

Small tech firms



Seizing the benefits of software and systems engineering standards

by Claude Y. Laporte, Normand Séguin, Gisele Villas Boas and Sanyakorn Buasung

The ability of organizations to compete, adapt, and survive depends increasingly on software. In the automotive industry, for instance, one manufacturer says its top-of-the-line cars have up to 100 million lines of code.

Manufacturers are also increasingly dependent on the components produced by their suppliers. A large manufacturing chain of mass-market products often has a pyramidal structure, as illustrated in **Figure 1**.

This can bring challenges: for example, when a large manufacturer integrated into one of its products a part with an unknown software error that was produced by one of its 6 000 lower-level producers, the manufacturer ended up losing millions of dollars.

Industries everywhere recognize the value of very small entities (VSEs) in contributing useful and beneficial products and services. A VSE is an entity (enterprise, organization, department or project) with up to 25 people.

In Europe, 85 % of the information technology (IT) sector's companies have up to 10 employees; in the Montreal area of Canada, 78 % of software development

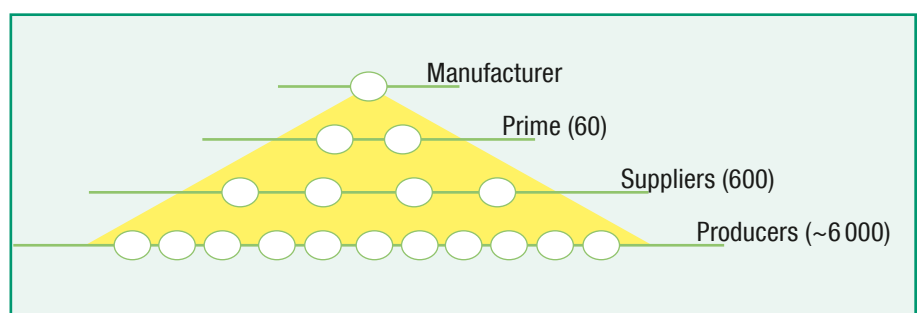


Figure 1: Example of a major manufacturer's supply chain (adapted from Shintani 2006).

enterprises have fewer than 25 employees, and 50% have fewer than 10; and in Brazil, IT companies with up to 19 people account for around 95% of companies.

The joint technical committee of ISO and IEC (International Electrotechnical Commission) ISO/IEC JTC 1, *Information technology*, subcommittee SC 7, *Software and systems engineering*, and others are working hard to encourage small tech firms to adopt the ISO/IEC 29110, *Software engineering – Lifecycle profiles for Very Small Entities (VSEs)*, series of standards.

Standards take-up

According to Altman, “International Standards have become, at the same time, the price of admission to the global economy and the glue holding it together. Adherence to standards is a condition of entry to the World Trade Organization. And as the global economy grows, so do they.”

Certifications can enhance access to markets.

In the past, ISO/IEC JTC 1/SC 7 standards were not easily applied, or readily adopted, by VSEs. Many VSEs found them difficult to understand and implement. They needed help in understanding the benefits of the concepts, processes and practices described in the ISO/IEC international software engineering standards – and in initiating their use.

What VSEs want

Within ISO/IEC JTC 1/SC 7, working group WG 24, *SLC Profile and guidelines for VSE*, was formed in 2005 and mandated to:

- Give VSEs a way to be recognized for producing quality software systems
- Produce a set of standards and provide guidance to VSEs in establishing software engineering processes
- Produce guides that are easy to understand, short, simple and readily usable by VSEs

WG 24 developed a survey to question software-related VSEs about their use of standards, as well as to collect data to identify problems and potential solutions to help them apply the standards.

Over 400 responses were collected from 30 countries, with the largest proportion, about 46%, originating from Latin America. More than 67% of respondents indicated that it was important to be either recognized or certified; over 62% said they would like more guidance with examples; 55% asked for lightweight and easy-to-understand standards, complete with templates; and a high proportion said it should be possible to implement standards quickly, easily and at low cost.

Generic profile group			
Entry	Basic	Intermediate	Advanced

Table 1: Graduated profiles of the generic profile group.

ISO/IEC 29110	Title	Target audience
Part 1	Overview	VSEs, customers, assessors, standards producers, tool vendors and methodology vendors
Part 2	Framework and taxonomy	Standards producers, tool vendors and methodology vendors. Not intended for VSEs
Part 3	Assessment guide	Assessors, customers and VSEs
Part 4	Profile specifications	Standards producers, tool vendors and methodology vendors. Not intended for VSEs
Part 5	Management and engineering guide	VSEs and customers

Table 2: ISO/IEC 29110 target audience.

