org

[23] Adapted from: Laporte, C.Y., O'Connor, R, Software Process Improvement in Graduate Software Engineering Programs, in: O'Connor, R.V., Mitasiunas, A. and Ross, M. (Eds), Proceeding of the 1st International Workshop on Software Process Education, Training and Professionalism (SPETP 2015), CEUR Electronic Workshop Proceedings, Vol. 1368, 2015, pp. 18–24.

development or maintenance of software. Students of the SPI course have to perform an intervention in an organization where they would identify an improvement opportunity and implement it in teams of 3 students. The objectives of the SPI course are:

- Identify weaknesses in the organizational software processes
- Prepare a business case about the cost and benefits of the intervention;
- Prepare a communication plan and a process improvement plan;
- Define or modify a software process
- Identify and manage risks associated with the process improvement project;
- Identify the human and organizational factors which may harm or help improve the process;
- Document the improvements to the process
- Conduct a pilot project to test the proposed improvements
- Document a project retrospective (i.e. document the lessons learned)

Since ISO 29110 was made publicly available by ISO at no cost, this standard was identified as a framework for the student projects. Professional students were able to rapidly understand it and use it in organizations.

Since students are not just doing a static analysis of the standard but had to implement a subset of the standard in real organizational processes, they are much more critical about the understandability, completeness and usability of the standard. In addition, since some of the documents of the set of ISO 29110 standards and guides were, a few years ago, under development, students were presented with the ISO development process and were invited to make comments about the documents being developed such as areas of potential misinterpretation and identification of weaknesses in the draft ISO 29110 documents. The comments provided by students were analysed and incorporated in the set of formal comments submitted by Canada to ISO.

A few students also decided to complete the requirements of the graduate software engineering program by doing their project in an organization using the set of ISO 29110 standards and guides.

### *Publication of ISO 29110 Papers on ETS Blog and ETS Press Releases*

As posted on the ETS site, the Blog titled 'Substance' is an interactive platform that allows the university's graduate students, professors and researchers to post articles about their activities at the university, including academic studies, social experiences, research projects or involvement with industry. The articles are open to comments and discussion from local and international readers. Thus, the blog is a dynamic communications platform that promotes participation and dialogue with its online audience. The blog will offer students who are interested in pursuing graduate studies, engineers and other industry professionals a wealth of information about education and research. ÉTS hopes that the blog will generate conversation and act as a forum for the online community – especially those who may be interested in the university's approach to graduate studies. The following blogs have been posted:

- Economic benefits of ISO/IEC 29110 Standard: a Case Study
  - http://substance-en.etsmtl.ca/economic-benefits-isoiec-29110-standard-a-case-study/
- ISO / IEC 29110 to Reduce Overruns and Delays in Project Management
  - http://substance-en.etsmtl.ca/iso-iec-29110-reduce-overruns-delays-project-management/
- ISO/IEC 29110: Systems Engineering Standards for Very Small Enterprises.
  - http://substance-en.etsmtl.ca/systems-engineering-iso-29110-standards/
- Teaching the ISO/CEI 29110 Standard to Computer Science Technology Students
  - http://substance-en.etsmtl.ca/teaching-isocei-29110-standard-computer-science-technology-students/
- Swicetrip: A Collaborative Travel Site Designed with the New ISO/IEC 29110
  - http://substance-en.etsmtl.ca/swicetrip-a-collaborative-travel-site-designed-with-the-new-iso-iec-29110/
- An Innovative Approach to the Development of an International Software Process Lifecycle Standard for Very Small Entities: Research Paper Introduction
  - http://substance-en.etsmtl.ca/an-innovative-approach-to-the-development-of-an-international-software-process-lifecycle-standard-for-very-small-entities-research-paper-introduction-rpi/

ÉTS has also published a few press releases in French and English about ISO 29110 projects. As an example, in October 2015, an English press release was published about a project done by a graduate student in a large engineering enterprise

- http://en.etsmtl.ca/en/News/News-2015/Implementing-ISO-29110-Standard-ETS

### *Application of ISO 29110 in Student Clubs of ÉTS*[24]

Over 25 student clubs are sponsored by ÉTS. «These clubs give students the opportunity to put into practice the theory that they learn in the classroom, and to develop their ingenuity and leadership skills. Every year, ÉTS students participate in a number of engineering competitions (Formula SAE, solar vehicle, concrete canoe, amphibious all-terrain vehicle, human propelled submarine, etc.) in order to assess their knowledge and that of their peers at leading North American engineering establishments. Over the years, ETS students have earned numerous prestigious awards, in addition to enriching their knowledge and generating recognition for the School in Canada and abroad.» [25]

As described on the ÈTS Blog, «ÉTSMobile is the mobile application portal used on a daily basis by several thousands of students at École de Technologie Supérieure (ÉTS). It is a mobile application developed as a joint project by the

[24] http://substance-en.etsmtl.ca/etsmobile-product-successful-collaboration-between-ets-students/
[25] http://www.etsmtl.ca/Etudiants-actuels/Baccalaureat/Vie-etudiante/Clubs-regroupements-etudiants

ApplÉTS student club, who specializes in mobile engineering, and the “Entreprise Systems” team of ÉTS’ IT organization. Thanks to this mobile application portal on the iOS and Android platforms, students can check course and exam schedules, access course evaluations and documents at any time and listen to the student radio. Figure 13 illustrates the application developed.

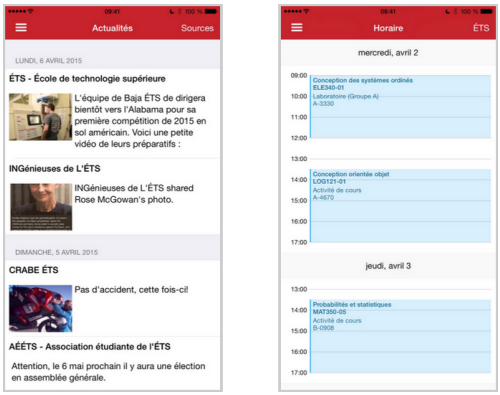



Figure 13. Screen shot of the Mobile Application

Throughout the development of this new version, the ApplÉTS team refined its development process. Among other things, the team was inspired by the ISO/IEC 14764 standard for maintenance and the ISO/IEC 12207 and ISO 29110 standards to establish a software lifecycle suitable for the dynamics of a student club, i.e. a variable number of members and regular turnover of students participating in the organization. The application’s security features were then validated with ÉTS’ IT department.»

### *Development of ISO 29110 Educational Material for IT Technical Colleges*

Another professional graduate student of ÉTS developed, for a professor and students of an IT technical college of the Montréal area, a set of ISO 29110 teaching material. The graduate student, who happened to have made his college level studies in this technical college, worked with the professor responsible for the software engineering course to develop a set of templates and guides. Figure 14 illustrates the process used to develop and validate the teaching material.

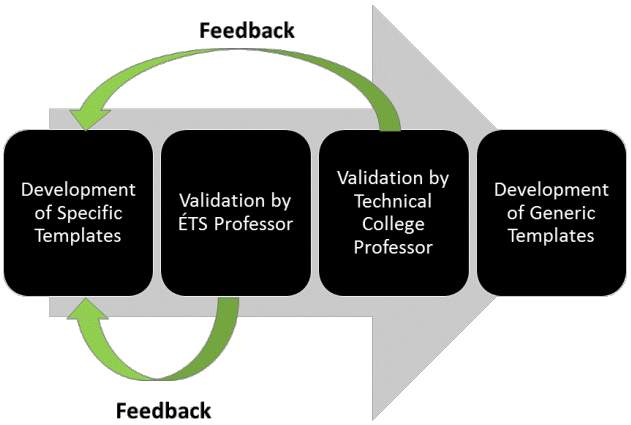



Figure 14. Teaching Material Development Process (Trudeau et al. 2014)

The teaching material has been tested in 2 software engineering courses. To evaluate if the templates met the needs and expectations of the professor and the students, two surveys have been conducted to allow them to offer their feedback. The survey illustrated that the students are interested in using the ISO 29110 standard because it helped them complete their projects more efficiently and enabled a better use of the topics presented in their courses. Table 14 lists the templates developed for the students.

Table 14. Templates developed for students

| |
|---|
| Vision Document |
| Project Plan |
| Specifications Document |
| Architecture and Design Document |
| Change Request |
| Quality Assurance Plan |
| Meeting Record |
| Test Plan |
| Delivery Instructions |

The results of the project performed by a graduate student have been presented, at a workshop, to the IT professors of the technical colleges of the province of Québec (Trudeau, Laporte, Lévesque 2014)[26]. This was an excellent opportunity to present the teaching material. The material is freely available to all professors of the 48 technical colleges in Québec.

### *Development of a mobile Application by IT students of a Technical College*

A team of IT students of a technical college of Québec developed a mobile application using ISO 29110. In an educational organization where, throughout the

[26] Trudeau, P.O., Laporte, C.Y., Lévesque, S., Enseignement de la norme ISO/CEI 29110 aux étudiants en technique informatique d'un collège technique québécois, Revue Génie Logiciel, Numéro 110, septembre 2014, pp. 33-45.

last decades, additions and modifications to the building were done, made it difficult for new students to rapidly find a specific classroom, laboratory or the place where a service was offered to them.

The main functions of the mobile application are the centralization of information from different departments and physical locations of the education institution, the positioning of a starting point and a destination point to guide a user from one point to another in the building.

Finally, the application offers a remote guided tour of the educational organization. It is also an interesting promotional tool for the institution since students looking for an educational institution can walk through the building and learn about the programs and services offered to them.

### *Development of the ISOPOLY© education board game*

The objective of the ISOPOLY© board game is to be the first Project Manager (PJM) to finalize the development a software product within the budget (in $$), effort (in staff-hours), duration (in days) and quality (in number of defects) described on a Project Card.

During a game, a PJM has to manage the project by developing a software product, by buying services, from Acme Service companies, and by being penalized for mistakes made during the project or simply because of bad luck. One day of a project is one complete cycle around the board beginning at the 'Start' location.

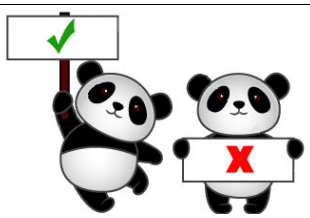
When a service has been purchased, a PJM landing on this place must pay the owner for the service as indicated on the Acme Service Cards. There are 4 levels of certification for a service (i.e. Thin, Bronze, Silver and Gold).

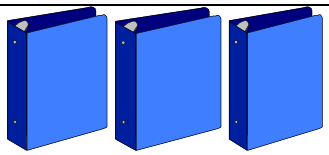
The ISOPOLY game, illustrated in figure 15, has been developed, using the well-known Monopoly© concept, to help learn the ISO 29110 standard developed specifically for VSEs.


Figure 15. ISOPOLY© Board Game

The game is played using different types of card. Table 15 describes each type of card.

Table 15. Categories of cards

| Logo | Description |
|---|---|
|  | **Project Cards**<br><br>A project card describes the objectives of a project. The project card lists the effort (hour), duration (day), budget (dollar) and quality (defect) objectives for a specific project.<br><br>All players have to play to meet these objectives. The first player who meets all objectives wins the game. |
|  | **True or False Cards**<br><br>Players must answer the question by True or False.<br><br>If a player answers correctly, he may plain again. If a player answers incorrectly, he will lose his turn the next time around. |

| | |
|---|---|
|  | **Chance Cards**<br><br>This card allows a player to obtain free service, additional money, schedule time or an opportunity to have fewer defects. |
|  | **Bad Luck Cards**<br><br>This card allows a player to lose money, schedule time or additional defects. |
|  | **Surprises Cards** |
|  | **Risk Cards** |
|  | **Management Cards** |
|  | **Communication Cards** |
|  | **Quality Cards** |
|  | **Human Resources Cards** |

The different types of card are illustrated in Figure 16.


Figure 16. Examples of ISOPOLY© cards

An electronic version of the ISOPOLY© game has been developed in Peru and in Canada. It should become available in 2016.

### *ISO 29110 self-study web site*

A Moodle web site has been developed in three languages (French, English and Spanish) by a graduate student of ÉTS (Olivares Romero, 2016). Figure 17 illustrates the welcome page.

