

Software Process Improvement for Small and Medium Enterprises: Techniques and Case Studies

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Chapter II

The Application of International Software Engineering Standards in Very Small Enterprises

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ABSTRACT

The software industry recognizes the value of very small enterprises in contributing valuable products and services to the economy. As the quality of software increasingly becomes a subject of concern and process approaches are maturing and gaining the confidence of companies, the use of ISO/IEC JTC 1 SC7¹ standards is spreading in organizations of all sizes. However, these standards were not written for development organizations with fewer than 25 employees and are consequently difficult to apply in such small settings. A new ISO/IEC JTC1 SC7 Working Group, WG24, has been established to address some of these difficulties by developing profiles and providing guidance for compliance with ISO software engineering standards. A survey was conducted to question these very small organizations about their utilization of ISO/IEC JTC1 SC7 standards and to collect data to identify problems and potential solutions to help them apply these standards. Over 400 responses were received from 32 countries. Results from the survey are discussed.

INTRODUCTION

This chapter presents a new ISO project which proposes to facilitate access to, and utilization of, ISO/IEC JTC1 SC7 software engineering standards in very small enterprises (VSEs). VSEs are organizations with fewer than 25 employees. In Europe, for instance, 85% of the information technology (IT) sector's companies have between 1 and 10 employees. In Canada, the Montréal area was surveyed, as illustrated in Table 1, and it was found that close to 80% of software development companies have fewer than 25 employees (Laporte, April, & Renault, 2006), and over 50% have fewer than 10 employees. In Brazil, small IT companies represent about 70% of the total number of companies (Anacleto, von Wangenheim, Salviano, & Savi, 2004). Finally, in Northern Ireland (McFall, Wilkie, McCaffery, Lester, & Sterritt, 2003), a survey reports that 66% of companies employ fewer than 20 software development staff.

There is a need to help these organizations understand and use the concepts, processes, and practices proposed by the International Standard Organization's (ISO's) international software engineering standards. A new ISO/IEC JTC1 SC7 Working Group, WG24, has been established to address some of these difficulties by developing profiles and providing guidance for compliance with ISO software engineering standards. A profile is defined as a set of one or more base standards and/or international standard profiles

(ISP), and, where applicable, the identification of chosen classes, conforming subsets, options, and parameters of those base standards, or ISPs, necessary to fulfill a particular function (ISO/IEC TR 10000-1, 1998).

This chapter is divided into six sections. In the first section, the ISO/IEC JTC1 SC7 organization's mandate and collection of standards are described. In the second section, a history of the recent events that led to an ISO/IEC JTC1 SC7 project proposal for very small organizations is presented. In the third section, a few centers and institutes focusing on small and very small software enterprises are described. The results of an IEEE survey performed to obtain feedback from software engineering standards users are discussed in the fourth section. The analysis of survey data, conducted by WG24, is presented in the fifth section. In the last section, we present the future work of WG24.

OVERVIEW OF THE ISO/IEC JTC1 SC7 MANDATE AND COLLECTION OF STANDARDS

In this section, we present the mandate of ISO/IEC JTC1 SC7, an overview of the collection of standards produced and maintained by this committee, and a description of the ISO standard development process. During 1987, the International Organization for Standardization and the International Electrotechnical Commission (IEC)

Table 1. Size of software development companies in the Montreal area (Laporte et al., 2006)

Size (employees)	Software Companies		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%

joined forces and put in place a joint technical committee called Joint Technical Committee 1 (ISO/IEC JTC1) with the following mandate: “Standardization in the Field of Information Technology: Information technology includes the specification, design, and development of systems and tools dealing with the capture, representation, processing, security, transfer, interchange, presentation, management, organization, storage, and retrieval of information” (Coallier, 2003). The mandate of subcommittee SC7, within JTC1, is to standardize processes, supporting tools, and supporting technologies for the engineering of software products and systems.

Figure 1 illustrates the evolution of the ISO/IEC JTC1 standards that are maintained and published under the responsibility of SC7.