Profiles for a progressive approach

ISO/IEC profiles were used to develop the new software engineering standard for VSEs. A profile is a kind of matrix that identifies which elements should be taken from existing standards.

Producing a new standard for VSEs involved:

- Developing a set of profiles for VSEs not involved in the development of critical software
- Selecting the ISO/IEC 12207:2008, *Systems and software engineering – Software life cycle processes*, subset applicable to VSEs with up to 25 people
- Tailoring the subset to fit VSE needs
- Developing guidelines, checklists, templates and examples

A generic profile group applies to a vast majority of VSEs that do not develop critical software. A collection of four profiles (entry, basic, intermediate and advanced) provides a progressive approach to serving most VSEs.

The entry profile focuses on start-up VSEs and those working on small projects (i.e., project size of less than six person-months). The basic profile describes the software development practices of a single application by a single project team, and with no special risk or situational factors. The intermediate profile is aimed at VSEs developing multiple projects, while the advanced profile applies to VSEs that want to grow as independent software development businesses. Table 1 illustrates the generic profile group as a collection of four profiles.

Table 2 describes the ISO/IEC 29110 series of standards and technical reports targeted by audience.

Part 5, the management and engineering guide, is the most valuable document for VSEs. It describes a set of activities and tasks of project management (PM) and software implementation (SI) processes, a set of documents to be produced during process implementation and a set of roles involved in task execution.

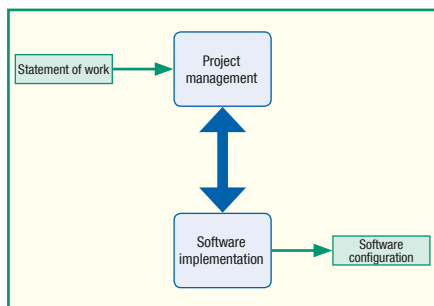


Figure 2: Basic profile processes.

Both PM and SI processes are interrelated, as illustrated in Figure 2. The customer provides a statement of work as an input to the PM process, and receives a software configuration (i.e., software and documentation) after executing the SI process.

Role	Task list	Input products	Output products
WT CUS	SI.2.2 Document or update the requirements specification	Project plan (product description)	Requirements specification

Table 3: Example of one task of the software requirements analysis activity.

The PM process aims to establish and systematically carry out the tasks of the software implementation project. This allows compliance with the project’s objectives in terms of expected quality, time and cost.

The purpose of the SI process is to ensure the systematic performance of the analysis, software component identification, construction, integration and test, and product delivery activities for new or modified software according to the specified requirements.

To remove a product’s defects, the activities workflow includes verification, validation and test tasks.

Figure 3 illustrates the activities of the PM process. Although the notation used here is sequential, the ISO/IEC 29110 series was not intended to dictate the use

of different life cycles such as waterfall, iterative, incremental, evolutionary and agile.

Each activity of ISO/IEC 29110 is described using the following format: a four-column table lists the roles (such as WT = work team and CUS = customer) involved in a specific task, the tasks, their input and outputs. As an example, one task of the software requirements analysis activity is illustrated in Table 3.

Many VSEs find standards difficult to understand and implement.