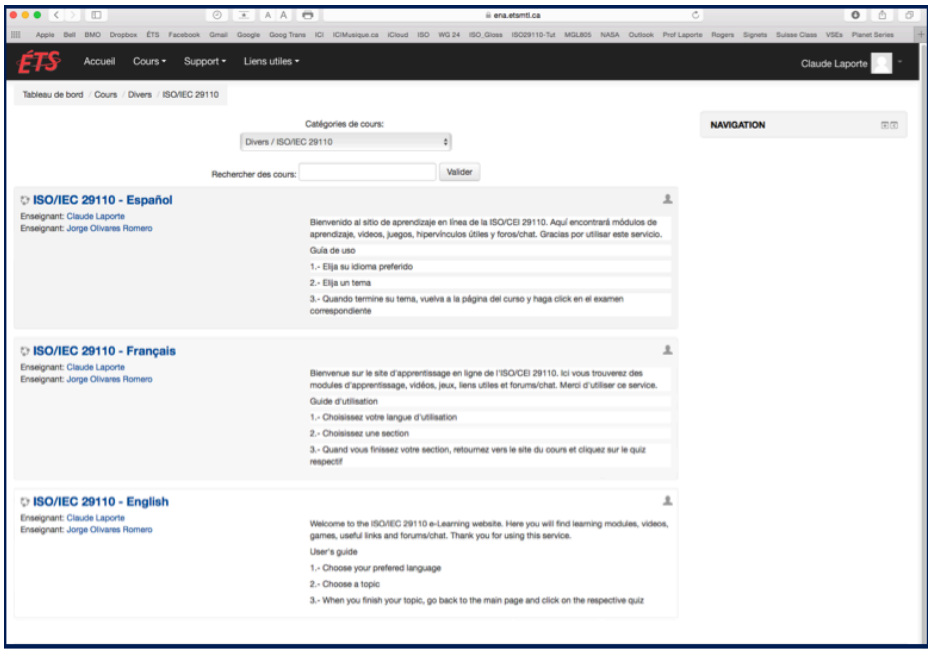



Figure 17. Screenshot of the welcome page of the Moodle site[27]

[27] https://ena.etsmtl.ca/course/index.php?categoryid=35

As illustrated in figure 18, the site contains the following components:

- Tools
- Slide presentations
- Quizzes (i.e. mini test)
- Videos (e.g. on ISO 29110, implementers)

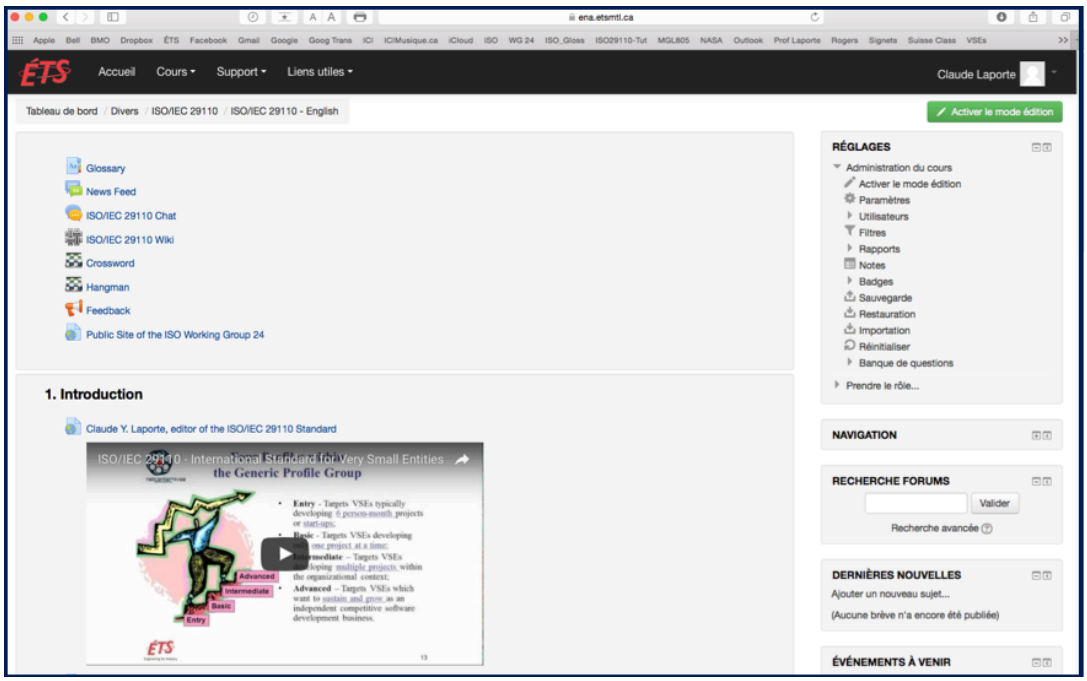



Figure 18. Screenshot of the English page of the Moodle site[28]

In addition, as illustrated in figure 19, the site has different tools such as a glossary, a wiki and games.

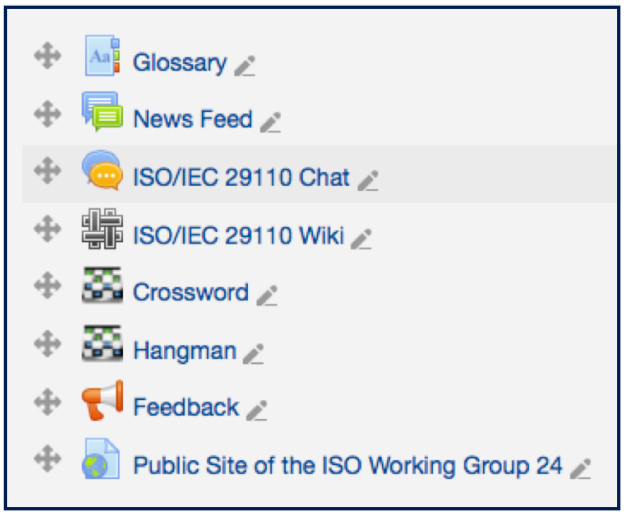



Figure 19. Screenshot listing the tools available on the Moodle site

[28] https://ena.etsmtl.ca/course/view.php?id=4430

The following ISO 29110 self-training modules are available on the Moodle site:

- An Introduction to ISO 29110 (33 slides):
    - Course Objectives
    - Importance of VSEs
    - Software Engineering Standards
    - ISO/IEC 29110 – OIQ Article
    - Software and Systems Engineering
    - Contents of the ISO/IEC 29110 Standard
    - Part 1: Overview
    - Part 2: Framework and Taxonomy
    - Part 3: Evaluation Guide
    - Part 4: Profile Specification - VSE Generic Profile Group
    - Part 5: Management and engineering guide - Generic profile group
    - The ISO/IEC 29110 Process
    - Deployment Packages
    - Pilot Projects
- An Introduction to the Management and Engineering Guide of the Software Entry Profile (24 slides)
    - Course objectives
    - Overview
    - Project Management Process (PM)
    - Software Implementation Process (SI)
    - Deployment Packages
- An Introduction to the Management and Engineering Guide of the Software Basic Profile (28 slides)
    - Course objectives
    - Overview
    - Project Management Process (PM)
    - Software Implementation Process (SI)
    - Deployment Packages
- An Introduction to the Management and Engineering Guide of the Systems engineering Basic Profile (22 slides)
    - Course objectives
    - Overview
    - Project Management Process (PM)
    - System Realisation Process (SR)
    - Deployment Packages

### *Ongoing ISO 29110 Implementations*

Table 16 lists ongoing ISO 29110 implementations developed in Canada. The implementations range from the development of processes for a video game VSE to the application of the ISO 29110 systems engineering profiles in a large organization involved in space programs.

Table 16. Ongoing ISO 29110 Implementations in Canada

| Description of organization | Project Description |
|---|---|
| ÉTS | • Development of on-line ISO 29110 training courses |
| Acme[29] - 1 – Game Developing Enterprise | • Develop ISO 29110 agile processes for a VSE developing on-line video games |
| Acme - 2 – IT Change Management Tool | • Develop using ISO 29110 a change management tool for a large organization |
| Acme – 3 – Space Component Developer | • Systems engineers will use ISO 29110 in the development of non-critical space components. |
| Acme – 4 – Aerospace Service Provider | • Development of a web application for an enterprise that specializes in the strategic management of customer supply chains and in international aerospace project management. |

As described in table 16, there are a wide range of ISO 29110 implementations in Canadian VSEs ranging from software development to non-critical space components.

## *8. Next Steps in Canada*

A survey conducted by WG24 showed that VSEs needed ways to be recognized nationally and internationally (Laporte et al. 2008). A lightweight, low-cost audit scheme has been developed for English and French-speaking Canadian VSEs. The audits will be readily available since auditors will be locally available, thus minimizing the time and travel expenses associated with an on-site audit. The system to be implemented to award the "Letter of Compliance" will be set up in two stages: an audit based on the ISO 29110 Profiles with audit report attached, with recommendation(s), to a second-level committee that will ensure the audit quality and validity of the recommendation(s). This committee will then issue a letter certifying compliance to an ISO 29110 profile. Following the issuance of the letter, the VSE may grant the permission to be listed on the Internet. A not-for-profit organisation will be established to conduct the audits, to ensure the effectiveness and integrity of audits, of the auditors' training, the recognition and maintenance of auditors' and technical experts' competence, the training of second-level auditors

[29] The name 'Acme' is used to protect the confidentiality of organisations

and the promotion of the audit system (e.g. via presentations and a website). There would be five directors of the not-for-profit audit organization, holding a 2-year term, renewable only once. It is expected that a first ISO 29110 systems engineering audit will be conducted in Canada in 2016.

## CONCLUSIONS AND FUTURE WORK

The ISO 29110 implementation projects conducted in Canada have demonstrated that it is possible to properly plan and execute a project, and develop a system or a software product, using the proven systems and software engineering practices documented in ISO 29110.

Those who still think of systems and software engineering international standards as a burden, unnecessary overhead, or a threat to creativity in VSEs should look at the Canadian ISO 29110 implementations and revisit their assumptions.

## Additional Information

The following web site provides more information, as well as articles by WG24 members and deployment packages for software and systems engineering:

http://profs.logti.etsmtl.ca/claporte/English/VSE/index.html

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# Annex C

## Activities in Japan

By Satoshi Fushimi and Kazunori Shioya

# "ISO/IEC 29110 and Japanese software industry"

# ISO/IEC 29110 Standard for Very Small Entities and the Japanese Software Industry

Satoshi Fushimi, Sofdela LLC, Japan

**Abstract**

*VSE (Very Small Entity) is the target of the International Standard ISO/IEC 29110 series. In Japan several communities have tried the VSE standard and have also developed applications of the VSE standard.*

**Keywords**

ISO/IEC 29110 • Very Small Entity (VSE) • Japan • Software • Trial

## 1. Why VSE in Japan ?

Generally, Japanese industries have hierarchies including several big enterprises and many many small or medium sized enterprises. Sometimes other countries also have similar industrial structures, but Japanese one is considered as the typical one. Japanese software industry has also a hierarchy. A governmental statistics is shown in the table 1.

**Table 1 - Enterprise hierachy of the Japanese software industry**

**(modified from METI statistics "Survey of Selected Service Industries" 2013)**

| Enterprise size (number of employees) | Number of enterprises | Sales of enterprises (Billion Yen) |
|---|---|---|
| < 30 | 24,154 (82%) | 2,263 (16%) |
| 30 - 99 | 4,083 (14%) | 3,143 (23%) |
| 100 - 499 | 1,037 (3.6%) | 3,561 (26%) |
| > 500 | 297 (0.5%) | 4,960 (36%) |
| **Total** | 29,433 (100%) | 13,928 (100%) |

Percentage of enterprises with less than 30 employees is over 80% in number and over 15% in sales amount. From the view point of software quality management, the number of management entities is important. Actually, in many cases, large enterprises only manages projects, and software production is performed by smaller enterprises which are subcontractors of large enterprises. Therefore, the quality of the software process of smaller enterprises is a key factor of the Japanese software industry. This problem has been discussed for many years, but recently some new issues have been impacting the Japanese sofware industry:

1) Percentage of smaller projects is growing. Such smaller projects are difficult to manage than bigger projects using traditional management techniques.

2) Most embedded softwares are developed by smaller enterprises with less software engineering skills. But, embedded systems requires high level quality.

## 2. History of the study for lightweight process models

JISA (Japan Information Technology Services Industry Association) is the major Japanese software industry association[1]. JISA has organized, for a long time, study groups for process quality. In early '90s and in the 2000-2003 period, Process Assessment was the primary concern of such study groups. JISA has developed an assessor training and qualification course for ISO/IEC 15504 assessment.

At the same time, more light-weight process models and assessment models are required, because the majority of JISA members is small or medium sized. JISA developed the SPINACH assessment models, and revised it several times. These models are very similar to the current ISO/IEC 29110 international standard. Some trial assessment had been performed based on these SPINACH assessment models in JISA member companies. Assessment results are not summarized, but the models have contributed to progress of Japanese software assessment study.

## 3. ISO/IEC 29110 standard and JIS X 0165

In 2005, ISO/IEC JTC 1/ SC 7, the international standardization committee for software and systems engineering, has decided to develop a process standard dedicated to very small enterprise (or entities). VSEs is the abbreviation of Very Small Entities, and the new working group mandated to develop this standard is named WG24. Japanese SC 7 also decided to participate to this project, and it organized the domestic WG24 in 2007.

In 2011, the first group of ISO/IEC 29110 standard and technical reports for VSEs has been published. In Japan, JISA has proposed to METI (Ministry of Economy, Trade, and Industry) to make the domestic standard corresponding ISO/IEC 29110, and the proposal has been approved. The national standard drafting committee for ISO/IEC 29110 has decided to make the domestic standard for only ISO/IEC 29110 Part 2 (2011) because of resource capability limitation.