Within the portfolio of SC7 standards, a number of international standards are grouped together in a category called “Software and Systems Engineering Processes.” These standards describe good software and systems engineering practices, as well as standards assessing them. Within this group, there are four key ISO/IEC standards:

- ISO/IEC 12207 Software Life Cycle Processes (ISO/IEC 12207, 1995)
- ISO/IEC 15288 Systems Life Cycle Processes (ISO/IEC 15288, 2002)
- ISO/IEC 15504 Software Process Assessment series (ISO/IEC 15504, 2003-2005)
 - As an example, the Capability Maturity Model^{®2} Integration^{SM3} (CMMI[®]) conforms to ISO/IEC 15504
- ISO/IEC 90003 (ISO/IEC 90003, 2004) Guidelines for the Application of ISO 9001 (ISO 9000, 2000) to computer software

The relationships between these standards are illustrated in Figure 2.

Although these standards are well known in large software and systems engineering organizations, the current SC7 Life Cycle standards are a challenge to use in VSEs, and compliance with them is difficult, if not impossible, to achieve. Consequently, VSEs have few, or a very limited number of, ways to be recognized as organizations producing quality software systems.

Figure 1. Evolution of published ISO/IEC JTC1 SC7 software and systems engineering standards (SC7, 2006)

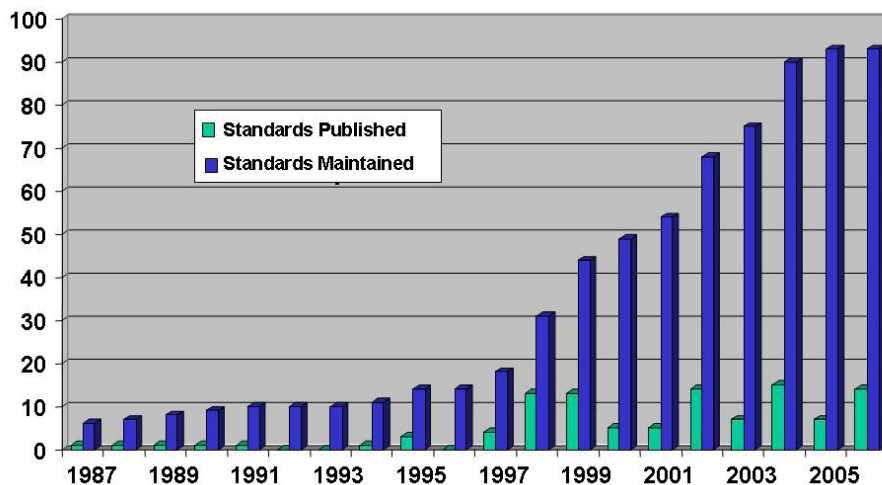
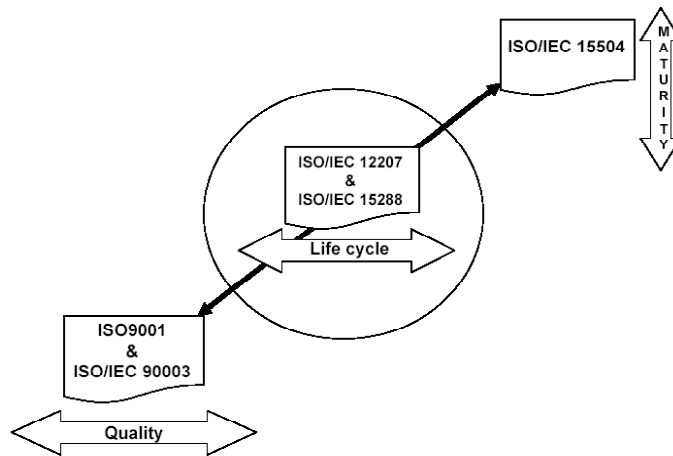


Figure 2. Relationships between key SC7 standards (Coallier, 2003)



HISTORY LEADING TO AN ISO/IEC JTC 1/SC7 PROJECT PROPOSAL FOR VERY SMALL ORGANIZATIONS AND RECENT ACHIEVEMENTS

In this section, a history of events leading to the creation of the new ISO/IEC SC7 Working Group, WG24, is presented. This section will also describe the mandate of WG24.