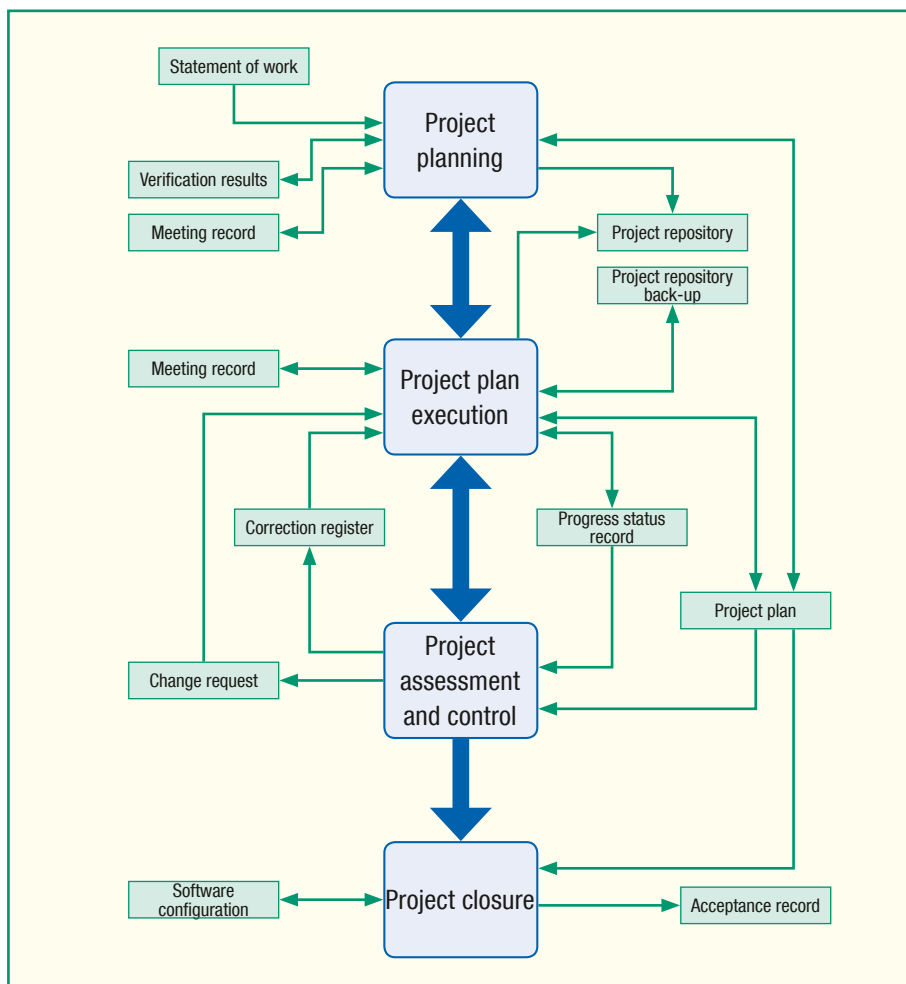


Figure 3: Project management process diagram.

To further help VSEs, the typical content of documents produced during the execution of a project is described. Table 4 shows one such document on change request. The descriptions of the documents produced during the execution of the PM and SI processes are based on ISO/IEC/IEEE 15289:2011, *Systems and software engineering – Content of life-cycle information products (documentation)*, with a few exceptions.

The documents listed in Table 2 for the basic profile were published in 2011. At the request of WG 24, the three ISO/IEC 29110 technical reports are available at no cost.

To facilitate the widest adoption possible and implementation of ISO/IEC 29110, members of WG 24 were involved in the translation of the documents into French, Japanese, Portuguese and Spanish. Translations of the entry profile into other languages are expected.

WG 24 also developed Wikipedia pages in English, French, Portuguese and Spanish. Short videos about the standards are available on Planet ISO’s YouTube channel (youtube.com/planetiso) in English, French, Portuguese and Spanish.

Deployment packages

To provide guidance on the actual implementation of the management and engineering guides in VSEs, deployment packages (DP) have been developed to define

guidelines and explain in more detail the processes in the ISO/IEC 29110 profiles. The elements of a typical DP are :

- Description of processes
- Activities
- Tasks
- Roles and products
- Template
- Checklist
- Example
- Reference and mapping to standards and models
- List of tools

DPs were designed such that a VSE can implement its content without having to implement the complete framework (the management and engineering guide) at the same time. Nine DPs have been developed to date and are freely available on the Internet. **Figure 4** illustrates the set of DPs developed to support the basic profile.

Teaching and applying ISO/IEC 29110

The new standard has been taught to undergraduate and graduate software engineering students in Canada, Haiti, Peru and Thailand.

In Canada and Haiti, for example, students of software quality assurance courses are using ISO/IEC 29110 to execute their projects in organizations and also to guide start-up VSEs. Students can observe actual processes used by an organization, draw on the standard as a guideline and evaluate if an organization's processes meet the standard.