Japanese domestic industrial standard, JIS (Japanese Industrial Standard), for ISO/IEC 29110 has been published in 2013, and numbered as JIS X 0165[2] ("X" means "an IT domain standard").

## 4. Industrial concern

JISA has organized the above-mentioned JIS drafting committee, and then a deployment study group for the VSE standard. That group edited a guide about how to implement the VSE standard in each enterprise. The guidebook has been published in April 2014. This guidebook provides an introduction of the management and engineering guide of ISO 29110 (i.e. ISO/IEC 29110 TR 5-1-2) and also provides a practical guide how to implement software engineering in corporate practices. The book has been printed with about 3000 copies[3], and deployed among JISA member companies, and also deployed using commercial book service (e.g. amazon.co.jp).

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[1] https://www.jisa.or.jp/Portals/0/resource/e/

[2] http://www.webstore.jsa.or.jp/webstore/Com/FlowControl.jsp?bunsyoId=JIS+X+0165-2:2013&dantaiCd=JIS&status=1&pageNo=0&lang=jp

[3] http://www.jisa.or.jp/publication/tabid/272/pdid/VSE2014/Default.aspx

Several seminars and presentations have been performed in and out of JISA.

In a major software company, SRA, people have performed several experimental software process mini-assessments using early VSE standard in their company. The result has been reported at EuroSPI (archived in a journal) and presented in several public software engineering events.

## 5. Academic initiatives

The Keio University, one of leading university of Japan, has organized the VSE center to study and deploy ISO/IEC 29110 to the industry. The center was founded in 2011 as an activity of the Graduate School of System Design and Management[4], and has provided study and education concerning VSE standard.

AIST, the National Institute of Advanced Industrial Science and Technology[5], which is one of the largest public research organizations in Japan, provides educational materials for a graduate school on VSE application to software development projects.

## 6. Process improvement

IPA (Information-technology Promotion Agency, Japan) is an independent governmental agency in IT domain. It has organized a working group to study software process assessment/improvement implementation in software communities including software industry, hardware industry, manufacturing industries, and other industries. A major focus of that working group was how to implement process improvement effectively.

As a result of that study, a lightweight process improvement method has been proposed: the SPINACH-cube autonomy-based improvement method[6]. The name means that the method is a kind of successor of the JISA's SPINACH lightweight assessment models. This improvement model focuses practical effectiveness in the actual software development activities. A variation of this model has been proposed as a part of ISO/IEC 29110 series (2015), and was published in 2015[7].

## 7. Future insight

The VSE standard is important as a technical guideline for VSE's daily development in Japan. It will provide advices to software engineers, project, and enterprises. It will provide a guideline for software development contract between a customer and a developer.

For software development enterprises, ISO/IEC 29110 will provide a list of minimal practices that are required to develop and operate qualified software in productive conditions.

For embedded software in the automotive industry, the EU-led Automotive-SPICE is the main stream of process assessment and improvement in Japan. Also, ISO 26262 standard is the important factor for software developers in such industry. Carmakers are implementing ISO 26262, and Automotive-SPICE assessments are used frequently. But, software enterprises should have its own process capability to perform contract based on ISO 26262 or Automotive-SPICE or other similar regulations. Medical device software enterprises also have similar problems.

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[4] http://www.sdm.keio.ac.jp/en/
[5] http://www.aist.go.jp/aist_e/dept/en_dithf.html
[6] http://www.ipa.go.jp/english/sec/reports/20120321.html
[7] http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=64782

Some groups are studying if VSE standard can be applied to such industrial domains. For instance, VSE+SS study group ("+SS" means Plus Security and Safety) has been organized in JISA. Output documents will be available in 2015 and 2016.

2015-08-22

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[1] ISO/IEC 29110-2:2011, *Software engineering -- Lifecycle profiles for Very Small Entities (VSEs) -- Part 2: Framework and taxonomy*

[2] ISO/IEC TR 29110-3-4:2015, *Systems and Software Engineering - Lifecycle profiles for Very Small Entities (VSEs) - Part 3-4: Autonomy-based improvement method*

# Annex D

## Activities in Mexico

**By Salvador Sánchez, Hanna Oktaba, Claudia González and Blanca Gil**

# Implementation and Certification Activities of ISO/IEC 29110 Lifecycle Profile Standard for Very Small Entities (VSEs) in Mexico

Salvador Sánchez, CIO of NYCE[1], México
Hanna Oktaba, UNAM; Claudia González, Kernel; Blanca Gil, Siecenter.

## 1. Background and Introduction

In late 2006, the Mexican government published the 2007-2012 National Development Plan[2] in order to boost productivity and competitiveness of the Mexican economy and to generate sustained economic growth. This program considered strategic to establish conditions that Mexico was at the forefront of technology.

Meanwhile, to meet the objective of increasing the country's competitiveness, the Ministry of Economy launched, in February 2008, a strategic document titled "Ten Guidelines to increase the competitiveness 2008-2012", where 10 strategies, grouped into four major blocks, were defined: Commercial Facilitation, Sectorial Policy, Innovation and Internal Market.

One of these four strategies raised the position of Mexico as a hub of information technology services and logistics, using geographical advantages of our country, preferential access to a large number of markets and the high availability of the more important resource in the service sector: human capital.

To create the conditions so that Mexico will feature a sector of internationally competitive IT services and ensure their long-term growth, version 2.0 of the Development Program of Information Technology Services (Prosoft) Sector was created based on his predecessor Prosoft version 1.0 with substantial improvements.

Within PROSOFT 2.0, a strategy to achieve international levels of process capability, the Mexican Standard: MoProSoft was created (NMX-I-059-NYCE).

Since 2006, Mexico has been involved in the development of ISO/IEC 29110 by its numerous contributions. As an exemple, 2 delegates from Mexico participated to the ISO working group mandated to develop ISO/IEC 29110, Working Group 24 (WG24), in Thailand by presenting the Mexican MoProSoft standard. The members of WG24 group considered that MoProSoft could serve as the basis for the first working draft of ISO/IEC 29110 even if it was felt that the Mexican standard was targeted at a higher segment of the market (in terms of the size of the enterprise, and resources available of 50 people) than the market targeted by WG24 (i.e. enterprise, organization, department or project having up to 25 people).

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[1] Normalización y Certificación Electrónica (NYCE), http://www.nyce.org.mx
[2] Plan Nacional de Desarrollo 2007-2012

## 2. The Mexican Standard MoproSoft

The Mexican standard NMX-I-059-NYCE was developed by small and medium-sized software development companies, with the collaboration and direction of the National Autonomous University of Mexico (UNAM), through Dr. Hanna Oktaba who is recognized as the author of this model (Oktaba, 2007). In addition, representatives of the Federal Government, Academic Institutions and IT Industry participated to the development of MoProSoft. The Mexican Standard is composed of 4 parts (NYCE 2005): Part 1, Definition of Concepts and Products; Part 2, Process Requirements (MoProSoft); Part 3, Guidelines for Process Implementation; and Part 4, Guidelines for Process Assessment (EvalProSoft).

NYCE, as the National Standardization Body authorized by the Ministry of Economy in the areas of Electronics, Telecommunications and Information Technology, contributed to the development of the standard, its publication in the Official Gazette and later evaluation, once NYCE was accredited as a Verification Body (Inspection Body) in 2005. Since then, NYCE assesses compliance with the standard, determining the process capability and maturity level of the software development companies.

As illustrated in table 1, the MoProSof standard is divided into 3 categories and 9 processes. The top management category contains the business management process. Its purpose is to establish the reason for the existence of an organization, its goals, and the conditions required to achieve them. The management category consists of process management, project portfolio management, and resource management. The operations category consists of specific projects management and software development and maintenance.

| Categories | Processes | Subprocesses |
|---|---|---|
| Direction level | Business Management | |
| Management level | Process Management | |
| | Project Management | |
| | Resources Management | Human Resources and Work Environment |
| | | Goods, Services and Infrastructure |
| | | Knowledge of the Organization |
| Operation level | Specific Projects Management | |
| | Software Development and Maintenance | |

**Table 1. Moprosoft standard categories, processes and subprocesses**

The process model MoProSoft uses ISO/IEC/IEEE 12207 as a general framework. It also incorporates practices from the Project Management Body of Knowledge (PMBOK®) of the Project Management Institute.

## EvalProsoft

NYCE, being an Standardization Body, is a Certification Body and Inspection Body accredited in accordance with the requirements of ISO/IEC 17065 Standard for Product and Processes Certification Bodies and the ISO/IEC 17020 for Inspection Bodies.

Since its creation and subsequent accreditation, NYCE has been a Third Part Assessment Body which has always remained outside and independent of the implementation of processes and systems audited, so in this document we will focus on the experience NYCE in the field of conformity assessment by certification audits and/or inspections.

The MoProSoft assessment model, known as EvalProsoft, gives evaluated companies a capacity level of the implemented processes and a level of maturity.

The profile of the capability level of the implemented processes is the set of levels of capabilities achieved by the processes which are within the scope of the assessment. As illustrated in figure 1, the level of process capability is defined on a 6-level scale, where level 0 means the incomplete capability and level 5 means that a process reach the optimization level. The capability maturity level of an organization, corresponds to the maximum level of capability reached by all processes assessed..

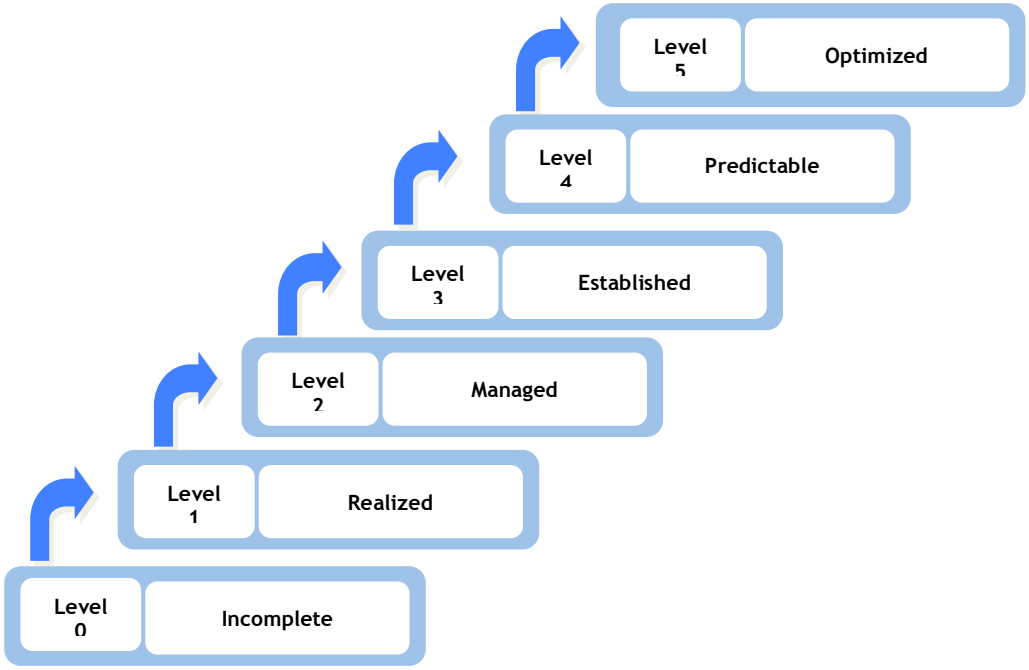
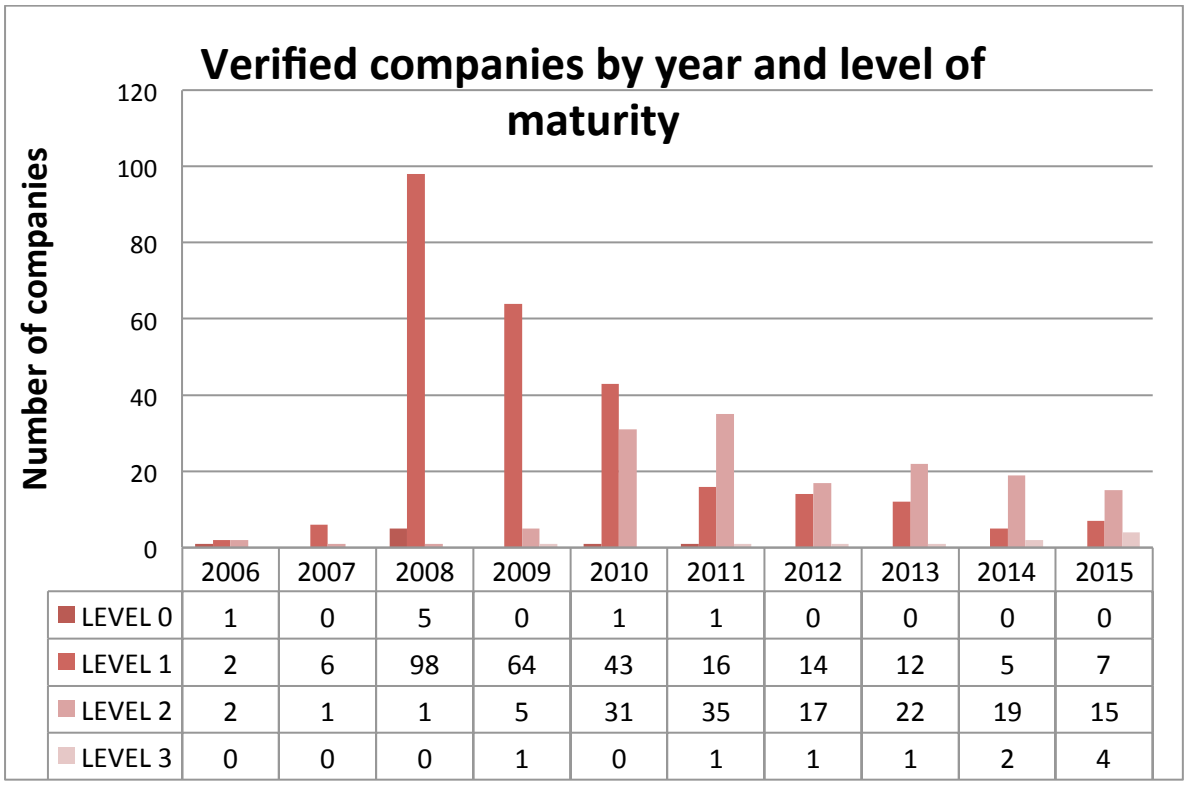



**Figure 1. Capability levels of MoproSoft**

The maturity level scheme is based on ISO/IEC 15504-2 and was used as reference for the creation of the EvalProsoft evaluation model. EvalProsoft, seen from the point of view of the process, consider the following assessment activities: preparation, planning, implementation, generation and delivery of results.