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

Modeling 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
- 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

First Special Working Group Meeting – Thailand

In March 2005, the Thailand Industrial Standards Institute (TISI) 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.

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

As illustrated in Figure 3, 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

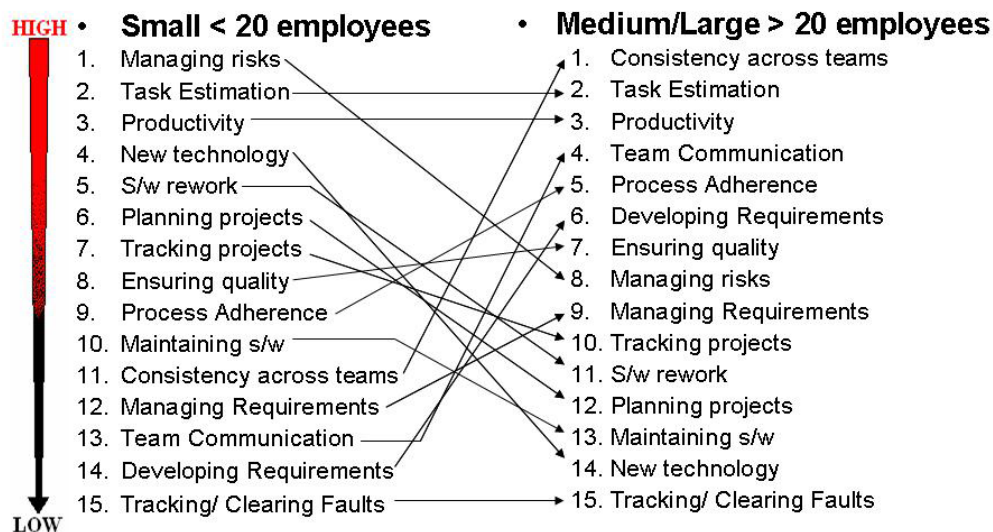
risk is of great concern while larger organizations rank managing risk as priority number 8 only. Conversely, for small organizations, consistency across teams is less of a concern, while for larger organizations it is a top-priority issue.

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 and organizations and projects with between 1 and 25 employees.

A list of actions that could be undertaken by a future ISO/IEC SC7 working group was developed at this meeting. The proposed action items are:

1. Validate the work products produced by the working group
2. Prepare, conduct, analyze, and communicate survey results
3. Search for other centers/organizations focusing on SMEs and VSEs
4. Assemble a complete list of characteristics of VSEs and projects
5. Generate multiple profiles from the standards mentioned above
6. Prepare communication material to inform VSEs about the work performed by the WG

Figure 3. Priority and concern differences based on organization size (McFall et al., 2003)



7. Develop business cases for the adoption and deployment of work products developed by the WG
8. Develop one or more ISO 12207 roadmaps
9. Pilot roadmaps, using an approach similar to the trials conducted by the ISO/IEC 15504 (SPICE) project