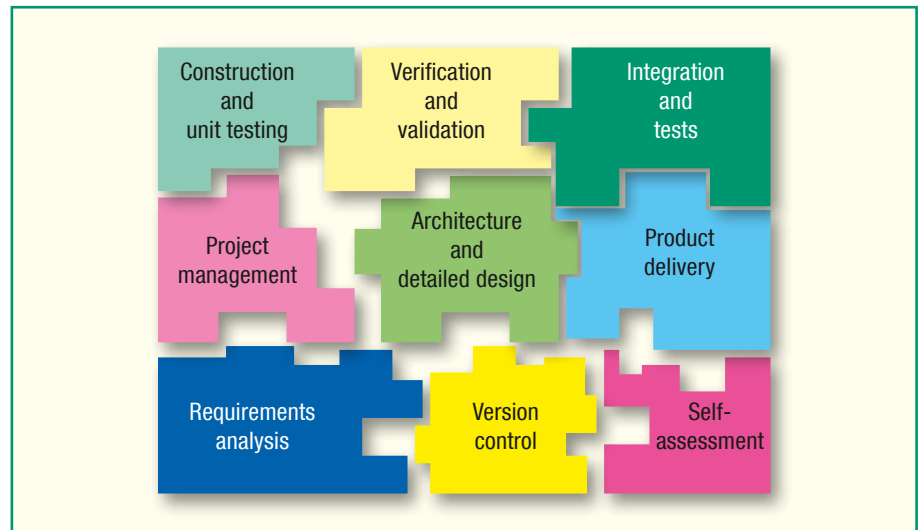


Figure 4: Deployment package to support the Software Basic Profile (Laporte 2012).

Afterwards they can suggest to the organization what to improve in their modus operandi to satisfy the processes of ISO/IEC 29110.

The certification added value

For all organizations, but in particular for VSEs, international certifications can enhance credibility, competitiveness and access to national and international markets.

For VSEs, a certification process should be simple, short and low in cost, and have international credibility. Brazil and Thailand lead the development of ISO/IEC 29110 certification processes to meet VSE needs.

Brazil has developed and piloted an ISO/IEC 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

By implementing ISO/IEC 29110, VSEs worldwide will be better equipped.

- Promote international acceptance of the ISO/IEC 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.

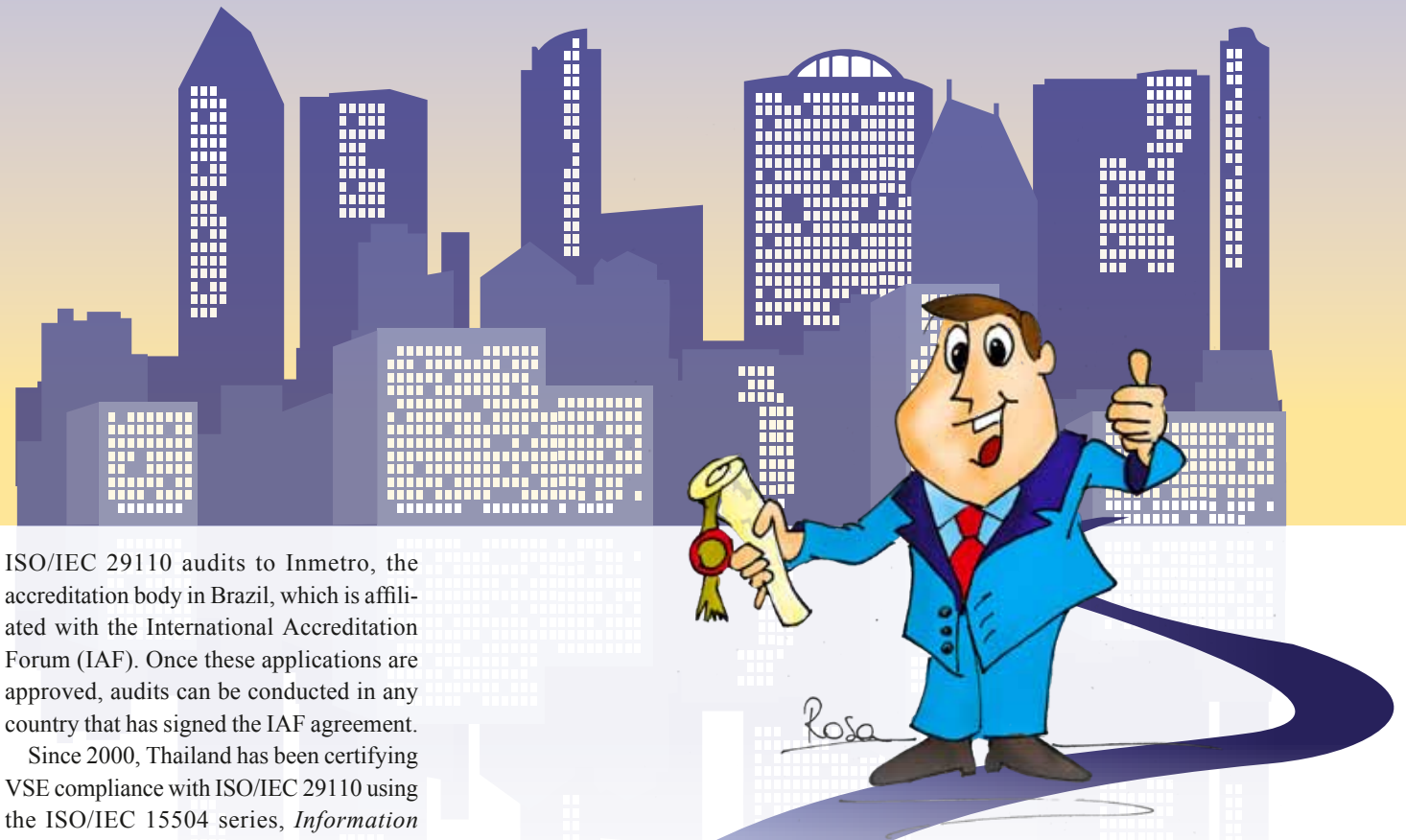
Brazilian auditors receive 40 hours of training. This approach shows that an ideal ISO/IEC 29110 auditor should be competent in auditing techniques, and have expertise in ISO/IEC 29110 concepts and experience in software development.