At the time of writing this article, NYCE has evaluated over 433 companies with the MoProsoft model. Figure 2 illustrates the annual statistics.




| | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| LEVEL 0 | 1 | 0 | 5 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| LEVEL 1 | 2 | 6 | 98 | 64 | 43 | 16 | 14 | 12 | 5 | 7 |
| LEVEL 2 | 2 | 1 | 1 | 5 | 31 | 35 | 17 | 22 | 19 | 15 |
| LEVEL 3 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 4 |

**Figure 2. MoproSoft Annual statistics**

## 3. The ISO/IEC 29110 standard and assessments in México

The five parts of ISO/IEC 29110, especially the management and engineering guides, have been described in many articles. But, little has been written about the assessment model of ISO/IEC 29110, whose guide is published in Part 3 of the series. Therefore we present a brief summary of how it has been used in Mexico.

Part 4 of ISO/IEC 29110 (ISO/IEC 29110-4-1:2011) defines two software profiles for the moment, the Entry profile and the Basic profile, containing the set of requirements that organizations and software development systems must meet to reach a certain level of maturity. According to the development plan of the ISO/IEC 29110 series, two additional profiles, the Intermediate and the Advanced profiles, will be developed. They will descibe processes relating to the management of VSEs.

Part 3 of ISO/IEC 29110 (ISO/IEC 29110-3: 2013), which is the Evaluation Guide, based its model on the ISO/IEC 15504 standard, which is an evaluation model that measures the capability of the processes and maturity of organizations. As defined in Evalprosoft, it establishes that for the Basic profile the evaluations will be conducted looking that the evaluated companies comply the level 1 of maturity (Realized) in the two processes that defines Part 2 (Project Management Process and Software Implementation Process), using the model of assessment described in ISO/IEC 15504 standard.

For Mexican's VSEs, engaged in software development, that have implemented the Moprosoft Mexican model, it is relatively easy for them to achieve compliance with the Basic profile of the ISO/IEC 29110, since there is only a small gap between the level 2 of MoproSoft and Basic Profile of ISO/IEC 29110, thanks to the two compatible models in many of their requirements and the evaluation model.

NYCE has not found difficulties during the evaluation process, which is carried out in 1 day. We have already evaluated 13 companies since the autumn of 2013, when NYCE achieved the accreditation as a Certification Body. The list include one Company from Medellín, Colombia. Figure 3 lists the numbers of VSEs certified by location in Mexico and other countries and year of certification.

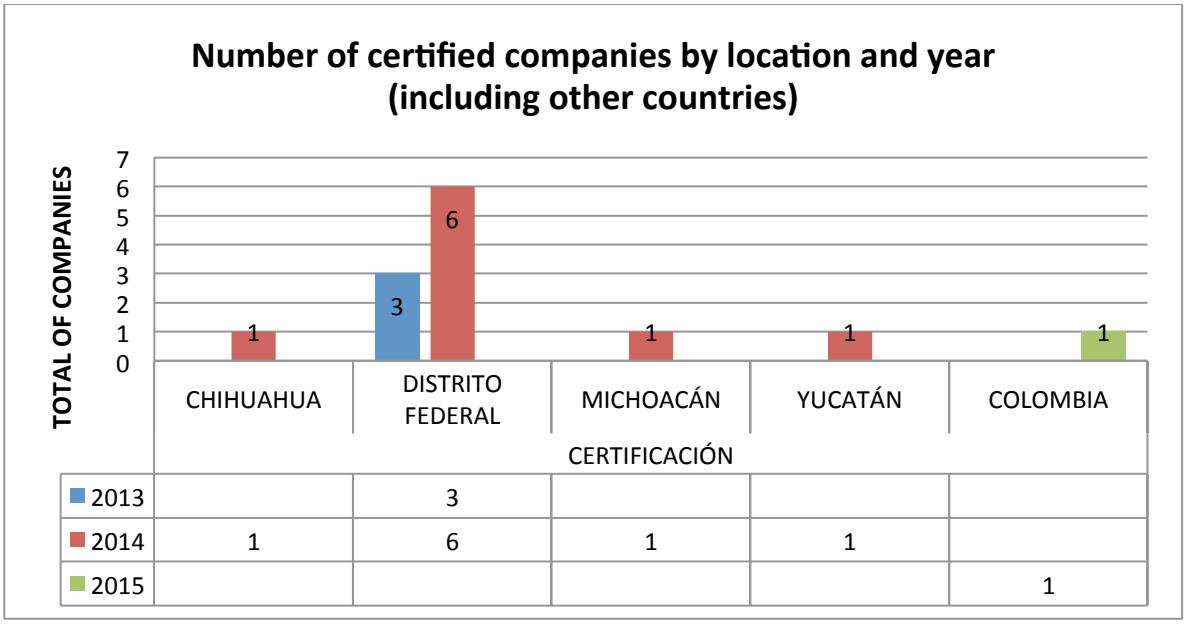



**Figure 3. Certified organizations in Mexico and other countries before ISO/IEC 29110**

Given the experience of 8 years performing MoproSoft assessments with the EvalProsoft model, in services such as gap analysis, pre-assessments and formal assessments, we firmly believe that NYCE assessors have accumulated more experience than others with this model in those years. Today, NYCE has 2 full-time assessors, 3 evaluators who belong to the organization but are assigned to other audits such as ISO/IEC 20000 and ISO/IEC 27000, and two additional external

auditors. All auditors have been qualified and certified by NYCE, in a system based on ISO/IEC 17024 which establishes the rules for the certification of persons, standard which NYCE is also accredited.

Of the 12 Mexican companies that have been certified with ISO/IEC 29110, two of them already had a follow-up audits. ISO/IEC 29110 follow-up audits are conducted once a year by NYCE.

The Mexican government has the firm conviction of supporting software development companies and continues to provide financial resources for companies wanting to implement quality models and becoming certified. ISO/IEC 29110 standard is already in the list of models that are supported by the government. The government supports between 15% to 25% of the total project cost. The remaining 75% will be paid by the VSE. Table 2 presents an overview of ISO/IEC 29110-related activities in Mexico.

| | |
|---|---|
| ISO 29110 certificates have been issued | 13 |
| ISO 29110 certifications are targeted in 2015 | 10-12 |
| ISO 29110 implementations have been completed recently | 13 |
| ISO 29110 implementations are being conducted in 2015 | 2-5 |
| ISO 29110 auditors/assessors | 3 |
| Government objective | 10 in 2015 |
| Government support for implementation and/or certification | 25% |

**Table 2. Overview of ISO/IEC 29110-related activities in Mexico**

## Deployment Packages

NYCE has developed an application that provides support for companies during the implementation of MoproSoft. The tool illustrated in figure 4, called KWE version 2.0, has been modified so that it can also be used during the implementation of ISO/IEC 29110 standard. It contains artifacts (templates) that store documents and records requested by the standard.

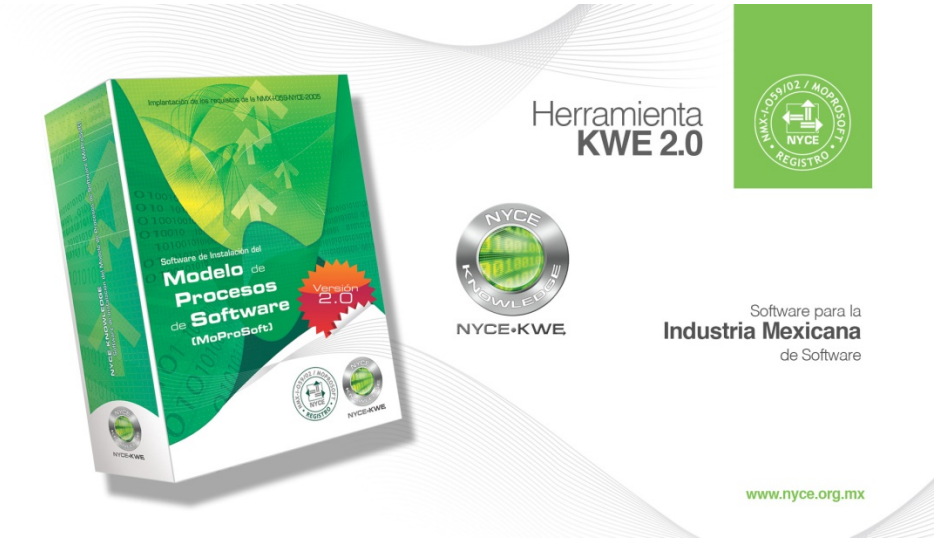



**Figure 4. Tool to support MoproSoft and ISO/IEC 29110 implemetations**

## 4. ISO/IEC 29110 Assessments and Evaluations

Mexican companies are quite satisfed that the ISO 29110 evaluation is performed according to ISO/IEC 15504 standard, as there is already some knowledge about maturity models and the method used to evaluate MoproSoft. The ISO 29110 evaluation model was developed that way because the intention of the Mexican Government was to help Mexican companies increasing their maturity over time as well as to help them refine their development processes.

Currently, VSE's Mexican companies have encountered difficulties in achieving high levels of maturity (i.e. from 3 to 5) for different reasons. One of those reasons is the difficulty small businesses have just to stay in business. Today between 30% to 40% of companies that were evaluated have disappeared, a phenomenon that is repeated in other Latin American countries.

Nevertheless, 60-70% of companies, still remaining on the market, have in mind to increase their levels of maturity. Some companies try and other only think that it will be possible in the future. Companies hope that the number of development projects increases substantially, allowing them to pay the cost of ISO 29110 implementation and evaluation.

ISO/IEC 29110-3-2, is the assessment model based on compliance audits (as in ISO 9000) and ISO/IEC 29110-3-3 is the evaluation model based on process measurement maturity (as in ISO/IEC 15504). For the companies that want to implement level 1 and level 2, based on ISO/IEC 15504 model, it would be very difficult or almost impossible, to switch to the another standard such as ISO 9000. None of these standards or models is better or worse than the other. One problem is that they are not equivalent, and it will bring confusion to the Information Technology Industry. A second problem is that there are no criteria about to selection of one model. It seems that countries will determine which one will be the preferred model.

## 5. Next Steps in Mexico

The Federal Government has created the Prosoft 3.0. A new version of the public policy directed to the Information Technologies Industry. The main goal of this policy, among others, is to get 1000 certified companies in 2018. This number includes models such as MoproSoft, CMMI, ISO/IEC 20000, ISO/IEC 27000 and ISO/IEC 29110. The challenge is huge, but the government, the industry, the academics and organizations, such as certifications bodys, have aligned their efforts to get it.

Also, as part of the National Program of Standardization (Programa Nacional de Normalización 2015, PNN) is included the revision of the Moprosoft standard. The intent is to realign the requirements of the levels 3 to 5 to find the best approach of the model by the companies. We hope to have a new version at the end of 2015.

On the other hand, among participating in JTC1/SC7 WG24, I have been representing Mexico under the Spanish Translation Task Force (STTF) which has the mission to translate the published standards of the series ISO 29110 in spanish. Once the documents have been translated and approved by the international group (countries participating are Spain, Uruguay, Peru, Costa Rica, Colombia and México), NYCE as the Standardization Body for Information Technologies matters in México, will publish them as Mexican Standard (Norma Mexicana - NMX).

## 6. Conclusion

ISO/IEC 29110 standard will succeed in Mexican software development companies as well as the MoproSoft standard. The reason is simple: VSEs represent between 80% to 90% of Mexican development companies, and each VSE strives to be a little more competitive and profitable than its nearest competitor. Also, some of them think about entering international markets and therefore, an international certification would allow them to compete with foreign companies.