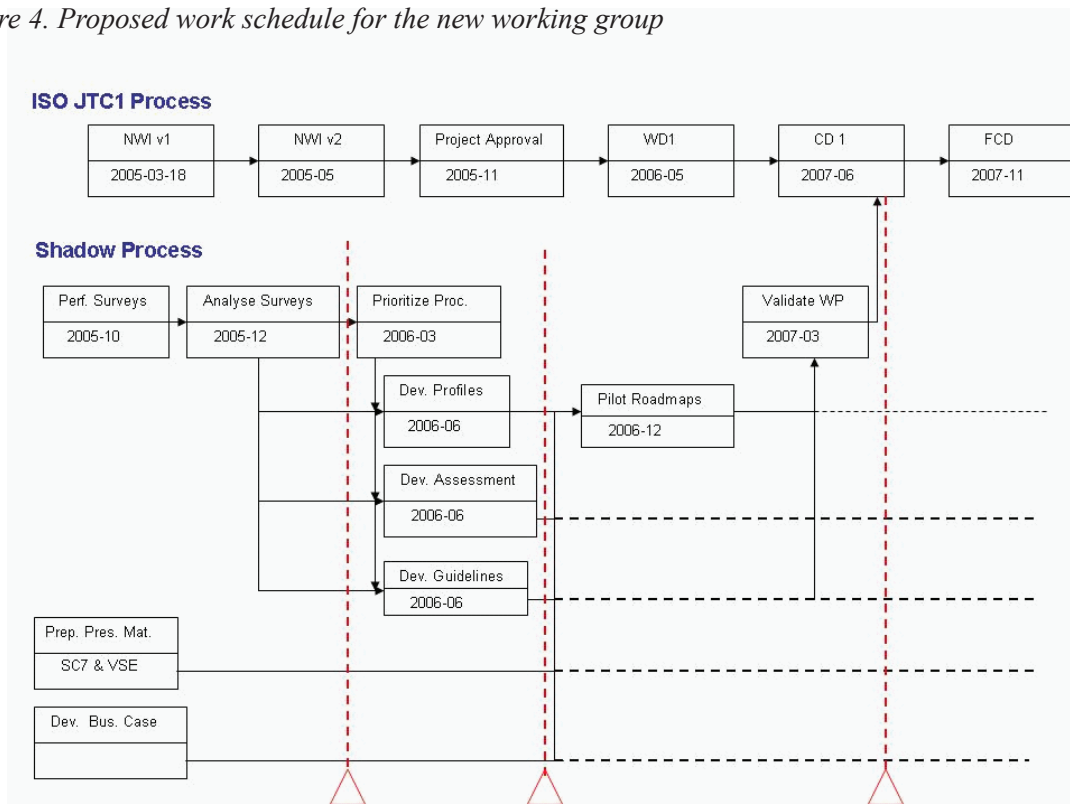
The major output of this one-week meeting was a draft list of new work items, as described later. A work schedule has also been developed for the new working group. As illustrated in Figure 4, the top row shows the standard steps for the development and approval of an ISO standard. The lower part of the figure illustrates the actions that would need to be performed, as well as their expected date of completion, in order to obtain a CD 1 (Committee Draft) by the end of 2007.

The major output of this one-week meeting was a document that has since been presented and discussed at the Helsinki SC7 meeting held in May 2005. The document was essentially a draft list of the new work item that was approved by ISO/IEC in September 2005. This document is presented later.

Plenary Meeting of ISO/IEC JTC 1/SC7 Meeting – Finland

The document developed in Thailand was reviewed during a meeting of one of the WGs at the 2005 SC7 plenary meeting in Helsinki. A resolution was approved as follows: “JTC1/SC7 instructs its Secretariat to distribute for letter ballot an updated version of New Work Item Proposal for the development of Software Life Cycle

Figure 4. Proposed work schedule for the new working group



Profiles and Guidelines for use in Very Small Enterprises (VSE) by 20 June 2005 (ISO/IEC JTC1/SC7 N3288, 2005).

Balloting on this document was open until September 21, 2005. Over 12 countries voted in favor of the NWI Proposal, 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.

Proposed Project Tabled at ISO/IEC JTC 1/SC7

The document tabled at the SC7 Helsinki plenary meeting describes the scope and purpose of the proposed working group, the justification for it, and a vision statement. In the following paragraphs, each element of that project is presented. The text below has been extracted from the document balloted by the ISO (ISO/IEC JTC1/SC7 N3288, 2005).