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

Name	Description	Source
Change request	<p>Identifies a software, or documentation problem or desired improvement, and requests modifications.</p> <p>It may have the following characteristics :</p> <ul style="list-style-type: none"> • Identifies purpose of change • Identifies request status (new, accepted, rejected) • Identifies requester contact information • Impacted system(s) • Impact to operations of existing system(s) defined • Impact to associated documentation defined • Criticality of the request, date needed by <p>The applicable statuses are : accepted and tracked.</p>	<p>Software implementation</p> <p>Customer</p> <p>Project management</p>

Table 4: Description of content of a change request in ISO/IEC 29110.



ISO/IEC 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.

Since 2000, Thailand has been certifying VSE compliance with ISO/IEC 29110 using the ISO/IEC 15504 series, *Information technology – Process assessment*, under the ISO/IEC 17065 certification body accreditation scheme.

Thailand has also been working with countries of the Association of Southeast Asian Nations (ANASE) and Asia-Pacific Economic Cooperation (APEC) to adopt both ISO/IEC 29110 and ISO/IEC 15504 schemes as a regional platform for trade and economic integration.

The project has been supported by the Thai government and its information and communications technology industries. ISO/IEC 29110 should soon be adopted as

one of the requirements for the procurement of software for Thai government agencies.

Systems development

In 2011, WG 24 was mandated to develop a set of standards and guides for VSEs involved in the development of systems. A system is a combination of interacting elements, such as electronic, mechanical and software components, organized to achieve one or more stated purposes.

A draft management and engineering guide for the basic profile has been developed in

collaboration with systems engineers of the International Council on Systems Engineering (INCOSE) and the *Association Française d'Ingénierie Système* (AFIS). The systems engineering basic profile is expected to be published in late 2013 or early 2014.

By implementing ISO/IEC 29110 standards, VSEs worldwide will be better equipped to develop products that meet customers' expectations – in terms of functionality, quality, cost and schedule. In addition, manufacturers will have greater confidence in the VSE-produced components that they integrate into their products. ■

About the authors

Dr. Claude Y. Laporte is a Professor at the *École de technologie supérieure*, Montreal, and Project Editor of ISO/IEC 29110. His published work includes two co-authored textbooks on software quality assurance. Dr. Laporte is a member of the Institute of Electrical and Electronics Engineers (IEEE), the Project Management Institute (PMI), the International Council on Systems Engineering (INCOSE), and the OIQ, the professional association of engineers.

Dr. Normand Séguin is a Professor of software engineering at the *Université du Québec*, Montreal, and Director of the software engineering master programme.

Gisele Villas Boas is responsible for coordinating standards, quality and software engineering in Riosoft, Rio de Janeiro's software production and export support agency. She is involved in several ISO/IEC JTC 1/SC 7 working groups and is Editor of ISO/IEC 29110-3. Ms. Villas Boas coordinates ISO/IEC 29110 development in ABNT, the ISO member for Brazil, and NetCenter, for VSE actions.

Sanyakorn Buasung is a member of technical committee TISI/TC 967, *Software and system engineering standards*, at the Thai Industrial Standards Institute. He is a Co-editor of ISO/IEC 29110-5 and an Assessor for ISO/IEC 15504, *Information technology – Process assessment*.