However, obtaining the consensus of WG24 participating countries, about the best evaluation model, has been dificult. Each country had been doing its best to carry on the best practices to its industry but the points of view from one country to other are different and now two evaluation models could generate confusion on the market. I think that the countries must have an agreement to have only one evaluation model. Some countries already have accredited certification bodies (México and Brasil) and there are many certified companies. So, to change the evaluation model will be difficult but it must be done in order to gain simplicity, international recognition and global adoption of the ISO 29110 standard.

In Mexico, although it is convenient to use the evaluation model of process maturity, IT companies could surely comply with a different model, as long as it is defined as the standard for all companies around the world. That is the only way that the assessments made in any country are recognized worldwide. If there are two evaluation models, there could be confusion.

**For more information**

- https://www.nyce.org.mx/sistemas-de-gestion-iso/
- List of ISO/IEC 29110 certifications issued in Mexico
    - https://www.nyce.org.mx/wp-content/uploads/2015/10/listaempresasiso29110.pdf

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ISO/IEC TR 29110-5-1-2:2011 Software engineering - Lifecycle profiles for Very Small Entities (VSEs) - Part 5-1-2: Management and engineering guide: Generic profile group: Basic profile. (2011).

# Annex E

# Activities in Peru

# By Abraham Dávila

# The Peruvian Software Industry Evolution and the ISO/IEC 29110

## An Approach developed by the Pontifical Catholic University of Peru

**Abraham Dávila**

**Abstract**: A well-established software industry is a key element in the development and progress of society. This development can be seen in the benefits offered by the software to organizations and people. However, the consolidation of this industry is not spontaneous and instead requires much effort, a sum of wills and solid skills, among others; all these have to be built or encouraged over time. In this document, the achievements and challenges for Peruvian software industry and the actors directly related from the academic perspective are identified. For this work, a reflection was conducted based on the facts from the Pontificia Universidad Católica del Perú. The impetus given by the University to the adoption of the ISO/IEC 29110 in the Peruvian industry has been successful but still requires the support of key institutions (public and private) to magnify the benefits of its application in software development organizations, its customers and society in general.

## 1. Introduction

Software is a key element in our society, used intensively by people and organizations. However, software still has characteristics which generate unwanted situations among its users, deficiencies which are related to the process followed for its construction and the operating conditions in a specific context. With respect to the first issue, the production of software has been and is a concern for many actors, and improve software process is very important to improve product quality. About the second issue, the need to solve situations that affect the operation of an organization, such as incidents (or problems among others), has led to the establishment of information technology services management models. This concern for the processes to develop software products and managing software services has been addressed by the Development in Software Engineering Research Group (GIDIS) at the Pontifical Catholic University of Peru (PUCP), which has deployed various actions joint with the industry and contribute to strengthen it.

Peruvian software industry is composed, largely, by micro and small companies, which have the same problems of quality and productivity than the most companies in the world. Also, several national companies have chosen to expand its offering by incorporating various services related to its core activities and specialized services; which contribute to a more stable cash flow. Peruvian software industry is young and despite its growth in recent years, it has high possibilities to continue growing and exporting services. However, to achieve this growth, certain conditions, especially at the national level, are required. On the other hand, the Peruvian software industry, as in other parts of the world, has several relevant stakeholders such as: (i) government, which may be regulatory or a big buyer, (ii) companies that may be business partners (new initiatives) or

potential customers, (iii) academia (universities or technical institutions) that train people who work in organizations, and (iv) other relevant organizations in the sector.

The remaining of this work is presented as follows: in Section 2 the relevant actors of the Peruvian software industry are presented; in Section 3, the actions directed from GIDIS-PUCP; and in Section 4, the reflections and future work on ISO/IEC 29110 in Peru are discussed.

## 2. Relevant actors in Peruvian Software Industry

Peruvian software industry has many stakeholders who have contributed to a greater or lesser degree in its development. The actors grouped by sector are presented below; these actors have contributed directly or indirectly to actions undertaken by GIDIS:

- Government Sector
  - ONGEI (National Office of Electronic Government and Information) is responsible for all informatics related subjects in the Peruvian government at national level. In 2004, ONGEI established the adoption of NTP-ISO/IEC 12207 and NTP-ISO/IEC 17799 as mandatory for all government levels. Later, in 2012, ONGEI retired ISO/IEC 17799 and adopted ISO/IEC 27000.
  - INACAL (National Quality Institute) is in charge, since 2015, of the national standardization in Peru and the participation of the international bodies such as ISO. Previously this responsibility was held by INDECOPI, who got the adhesion of Peru, first as an observer member and then as a plenary member of ISO. The beginning of Peru's participation in the ISO/IEC JTC1/SC7 WG24 occurs at the WG24 meeting of Mexico in November 2008.
  - FINCYT and INNOVATE PERU are grant funds programs provided by the government to strengthen technological innovation in businesses and universities. Since July 2015, they provide funds for quality certification processes for different industries, including software.
- Business and Professional Sector
  - APESOFT (Peruvian Association of Software Producers), established in August 2000, represents companies that produce software in Peru. APESOFT carried forward from 2004 to 2006, along with the Chamber of Commerce of Lima, the PACIS project to drive process improvement in the Peruvian software industry.
  - CCL (Chamber of Commerce of Lima) besides PACIS executed the RELAIS project (2010 – 2013), to implement process models in small software development companies.
  - CAPETI (Peruvian Chamber of Information Technology), APESOL (Free Software Association) and Departmental Council of Lima (CD-Lima) of the College of Engineers of Peru (CIP) have participated in various initiatives organized by GIDIS, as well as the Competisoft project (2007-2008), Competisoft-Perú project (2009-2011) and ProCal-ProSer project (2014-2016).

## 3. Actions directed by the PUCP in the software industry

GIDIS-PUCP was formed in 2001, initially to contribute to the development of courses of the undergraduate informatic engineering program, having among its members, professors and undergraduate students. Soon GIDIS members initiated actions for the national software industry. A summary of the activities of GISDIS-PUCP has is described below:

- In 2003, it established the Standardization Technical Committee on Software Engineering and Information Systems (CTN-ISSI), which acts as secretary, since and is attached to the National Standardization Agency (then INDECOPI).
- In 2004, the ISO/IEC 12207 was published, which in a few weeks was declared by ONGEI as mandatory for all instances of the Peruvian government use.
- In 2007, GISDIS-PUCP started its participation in COMPETISOFT, where the implementation of MoProSoft (Mexican model) was achieved in 22 companies in Lima, Trujillo and Arequipa. Over 40 undergraduate students were trained in process improvement with MoProSoft.
- In February 2009, the official international course on ISO/IEC 15504 was developed and 4 members of GIDIS obtained the status of assessor.
- In May 2009, the NTP-291.100-1:2009 was published. NTP-291.100-1:2009 is a standard adopted by the Mexican industry (based on MoProSoft). That specific number is assigned to make it closer to the ISO/IEC 29110 that was being prepared.
- In 2010, the Institute for Quality of PUCP granted certification to five companies in the NTP-291100-2 based on ISO/IEC 15504-2, as part of COMPETISOFT-Peru Project (3rd Stage).
- In 2012, ISO/IEC 29110 Parts 1, 3 and 5-1-2 were published, which were spread in several cities.
- During the second term of 2012, ISO/IEC 29110 was introduced in two undergraduate courses of PUCP: software development project 1 and 2. Both courses have teams composed by 5 students. In the first course every team develops separately their project (same problem) while in the second course they work together in only one project (software development and integration).
- In November 2013, IC-PUCP certifies what would be the first Peruvian software development company to achieve the Basic profile of the ISO/IEC 29110.
- In December 2013, GIDIS starts the ProCal-ProSer project, with funding from the government, to initiate a pilot implementation in 10 companies in Trujillo, Arequipa and Lima. To date more than 50 people have been involved, including undergraduate and graduate students and faculty with good results in the academic and business worlds.
- In November 2014, the development of a service management model aligned to the ISO/IEC 29110 which is at stage of field testing was completed. In November 2015, an improved version of the model is published. It has been circulated to international experts for review.
- In May 2015, the ONGEI declared (an unofficial version) its interest in adopting the ISO/IEC 29110 Parts 1, 3 and 5-1-2 as standards for government units as a way to adopt the ISO/IEC/IEEE 12207.

There have been many activities (e.g. conferences, workshops, forums) in different cities across the country aimed at professionals and students to disseminate ProCal-ProSer COMPETISOFT-Peru projects, emphasizing the issue of quality of process using the ISO/IEC 29110.

## 4. Reflections and future work related to the ISO/IEC 29110 in Peru

From the interactions and experiences with small businesses and informatic units from the public and private sector, it was observed that, in addition to software development, these organizations also have the responsibility to keep in operation software products delivered.

Also, for government institutions, they have responsibility to address other related information technology needs. This situation sets a particular need for organizations that develop software and provide software services. To attend that need, within ProCal-ProSer project an ad-hoc process model called service management Basic profile was developed. This process model is based on the Basic profile of the ISO 29110 and IT service management models (for example ITIL, ISO/IEC 20000 and CMMI for Service). The proposed model is under review and pilot projects are conducted to determine their applicability to organizations mentioned earlier. It is a goal of GDIS-PUCP to raise this document to the status of a national standard and contribute to this kind of organizations.

From the experience in software development process models implementations in small businesses (22 conducted in Competisoft project and 10 in ProSer ProCal project), it can said that MoProSoft and the Basic profile of ISO/IEC 29110 for software development are comparatively easier to implement than other process models. However, there are internal and external difficulties to each organization that must be considered to achieve success in their activities. An internal difficulty, in each organization, is related to the level of technical knowledge for the software engineering professional; for which universities have a big responsibility, being necessary to review their curriculum and align it more to the discipline of software engineering. An external difficulty, in public informatics units, is that the tender and contract regulations do not allow them to require certifications for their suppliers, which ends up in projects with deficiencies that need to be maintained. For this difficulty, ONGEI should consider a gradual adoption strategy of a requirement for an ISO/IEC 29110 certification. For example, giving bonus points in a tender process to suppliers that hold the certification. Another external difficulty in small businesses is the low level of demand for services (small market). To address this difficulty, enterprises associations such as APESOFT, APESOL, CAPETIC or CCL, among others, should encourage its partners to define and implement more appropriate ways of marketing strategies of offering service export. There are other difficulties, but not related to information technologies, hence, they have not been considered in this reflection.

From the interactions with businesses, we noted that they understand that quality is a necessity to grow as an organization. But, they are not always aware of the cost and effort that need to be invested and the potential benefits involving these adoptions. Enterprises associations such as APESOFT, APESOL, CAPETIC and others should work harder sensitizing companies to understand the benefits of quality.

Finally, we want to remarks that Peruvian Government, companies (employers) and universities, should meet and set goals as a country: (i) to achieve greater adoption of software engineering and management best practices, such as the ones described in ISO/IEC 29110, because best practices contribute to develop software products with better quality; (ii) to introduce ISO/IEC 29110 and techniques related in university courses for increase software development capability in students and professionals; and (iii) to establish national regulation (e.g. certification of ISO/IEC 29110) to increase qualifications in the acquisition process from governments offices.

# Annex F

## Activities in Thailand

**By Anukul Tamprasirt, Tanin Uthayanaka and Sanyakorn Buasung**

# ISO/IEC 29110 Framework for Government Procurement of Thailand

Anukul Tamprasirt, Tanin Uthayanaka, Sanyakorn Buasung

**Abstract**

The development of the set of ISO/IEC 29110 standards and technical reports was initiated in Thailand in 2005 to facilitate the development of software by very small organizations. In Thailand, very small organizations represent over 90% of the software industry. After describing the important role played by Thailand, we describe how the Thai government addressed the issues raised by software suppliers as a standard complicated and difficult to implement. The project to develop an ISO/IEC 29110 government procurement handbook is intended to align the demand and supply constraints using ISO/IEC 29110 work products and related processes in order to increase the implementation in small Thai software organizations. Finally, we describe the Thailand approach concerning the recent systems engineering and service delivery additions to the ISO/IEC 29110 family.

**Keywords**

ISO/IEC 29110 • Very Small Entity (VSE) •Thailand •System and Software • Trial • Deployment Package • Defector Standard •IT Service Framework •Government Procurement

## 1. Introduction

Since ISO/IEC 29110 was initiated, the important of the standard implication remains the priority objectives of the on-going of the standard development and improvement. Thailand as one of the vital parts of the ISO/IEC SC7 designated working team for the development of this, Thailand has gone through initiations and pilot projects even before the ISO/IEC 29110 formally published in 2011. The projects range from building awareness for software and related industries, assessor development, academic program initiation, ASEAN (Association of Southeast Asian Nations), APEC (Asia-Pacific Economic Cooperation) and international partnership programs and etc. With the strong support from the Ministry of Information and Communication Technologies of the Royal Thai government, the new pilot project is initiated in 2015 to implement system and software delivery framework using ISO/IEC 29110 to facilitate ICT procurement for Thai government.