Project Scope

- Organizations and projects with fewer than 25 employees.
- The current scope of ISO/IEC 12207 and its amendments, the associated guidance document and other relevant SC7 standards (e.g., ISO/IEC 15504, ISO/IEC 90003).
- Production of technical reports (guides) establishing a common framework for describing assessable life cycle profiles used in VSEs,

including small software systems development departments and projects within larger organizations.

- Guides to be based on ISPs identifying which parts of the existing standards are applicable to VSEs at a specific level and for a specific domain.
- Guides which can be applied throughout the life cycle for managing and performing software development activities; the ultimate goal is to improve the competitiveness and capacity of VSEs.

Purpose and Justification

The software systems industry as a whole recognizes the value of VSEs in terms of their contribution of valuable products and services. The majority of software organizations fall within the VSE size category. From the various surveys conducted by some of the national bodies that initially contributed to the development of this NWI list, it is clear that the current SC7 Life Cycle Standards (ISO/IEC 12207 and the related guide) are a challenge to use in these organizations; compliance with them is difficult (if not impossible) to achieve. Consequently, VSEs have few, or a very limited number of, ways to be recognized as organizations producing quality software systems, and therefore they do not have access to some markets. Currently, conformity with software engineering standards requires a critical mass in terms of number of employees, cost, and effort, which VSEs cannot provide.

This project will attempt to ease the difficulties associated with the use of ISO/IEC 12207 processes and ISO 9001:2000 and reduce the conformance obligations by providing VSE profiles. The project will develop guidance for each process profile and provide a roadmap for compliance with ISO/IEC 12207 and ISO 9001:2000.

It has been reported that VSEs find it difficult to relate ISO/IEC 12207 to their business needs and to justify the application of the international

standards in their operations. Most VSEs cannot afford the resources for, or see a net benefit in, establishing software processes as defined by current standards (e.g., ISO/IEC 12207). A liaison will be established between the proposed work and other SC7 work; specifically, the progress of ISO/IEC 12207 will be tracked.

Vision Statement

This project will:

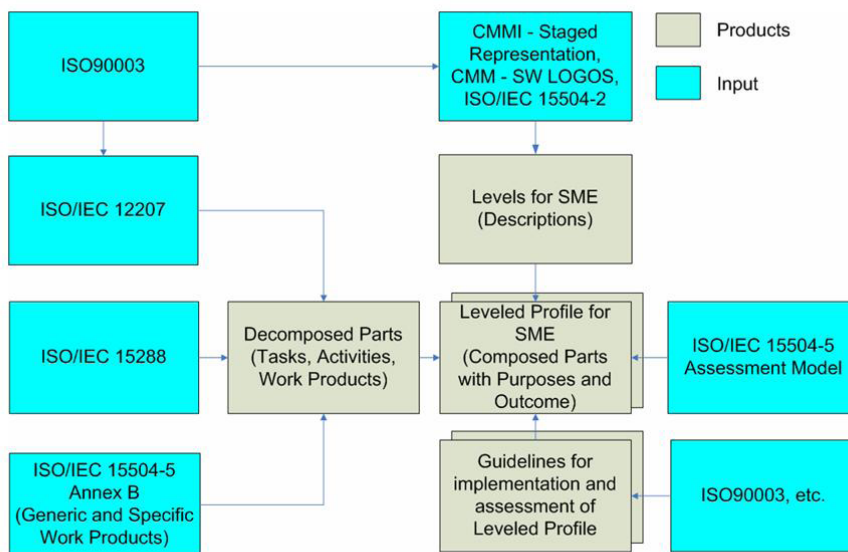
- Provide VSEs with a way to be recognized as producing quality software systems without the initial expense of implementing and maintaining an entire suite of systems and software engineering standards or performing comprehensive assessments.
- Produce guides which are easy to understand, affordable, and usable by VSEs.
- Produce a set of profiles, which build on or improve a VSE’s existing processes, or provide guidance in establishing those processes.