## 2. Background

### 2.1 Thai Quality Software (TQS) standard

In 2003, Thai small setting reference model 'Thai Quality Software' (TQS) was initiated by *Mr. Anukul Tamprasirt, Mr. Tanin Uthayanaka and Mr. Sanyakorn Buasung.* The TQS was a response to many constraints imposed to the software process improvement when applying

large reference models, such as CMMI®, to the small software organizations. With the objectives of developing a version of a reference model suitable for the Thai requirements in the conjunction with the well-defined processes for international acceptance, TQS was created a bridge model using a staged implementation of ISO/IEC/IEEE 12207 software lifecycle process standard. The TQS reference model was introduced by the assistant of *Mr. Stan Mcgee* under the supporting funding from the KENAN Institute. TQS was developed to respond to the following issues:

- It was impossible for Thai SMEs to implement the vigorous software processes of frameworks such as CMMI® or ISO/IEC/IEEE 12207
- Not all of the large process activities of such frameworks are suitable for Thai SMEs.
- Budget and time are the major constraints for the scope of software projects.
- In order to have an acceptable reference model, certification must be available to credit the effort made.

The TQS reference model was developed using the following guidelines:

- ISO/IEC/IEEE 12207 will be broken down into stages in order to match capability measurement similar to CMMI which Thai's software industry familiar with.
- A set of templates and examples to avoid the misinterpretation of the process guidance will be provided.
- A set of checklists for assessments guidelines will be developed.

The TQS provides a 5-stage implementation of ISO/IEC/IEEE 12207, where each stage ensures an improvement of the software development process. TQS focused on level 1 and 2 and the coordination of the certification methods. TQS comprises in 3 main processes: Primary Life Cycle Process, Supporting Life Cycle Process and Organizational Life Cycle Process. Table 1 lists the ISO 12207 processes implemented in the 5 levels of the TQS reference model.

| Level I | Level II | Level III | Level IV | Level V |
|---|---|---|---|---|
| Process implementation | Process implementation | Process implementation | Process implementation | Process implementation |
| Software requirements analysis | Systems requirements analysis | Systems requirements analysis | Systems requirements analysis | Systems requirements analysis |
| Software architectural design | System architectural design | System architectural design | System architectural design | System architectural design |
| Software coding and testing | Software requirements analysis | Software requirements analysis | Software requirements analysis | Software requirements analysis |
| Software acceptance and support | Software architectural design | Software architectural design | Software architectural design | Software architectural design |
| | Software coding and testing | Software detailed design | Software detailed design | Software detailed design |
| | Software installation | Software coding and testing | Software coding and testing | Software coding and testing |
| | Software acceptance and support | Software integration | Software integration | Software integration |
| | | System qualification testing | System qualification testing | System qualification testing |
| | | Software installation | Software installation | Software installation |
| | | Software acceptance and support | Software acceptance and support | Software acceptance and support |

**Table 1. Breakdown of the TQS software development process**

The model underlined the different processes implemented at 5 capability levels, and each level had different requirements (L1= records, L2= procedures, plans, and L3, L4, L5= more processes). Table 1 illustrates a subset of the breakdown, from level I to level V, of the TQS reference model.

However, in spite of the TQS 5-stage approach, VSEs found it too complicated and difficult to implement and were not able to foresee the benefits of improving their software processes.

### 2.2 From TQS to ISO/IEC 29110

With more understanding about Software Engineering and the importance of "OPEN" standards, in 2004 the Thai Technical Committee (TC-967) was established and began to participate to the program of work of ISO/IEC SC7 in 2005. Then, Thailand realized that situation facing the country was not different to the rest of the world where about 90% of the software firms are very small organizations. TC-967 with the support from Thai government, in collaboration with a few other countries, proposed a new area of international standard development for very small organizations to SC7.

In March 2005, a special working group (SWG) for the small settings was created and met first time in Thailand with the support of the Thai Government with the commitment to address the fundamental issues of the global software industry for SMEs. The meeting was attended by delegates from Australia, Belgium, Canada, the Czech Republic, Finland, South Africa, South Korea, the USA and Thailand (Laporte et al 2008).

The term 'Very Small Enterprise' (VSE) was first introduced to clearly define targeted audience of the future software standard by the SWG. VSE concept based on a paper of the Centre for Software Process Technologies of Ireland (McFall et al 2003). As illustrated in Figure 1, the priorities and concerns of organizations with fewer than 20 employees are quite different from those of larger organizations. As an example, medium and large organizations rank process adherence higher than do small organizations. For the latter, managing risk is of great concern; while for larger organizations this ranks as priority number 8 only. Conversely, for small organizations, consistency across teams is less of a concern, while for larger organizations it is a top-priority issue.

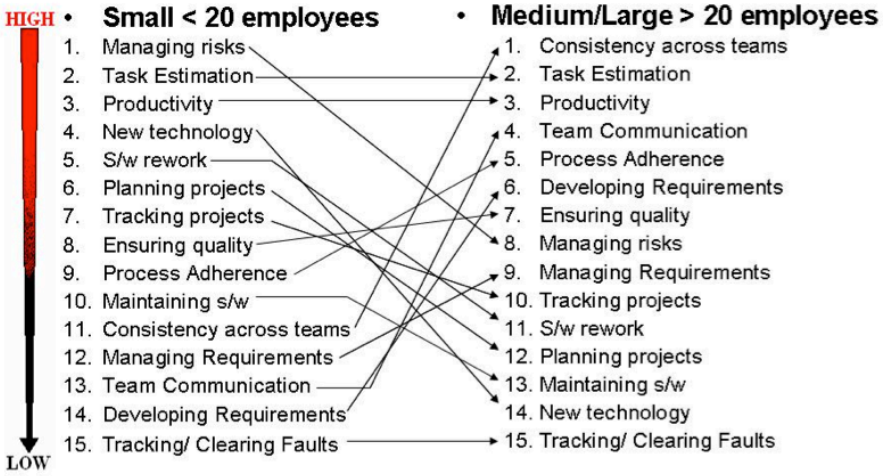


**Figure 1. Priority and concern differences based on organization size** (McFall et al 2003)

The definition of VSE was initially proposed by Dr. Claude Y. Laporte and a consensus was achieved by the SWG and the actions that could be undertaken by a future ISO/IEC SC7 working group was developed. VSEs were defined, in 2005, as enterprises having up to 25 people. A few years later, the term VSEs was modified to include not only enterprises, but organizations (such as government organizations or not-for-profit organizations), projects and departments having up to 25 people. The architecture of the future ISO/IEC 29110 standard is credited to Mr. Jean Bérubé of Canada. It is based on the concept ideas of reusing existing standards without reinvent the wheels by developing International Standard Profiles (ISPs).

In 2005, Working Group 24 (WG24), under ISO/IEC SC7, was established as one outcome of the 2 SWG meetings in Thailand. ISO appointed Mr. Tanin Uthayanaka (Thailand) as the WG Convener, Mr. Jean Bérubé (Canada) as the Secretary, Mr. Claude Y. Laporte (IEEE Computer Society) was appointed Project Editor along with the idea creator, Mr. Anukul Tamprasirt, as a

supporting role in the business planning working group (SWG1). The action items of WG24 were:

- Validate the work products produced by the SWG;
- Prepare, conduct, analyze and communicate survey results;
- Search for other centers/organizations focusing on SMEs and VSEs;
- Assemble a complete list of characteristics of VSEs and projects;
- Generate multiple profiles from the standards mentioned above;
- Prepare communication material to inform VSEs about the work performed by the WG;
- Develop business cases for the adoption and deployment of work products developed by the WG;
- Develop one or more ISO/IEC/IEEE 12207 roadmaps;
- Pilot roadmaps (using an approach similar to the trials conducted by the SPICE project).

The first version of ISO/IEC 29110 standard was published by ISO in 2011. Today, software industry around the world has the formal "OPEN" ISO/IEC 29110 standard to help meet the industry needs from the dedication of WG24 members around the world such as Mexico, Thailand, Canada, Ireland, South Africa, Luxemburg, Belgium, Australia, Finland, South Africa, the Czech Republic, South Korea, Japan, Peru, Argentina, France, Germany, USA, Spain, and Brazil.

The membership to WG24 has been growing significantly over the years due to the belief that "**it is a standard suitable for the majority of the entities in the software ecosystem**" since it respond to the needs of industry and many government organizations. The ISO/IEC 29110 standards and guides should evolve and continue to respond the on-going industry demands as it intended to when it was created.

## 3. Implementation of ISO/IEC 29110 in Thai VSEs, Universities and Government Agencies

Even before the publication of ISO/IEC 29110 by ISO in 2011, Thailand had already promoted its implementation.

Table 2 lists the ISO/IEC 29110 activities that were conducted in Thailand in 2015 as well as the actual number of VSEs that have been granted an ISO/IEC 29110 certificate.

| | |
|---|---|
| How many ISO 29110 certificates have been issued ? | 300 |
| How many ISO 29110 certifications are targeted in 2015 ? | 15 Government<br>30 VSEs |
| How many ISO 29110 implementations have been completed ? | 50 Government<br>40 VSEs |
| How many ISO 29110 implementations are being conducted in 2015 ? | 30 + |
| How many ISO 29110 auditors/assessors ? | 20 + |
| Any Government Strategy and/or objective ? | |

| | |
|---|---|
| Any Government support for implementation and/or certification ? | 90% Government Funding |

**Table 2. ISO/IEC 29110 state of practice in Thailand in 2015**

## 4 Ongoing Issues of the Supply side of ISO/IEC 29110 Standards

ISO/IEC 29110 was established based on the belief of the "right sizing" or even the minimization of the number of artefacts to resolve the issue of constraints rather than the ideology of engineering for quality per say. Evident from the 2006 survey conducted by WG24. Over 435 responses received from 32 countries (Laporte et al 2008) are the perpetually facts that VSEs focusing on the short term gain rather than best practice standards adaption for the long term benefits. Figure 3 illustrates the positioning of ISO/IEC 29110 in the spectrum of approaches. ISO 29110 is located in the middle of the level of ceremony, from a low ceremony approach with little documentation (e.g. agile approach) to a high ceremony approach with a comprehensive documentation (e.g. plan driven CMMI® approach) and the level of risk, a top part of the low risk with linear approach using a waterfall approach while a risk-driven project using an iterative approach in the lower part of the chart.


**Figure 3. Positioning of the ISO/IEC 29110 (adapted from Kroll and Kruchten 2003)**

## 5 The new demand side requirements of ISO/IEC 29110

Since 2010, Thailand has gone through multiple cycles of ISO 29110 deployments. Over 300 VSEs have implemented ISO 29110 and have been formally assessed. Even with the government funding support, 90% of VSE in Thailand are still questioning the benefits of standard ***which concurred to the assumption that VSE focus on the immediate economic implication rather that the adoption ISO 29110 practices for long term benefits***. Therefore, it is not only the benefit of implementing the standard and learning to be better software organizations with software process and software engineering. It is also the competiveness

building efforts for the government to support VSE by aligning with the quality of demands to the work of the supplier.

## 6. The Government Procurement handbook

With the support from the Ministry of Information and Communication Technologies of the Royal Thai government, the government procurement handbook project, based on ISO/IEC 29110, was initiated in 2015. The initiative is not primary concern on the supplier as previously done in the past. However, it introduces the perspective of minimum requirements to align supplier's work outcome. The scope of the project includes the training of 200 government officers from governmental related entities with ICT budget approved projects. The project range from software coding, system and software implementation, share services, etc. By using the ISO/IEC 29110 systems and software engineering and service delivery guides and ISO/IEC related work products, the pilot project targets to go through the complete cycle of deployment from initiation, development phase, the deployment and certification phase by the first quarter of 2016.

The government procurement handbook is based on the requirements driving the process development to satisfy the service provided from government procurement requirements as show in figure 4. The final goal of government IT system consists of:

- Availability Management
- Capacity Management
- IT Service Continuity Management and
- IT Financial Management

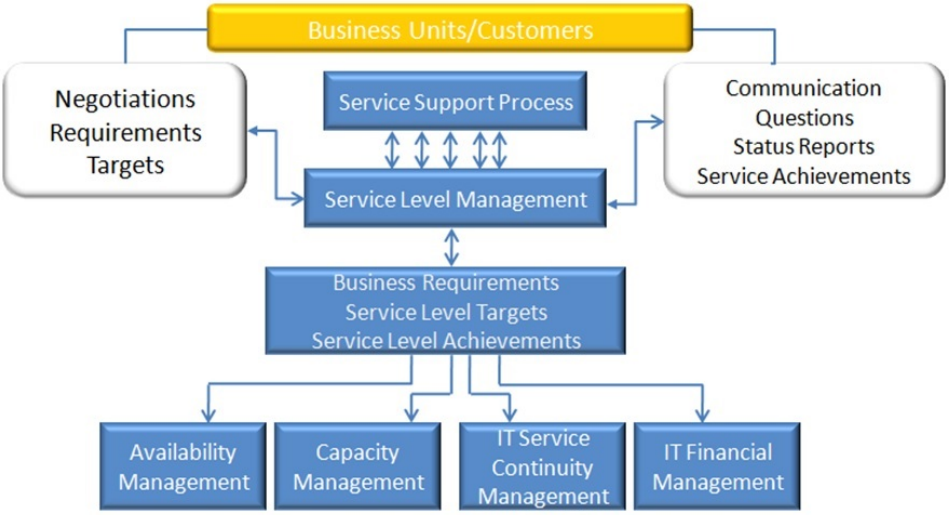


**Figure 4. Referring ITSM Process Assessment Supporting ITIL (Renault et al. 2009)**

With 3P modeling, the procurement handbook consists of 3 process activities (selective) in order to produce required products and services with appropriate resources right from the

beging of the project as showed in figure 5. This addresses 60% of the services required by ICT system where by the ICT goverment services may require even higher.