- Address the market needs of VSEs by allowing domain-specific profiles and levels.
- Provide examples to encourage VSEs to adopt and follow processes that lead to quality software, matching the needs, issues, and risks of their domain.
- Provide a baseline for how multiple VSEs can work together or be assessed as a project team on projects that may be more complex than can be performed by any one VSE.
- Develop scalable profiles and guides so that compliance with ISO/IEC 12207 and/or ISO 9001:2000 and assessment become possible with a minimum of redesign of the VSE’s processes.

Referenced Documents

As illustrated in Figure 5, a number of documents have been identified as pertinent inputs to this project: ISO 90003, ISO/IEC 12207, ISO/IEC 15504, Capability Maturity Model Integration

Figure 5. Referenced documents (ISO/IEC JTC1/SC7 N3288, 2005)



(CMMI) and the Software Capability Maturity Model (SW-CMM).

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 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. The main outputs of the meeting were:

- Proposed requirements for ISPs 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

First ISO/IEC JTC 1/SC7 WG24 Meeting – Italy

In October 2005, Italy hosted the 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, that is, 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 requirements were validated by WG members. 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. Finally, WG24 designed a survey in 2006 to collect relevant information from VSEs around the world. 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.

Second ISO/IEC JTC 1/SC7 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:
 - 345 responses were collected from 26 countries.
 - 219 responses were received from enterprises with 25 or fewer employees.
 - Over 67% indicated that it was important to be either recognized or certified (e.g., ISO, market).
 - WG24 decided to prioritize the development of profiles and guides for organizations with 25 or fewer employees (total staff). These profiles and guides should also be usable for projects and departments with 25 fewer employees.
 - WG24 decided to propose separate profiles for:
 - Enterprises with fewer than 10 employees and
 - Enterprises with 10 to 25 employees.
 - WG24 decided to focus first on enterprises with fewer than 10 employees.
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 Mexican standard is presented later.)

Centers and Initiatives Focusing on Small and Very Small Software Enterprises

In this section, we describe the work performed by a few centers and initiatives that focus their activities on small and very small enterprises. Most software engineering research centers, such as the Software Engineering Institute, dedicate their resources mainly to large organizations. Even though there seems to be a certain awareness of those needs for VSE solutions, these are still quite unusable by companies with 25 or fewer employees. We discuss their objectives and accomplishments in helping these enterprises become more

competitive, since WG24 will try to benefit from the experience gained by these centers.

Centre for Software Process Technologies

The Centre for Software Process Technologies (CSPT)⁴ is a research and knowledge transfer organization hosted by the Faculty of Engineering at the University of Ulster. Its activities cover a wide range of areas affecting the quality and effectiveness of both software development processes and products, from process measurement, through business process co-evolution, to object oriented software complexity metrics. The CSPT recently published the results of its first six assessments in small- and medium-sized enterprises (SMEs) using its express process appraisal (EPA) method (Wilkie, McFall, & McCaffery, 2005). EPA is a class C method that complies with the appraisal requirements for CMMI (2002). The EPA model assesses six of the seven process areas at maturity level 2: requirements management, configuration management, project planning, project monitoring and control, measurement and analysis, and process and product quality assurance. The authors reported that the EPA method requires approximately 45 person-hours of the appraised organization's time and 42 person-hours of the CSPT appraisal team's time over a two-week period.

The CSPT also published a paper (McFall et al., 2003) in which the authors present the various perceived priorities and concern areas for different sizes of organizations. As illustrated in Figure 3, the priorities and concerns of organizations with fewer than 20 employees are quite different from those of larger organizations. As an example, for small organizations, managing risk is of great concern, while for larger organizations, this only ranks as priority number 8. Conversely, for small organizations, consistency across teams is less of a concern, while for larger organizations, this is the top-priority issue.

British “Toward Software Excellence”

Toward Software Excellence (TSE)⁵ provides a self-assessment “health check” facility and corresponding guidance on best practices (the Route Map) and is based on the ISO/IEC TR 15504 International Standard. It proposes an interesting mix of functionalities and characteristics that can explain small organizations’ success: it uses business language and addresses the business perspective of the process issue, aiming at solving business problems first and highlighting the importance of customer relationships. TSE is, in fact, much more than an assessment tool, as it helps to explain issues to people using a language they can understand. This one (with the Belgian Gradual Framework) is probably a good example of how to make tough topics accessible to all.

European Software Institute – IT Mark

The European Software Institute (ESI) is a technological center with an aim to contribute to developing the information society and to increase industry competitiveness by means of knowledge, innovation, continuous improvement, and the promotion and dissemination of IT.

The ESI commercially promotes and delivers the ESI’s products and services to the European and Latin-American market in the first phase and at the worldwide level in the second phase. It has established a network of partners, called ESI@net, with companies in which activities are related to SPI (software process improvement) and IT in general.

The ESI Centre Alliance has launched the IT Mark Certification⁶ worldwide, which is aimed at certifying the quality and maturity of the processes in SMEs (up to 250 workers) that develop and maintain IT systems. IT Mark assesses and certifies the quality of SMEs in three main areas: business management (overall management: strategic, commercial, financial, marketing, etc.);

information security management; and software and systems processes (maturity).

In matters relating to business management, the reference used is the 10² model that was developed to assess venture capital applications. For information security management, the reference model used is ISO 17799 (ISO/IEC 17799, 2005), and for software and systems processes, a light-weight version of CMMI® (2002) is used.

SataSPIN

SataSPIN (Varkoi & Mäkinen, 1999) is not a methodology or a solution for assessing or improving software processes, but rather a regional network for software SMEs wanting to make improvements. The authors’ main goal is to set up an SPI program in each of the participating companies with a view to establishing a network of companies promoting good software practices in a region. The project provides the participating companies with training and consultation on subjects related to software processes. An essential part of the project is the process assessment. Companies can also obtain assistance in planning and implementing the improvements. Training activities within the project are targeted to support improvement of the software processes and enhance the skills of the personnel. All the activities are tailored separately for each company to ensure flexibility in participation and alignment with business goals.

The core of the SataSPIN project is to help software SMEs develop their operations using international software process models. The project uses the ISO/IEC 15504 standard as the software process assessment tool and improvement framework (which requires public funding as an enabler). The project is based on the cooperation of the participating enterprises, and offers a wide variety of courses and seminars in the area of software engineering and management.

SataSPIN⁷, located at Tampere University of Technology of Finland, offers the following services:

- Training and expert services for software process improvement
- Process assessments, improvement planning, and results evaluation
- Training and expertise in software management, methods, and technologies

Two SataSPIN projects have involved 20 software SMEs and over 400 IT professionals.

NORMAPME

NORMAPME⁸ (2006) is the European Office of Crafts, Trades, and SMEs for Standardisation. It is an international nonprofit association created in 1996 with the support of the European Commission and the only European organization focusing on small enterprise interests in the European standardization system. Its members represent over 11 million enterprises in all European countries, including all EU and EFTA member states, and its mission is to defend the interests of all of them. This mission is of crucial interest, as SMEs represent over 90% of European companies, and they employ nearly 81 million people, which is 66% of Europe's total employment.

Standards are essential for SMEs today, as they are for any company operating in an internal market. The application of standards adoption guarantees them several advantages, such as enlarging the potential market for products, facilitating product acceptance, lowering transaction costs, achieving economies of scale, reducing external effects (like environmental impact), interoperability, improving management systems, and so on. Thus, standards definition cannot be a privilege enjoyed by big companies alone. SMEs must be represented. However, SMEs lack knowledge with respect to standards and standardization, and they need some support to help them implement existing standards, as well as have a voice in the standardization process.

The European Commission (EC) has supported NORMAPME during its first years of

operation. Currently, NORMAPME is party to an EC contract offering standardization services to SMEs.

The principal and most important activity of NORMAPME is participation in the standardization process: experts recommended by member SME organizations participate in the work of technical committees at the European standardization organizations (CEN, CENELEC, ETSI) and at the ISO.