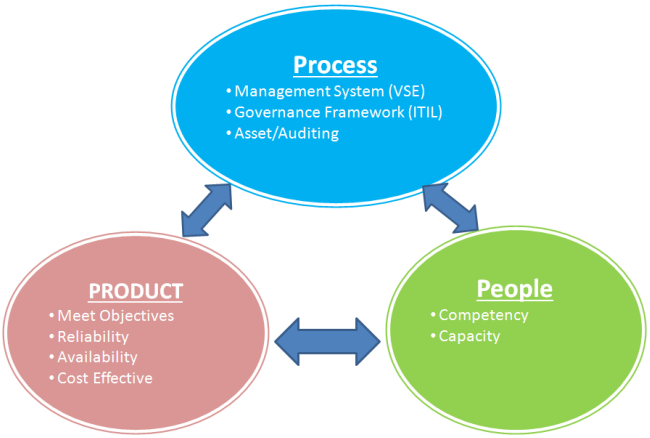


**Figure 5. Modified 3P Modeling**

## Government Handbook Deployment Packages

Witht the novel approach of the Deployment Package (DP) of ISO/IEC 29110, a set of tools will be provided as a part of the handbook to define guidelines mapping in details the processes and work products. The elements of a DP include processes, activities, tasks and steps, templates, checklists, references and a list of tools to be used as part of going development and delivery. The overview of DP of the handbook as shown in figure 6.

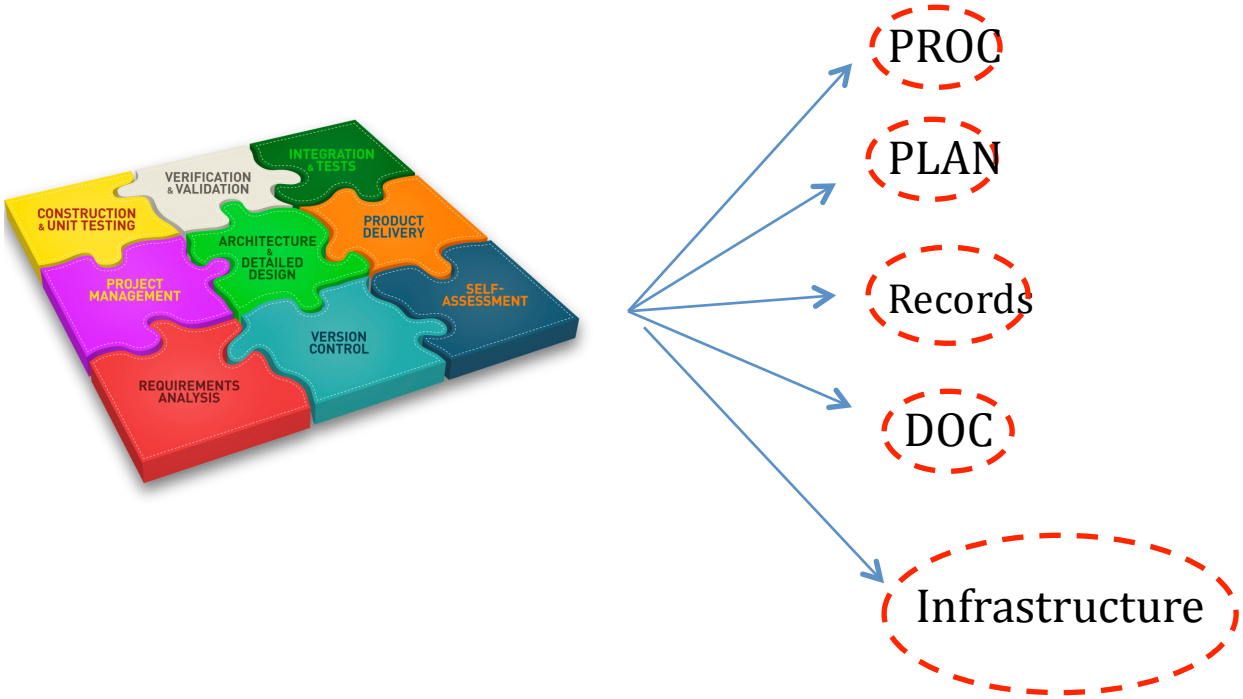


**Figure 6. Thai Government Handbook DP**

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# Annex G

## Activities in Thailand

**By Thanwadee T. Sunetnanta, Sujimarn Suwannaroj and Prakit Sangpar**

# ISO/IEC 29110 for Competitiveness - Challenges of Digital Cluster Development in Thailand

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**Abstract**

Quality plays a vital role to the growth of small and medium enterprises, especially when facing with competitiveness of their products in global challenges. As quality products begin with a well-defined product development process, the promotion and support of digital cluster development in Thailand therefore set forth the implementation of process standards in response to its competitiveness challenges. This paper presents the project activities and the preliminary result for ISO/IEC 29110 implementation to take up such challenges.

## 1. The Development of Digital Cluster in Thailand

Cluster development has become the focus of strategic approach for capacity building of industrial and economic development in Thailand since 2004 (http://www.thaicluster.com/). The well-known definition of clusters is that "a cluster is a geographical proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and externalities" (Porter, 1998 p.125). In Porter's view, clusters have the potential to affect competition in three ways: by increasing the productivity of the companies in the cluster, by driving innovation in the field, and by stimulating new businesses in the field (Wikipedia, 2015). The initial targeted clusters of Thai government programmes in the Thaksin government were (i) food cluster from the vision of being Kitchen of the World, (ii) automotive cluster from the vision of being Detroit of Asia, (iii) fashion cluster from the vision of being Asia Tropical Fashion, (iv) part of software cluster from the vision of being World Graphic Design and Animation Centre, and (v) tourism cluster from the vision of being Asia Tourism Capital (Intarakumnerd, 2010). Later, the development of *ICT cluster* in Thailand was moved forward for core IT-related businesses, including hardware, software, services, and communications companies, located mostly in Bangkok and the central part of Thailand (Charoen, 2012) and became part of super cluster in the cluster policy of Thai government at present (Thailand Board of Investment, 2015).

In 2015, the Office of SMEs (small and medium enterprises) Promotion (OSMEP) Thailand and its alliances under Ministry of Interior, Ministry of Industry, Ministry of Agriculture and

Cooperatives and Ministry of Science and Technology of Thailand joined forces to further deploy cluster-based economic development strategies to strengthening competitiveness and productivity of SMEs in Thailand. Along that, the initiatives were set to develop 54 clusters of which 7 including digital cluster were under the responsibility of the Federation of Thai Industries (FTI) as one of the key partners in the initiatives. To this end, the development of software or ICT cluster was revised to become the development of *digital cluster* spanning over three main digital products of *software*, *software services* and *digital contents*.

For the development of digital cluster in Thailand, there are many valuable lessons to learn from the past. Although the development of Thai ICT cluster gained much attention and high expectations, it did not yield the expected results due to several reasons as addressed in (Charoen, 2012). The barriers to the development of Thai ICT cluster include unclear direction for cluster policy and management by the government, weak collaboration among the cluster members, occasional legal battles among institutions in the cluster and with the government agencies, the instability of the political and legal systems and government corruption, and government interference with competition which impeded the normal functioning of the cluster (Charoen, 2012).

This paper focuses on productivity issues for leveraging the growth and competitiveness of digital cluster, rather than tackling political and management barriers. Towards that, we will discuss how ISO/IEC 29110 implementation can be driven as a key to the competitiveness challenges of Thai digital development and we will present the project activities that were carried out by FTI and SIPA – Software Industry Promotion Agency (Public Organisation) Thailand to implement ISO/IEC 29110 for such challenges.

## 2. The Demands of Process Standards for Competitiveness Challenges of Thai Digital Cluster

As quoted in (NémethnéGál, 2010), the Organisation for Economic Co-operation and Development or OECD defined that "the *competitiveness* is the capability of companies, industries, regions, nations and supranational regions to create a relatively high income factor and relatively high employment levels on a sustainable basis, while permanently being exposed to international competition". In that respect, one way to raise competitiveness obviously is through increasing productive capacity. One of the Expert Meeting of the United Nations Conference on Trade and Development discussed that there were four main issues considered for improving the competitiveness of SMEs through enhancing productivity (UNCTAD, 2005). The issues were (i) promoting the linkage between SMEs and transnational corporations (TNCs) (ii) providing access to financing technology for SMEs (iii) driving technology development and mastery and (iv) promoting SMEs export competitiveness.

In the view of export competitiveness, there are two kinds of competition - price competition and quality competition. Towards quality competition, quality of digital products also begins

with a well-defined product development process just like that of physical products. However, the development process of digital products is somewhat more abstract than physical product manufacturing. Moreover, digital product development process varies tremendously. For digital cluster development, process standard therefore become a mandatory and significant factor to quality competition.

In response to taking up competitiveness challenges, the FTI's digital cluster project team in partnership with the researchers from Thai universities and private sectors conducted SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis and used Porter's diamond model to develop the roadmap for Thai digital cluster development. There were three stages in the resulting roadmap. Firstly, *competitiveness gap closing* stage is to deal with prioritized weakness of the cluster. Secondly, *competitiveness boosting* stage is to deploy the strategies which will make the most out of the existing strengths and opportunities of the cluster. Finally, *competitiveness sustainability* stage is to deal with the lower priority weakness, as well as to deploy the strategies to remove some barriers that are the threats to the cluster, thereby driving towards the sustainable growth of the cluster. Figure 1 shows the relations between the elements of the analysis and these three stages in the roadmap as discussed.

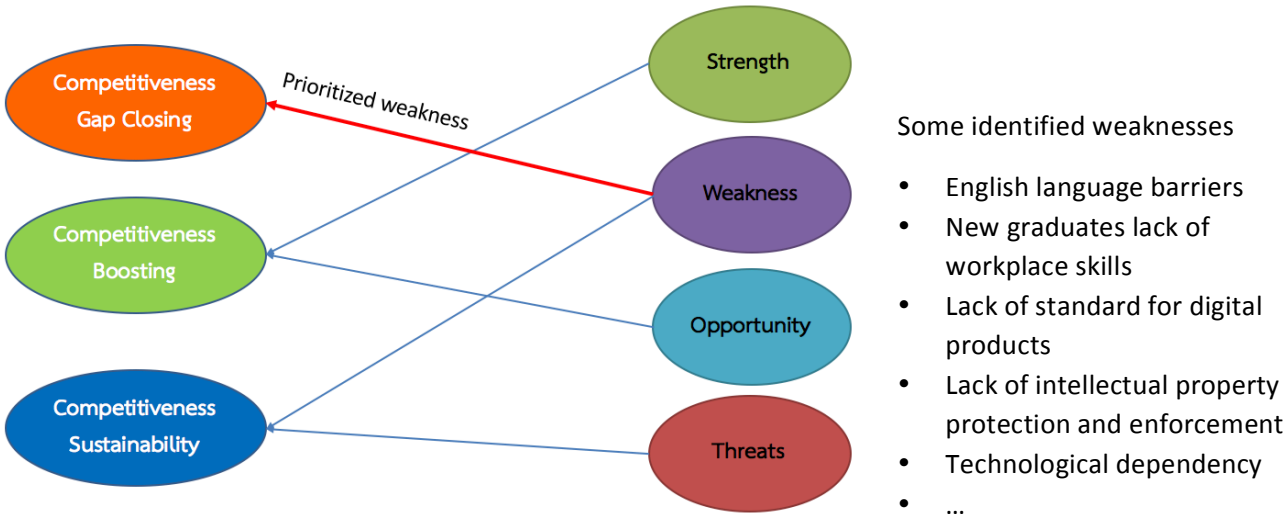


Figure 1. Roadmap Staging for Taking Up Competitiveness Challenges for Thai Digital Cluster

As seen in Figure 1, lack of standard for digital products is one of the identified weaknesses that should be tackled in the roadmap of Thai digital cluster development. In the light of that, one of the initiatives in the Thai digital cluster development is "*to increase competitiveness through the use of standard for increased quality of products and professional development*".

## 3. Taking up the Challenges with ISO/IEC 29110

As part of competitiveness gap closing strategies, ISO/IEC 29110 was selected as a suitable set of software engineering profile during the Thai digital cluster process development initiatives in 2015 because the software companies in Thailand are mainly very small entities (VSEs) and SMEs. Figure 2 illustrates the resulting Thailand flagship to deploy ISO/IEC 29110 as a driver for digital economy. The basement or underlying of the flagship is to striving for quality by empowering VSEs in the cluster with software process standards. In so doing, the development of supportive ICT and government procurement policy, quality resources from educational unit, mechanism to support and to well integrate the digital cluster with other industries are needed. Digital economy in the country will therefore be leveraged through the use of quality digital products and services in private, public and government sectors. The flagship will also pave way for increasingly globalised and competitive environment for Thai digital cluster to AEC and world markets.

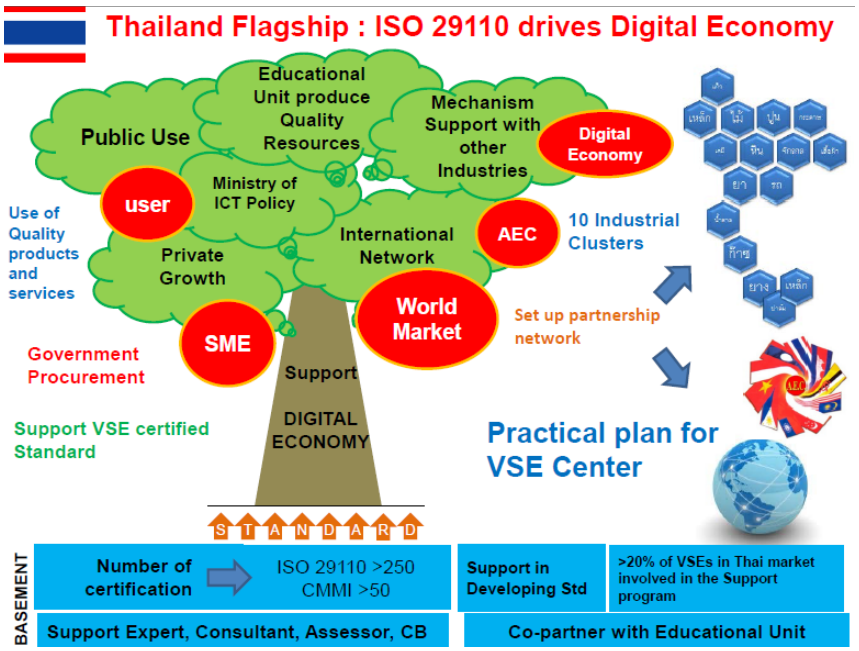


Figure 2. ISO/IEC 29110 Driven Thailand Flagship

Towards that flagship, the ISO/IEC 29110 project was launched under the collaboration between FTI and SIPA Thailand to promote Thai software companies the implementation of ISO/IEC 29110 standard, as well as to support the development of the standard itself. The target is to build over 250 companies with ISO/IEC 29110 certification in the Thai digital cluster. Figure 3 illustrates the three main activities in such ISO/IEC 29110 project. Firstly, the targeted companies were trained with essential software engineering principles that are related to the ISO/IEC 29110, such as project management, requirements management, configuration management and so on. Secondly, they went through the consulting phase for conducting *gap analysis* of their processes to determine the areas for process improvement according to ISO/IEC 29110. After that, the companies worked to improve their processes with the guidance from the

consultant teams. Finally, the companies undertook assessment process for their software process. Along these activities, data were collected and analysed to conduct and sustain process improvement activities for the digital cluster as a whole.

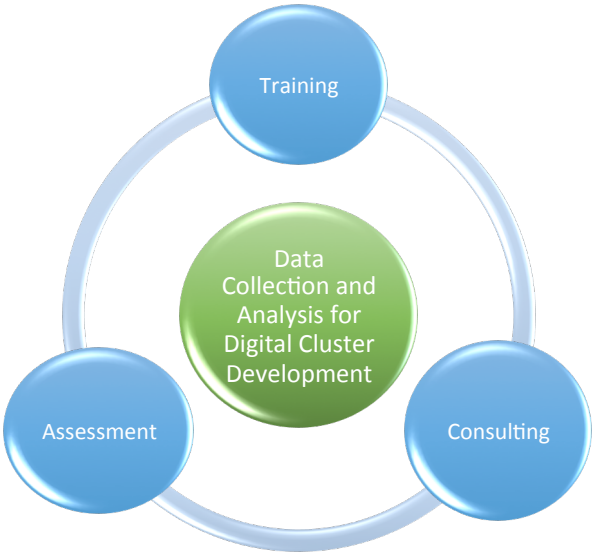


Figure 3. Activities in ISO/IEC 29110 Project by FTI and SIPA Thailand

Figure 4 exemplifies the preliminary result from gap analysis activities of the 39 companies that participated in the ISO/IEC 29110 Project by FTI and SIPA in 2015. Prior to the implementation of ISO/IEC 29110 by the companies, ISO/IEC 29110 consultants conducted interviews and group meeting to evaluate the as-is software processes of the companies with respect to eight groups of software development activities as shown in Figure 4. These groups were mostly aligned with the group of activities defined by ISO/IEC 29110 with slight rearrangement. The ISO/IEC 29110 software integration and test were combined with software construction in the analysis as Thai software developers often perceived these processes together. Furthermore, the hypothesis was that Thai software developers were not familiar with the concepts of software configuration management and quality assurance. So configuration and QA activities were evaluated separately to distinguish and emphasize such activities to a greater degree in terms of understanding and practice of configuration items listing, baselining, validation and verification.

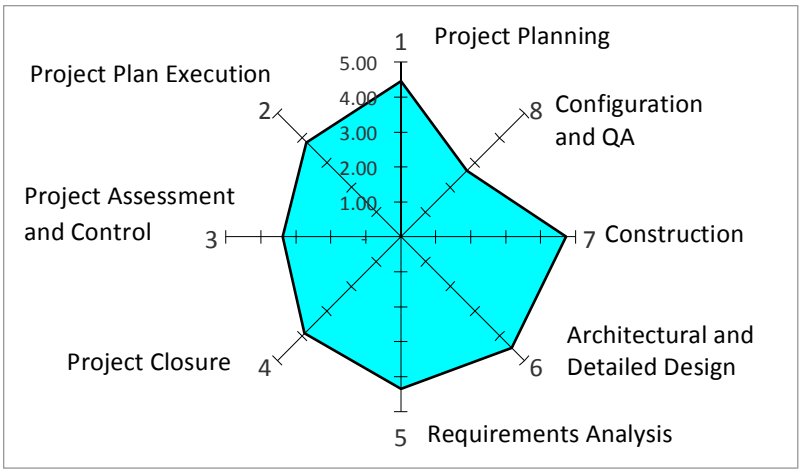


Figure 4. Preliminary Result from Gap Analysis Activities of ISO/IEC 29110 Project by FTI and SIPA in 2015

From this preliminary result, the overall strength of the companies that participated in the project laid in their software construction process while the weak process areas that required attention or further improvement were configuration management and quality assurance, then project assessment and control respectively. This may lead to the assumption that lack of good practices in configuration management, quality assurance, project assessment and control could be the causes of project failure of many software companies in Thailand, leading to quality problem in delivering their products. As a result, to leverage competitiveness of the Thai digital cluster as whole through quality improvement, the supervision and process management of such weak process areas should be investigated and improved further as part of the activities in the cluster development plan.

## 4. Conclusion

The development of Thai digital cluster is facing with many competitiveness challenges, especially quality competition. The assurance of product quality through improving process quality can significantly help level up competitiveness of the cluster, in particular for export competitiveness. To that end, we have highlighted where the ISO/IEC 29110 Project done by FTI and SIPA Thailand could continuously contribute in the roadmap. The ISO/IEC 29110 was used as a mechanism to increase quality of product through the establishment of well-defined processes. Moreover, the practice of the ISO/IEC 29110 can help raising professional standing at both organization and individual workforce levels. We also have discussed how the preliminary result of the ISO/IEC 29110 implementation in the project may lead to further analysis of the activities that can help determine further plan of actions or activities for the digital cluster development.

Nonetheless, since there were only 39 companies that participated in this ISO/IEC 29110 project in 2015, more data collection and analysis will be further required for strong effective response of ISO/IEC 29110 to the competitiveness challenges for Thai digital cluster

development plan. Future works will be continued, including new, suveillance and reassesment of ISO/IEC 29110 for VSEs, ISO/IEC 15504/33000 auditor training, network building to support the development and use of the standards, knowledge transfer and exchange in education sector for software development process, last but not least, further activities to drive the certification of software process standard to be part of requirements or criteria for software development procurement in government sectors to encourage the implementation of ISO/IEC 29110 for our Thai digital cluster.

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# Annex H

## VSE Session Synthesis

## AFIS EMEA Workshop, Paris, October 2015

**Claude Y. Laporte, Jesko G. Lamm, Christopher Krainer**

# Workshop AFIS EMEA 2015
# VSE session synthesis

Claude Y Laporte, Jesko G Lamm, Christopher Krainer

## Introduction

In the course of the 2015 AFIS/EMEA Workshop, a session was held focusing on Systems Engineering for Very Small Entities (VSEs). VSEs are, according the definition of the ISO/IEC 29110[1], "enterprises, organizations (e.g. government agencies, not-for-profit organizations), projects or departments having up to 25 people, involved in system or software development". The workshop objective was two fold. First, to share motivation and concerns about VSEs and systems engineering as such. Second, develop an action items to address the concerns in the INCOSE chapters. This discussion was facilitated by a one-hour presentation and discussion of the ISO 29110, a common framework for describing assessable system engineering life cycle profiles for VSEs. In addition to that, case studies were presented to underpin the practical relevance of ISO 29110 for VSEs.

## Main lessons learned

The fact that only 2 persons of approximately 30 workshop participants were working for Very Small Enterprises sets an interesting tone. The workshop participants formed focus groups and chose to examine four key topics from a list of 8 proposed topics. Main takeaways are summarized by selected subject.

**1. Cost savings in large organizations by applying a VSE approach. (attended by 13 persons)**
Large organization could benefit by considering ISO 29110 or Agile methodology as an inspiration to further tailor existing processes in addition to standard value stream analysis and requirement driven business process development. Another way of achieving cost savings could be also the establishment of VSEs within large organization, which basically means the creation of spin-offs. VSEs are perceived as highly efficient or having low overhead.

**2. Benefits of Systems Engineering for VSEs. (attended by 6 persons)**
The group looked at the benefits that VSEs with little or missing implementation of Systems Engineering could obtain from investing into Systems Engineering. They identified risk reduction potentials (e.g. enhance defect management to reduce the amount of defects, have a managed life cycle and manage complexity) and strategic opportunities (e.g. grow the value chain by taking responsibility of the whole system, invest into the future by growing Systems Engineering now to be prepared for a more complex future, and increase credibility as well as attractiveness for customers by showing that processes are under control) through the application of Systems Engineering.

**3. VSEs inside INCOSE (attended by 5 persons)**
The group assessed the question how INCOSE can better serve VSEs and also become more attractive for them. The conclusion was made that VSEs might be unaware of the fact that systematic systems engineering / ISO 29110 exists or that VSE business leaders do not recognize a positive or immediate return-on-invest.

[1] http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=51150

**4. Pitfalls and solutions for VSEs. (attended by 3 persons)**

The group identified pitfalls from the viewpoint that large organizations interact with small suppliers (VSE). Identified pitfalls are lack of focus on relevant requirements, creating design proposals without proper expectation management and missing possibilities of integration, verification and validation. Closer cooperation with the customer, for e.g. negotiating with the customer about the using the customer's integration possibilities and streamlining the requirements could help VSE suppliers to reduce those risks.

## Key challenges for the future

The key challenge for the future will be to make VSEs aware of the benefits in applying Systems Engineering and joining INCOSE. This should include the promotion of the ISO 29110 to establish systems engineering within VSEs. Applying the ISO 29110 will strengthen the collaborations between large and very small entities eventually reducing risks introduced by the lack of a structured systems engineering approach. On the other side, the potential consideration of the ISO 29110 within larger cooperation's could have a positive impact as well, particularly on business process tailoring or innovative organizational structures such as in-house spin-off establishments.

## Recommendation for INCOSE

1. VSEs may be unaware that Systems Engineering/ISO 29110 exists. Therefore, information about Systems Engineering and the VSEs' activities inside INCOSE should be more prominent on digital media.
2. Training should be available in a format that meets time and budget restrictions that may typically be assumed for some VSEs:
    a. Offer webinars to avoid time and expenses of travel. Consider YouTube channels.
    b. Offer low cost / no cost training (again, consider webinars).
    c. Keep training modules short.
    d. Consider evening schools.
3. VSEs may have missed the invitation for international events or may not feel invited. They may also have difficulty in attending them, again due to time and budget restrictions. To address this, we should consider strengthening offerings towards VSEs via local INCOSE chapters.
    a. Local chapters could find channels (e.g. local chamber of commerce) to contact local VSEs and could offer events that require less time and lower travel investments than the international ones.
    b. When looking for channels to make VSEs aware of INCOSE, local fairs or local chambers of commerce could be considered. They can also consider opportunities of cooperation with other players, as described in the next section.

## Cooperation opportunity with other players (outside INCOSE)

In the context of the EMEA, INCOSE can also consider strengthening the contact with the European Union and other EMEA sector authorities to drive the awareness of Systems Engineering.