Second, NORMAPME collects information on new directives, directives under review, and standardization works. Essential parts of this information are published in simple language by means of newsletters, specific circulars, a Web site, seminars, and the like. All publications are translated into six languages (English, French, German, Spanish, Italian, and Polish) in order for them to be accessible by the largest number of Europeans.

NORMAPME members, and all SMEs and their organizations, have the opportunity to formulate proposals for the improvement of standards and directives. These opinions are debated in the expert groups in order to draft SME representative positions. Once these positions are finalized, they are promoted in the standards organizations, in European institutions, and through the media by publishing articles and through the press.

Software Quality Institute

The Software Quality Institute, Griffith University (Australia), developed the rapid assessment for process improvement for software development (RAPID) method in conformity with ISO/IEC 15504 (Rout, Tuffley, Cahill, & Hodgen, 2000). RAPID was developed for SMEs with limited investment of time and resources. The model includes eight ISO/IEC 15504 processes: requirements gathering, software development, project management, configuration management, quality assurance, problem resolution, risk management, and process establishment. The scope of the

model is limited to Levels 1, 2, and 3, although capability ratings at Levels 4 and 5 are possible. The organizations assessed in Queensland ranged in size from 3 to 120 employees, with an average size of 10 to 12 employees.

ESPRIT – ESPINODE Initiative

An assessment methodology has been developed by ESPINODE for Central Italy, with the aim of using rapid software process assessment as a way to promote innovation for SMEs (Cignoni, 1999). The methodology is based on a two-part questionnaire compiled by experts who interview representatives of the enterprise. Part 1 is conducted by phone, and Part 2 is completed in a direct audit meeting.

Rapid-assessment meetings to allow enterprises to “taste” SPI and awareness and training events are used as a way to establish the very first contact with the enterprises and to present the opportunity of a rapid software process assessment as a free service. The specific goals of the subsequent assessment program are:

- To stimulate interest in software process assessment and improvement
- To contribute to the definition of specific improvement plans
- To collect data and statistics about software process maturity

Being “rapid,” the methodology developed is also approximate. Due to time constraints, the scope and accuracy of the assessment are sacrificed, since the assessment meeting is limited to half a day, including time for discussion. In particular, a very general assessment is made of the 35 processes, and some more accurate questions are formulated on just three processes belonging to two of the five SPICE process categories. Moreover, the accuracy of the assessment is limited to the answers given by the enterprises,

and the answers are neither cross-checked nor validated.

The rapid assessment procedure offered through awareness and training events shows that, in very many cases, identifiable benefits can be achieved via focused SPI projects. The offer of a free (rapid) assessment is a way to both diffuse process quality concepts and propose actual improvement paths to enterprises.

Mexican Approach

In Mexico, it was felt that standards such as ISO/IEC 12207, or models such as CMMI, were either too general or too costly for Mexican enterprises. A Mexican standard was therefore 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®.

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 Process Model

The process model MoProSoft uses ISO/IEC 12207 as a general framework. It was developed considering integration between software processes and business processes and borrows practices from ISO 9000:2000 and CMMI®. It also incorporates practices from the Project Manage-

ment Body of Knowledge (PMBOK, 2006) and the Software Engineering Body of Knowledge (SWEBOK) (ISO TR 19759, 2005). In addition, MoProSoft addresses the process model requirements of ISO/IEC 15504-2 (ISO/IEC 15504-2, 2003). The percentage of coverage by MoProSoft with respect to these practices is as follows:

- ISO 9001:2000 92%
- ISO/IEC 12207 (Amendments 1 and 2) 95%
- CMMI level 2 77%

MoProSoft focuses on processes and considers three basic organizational or structural levels under which processes are organized: top management, management, and operations.

- 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.

In addition, MoProSoft highlights informative data, added to the normative part, and proposes tailoring guides for each process. This is a very helpful feature and one requested by VSEs in the survey.

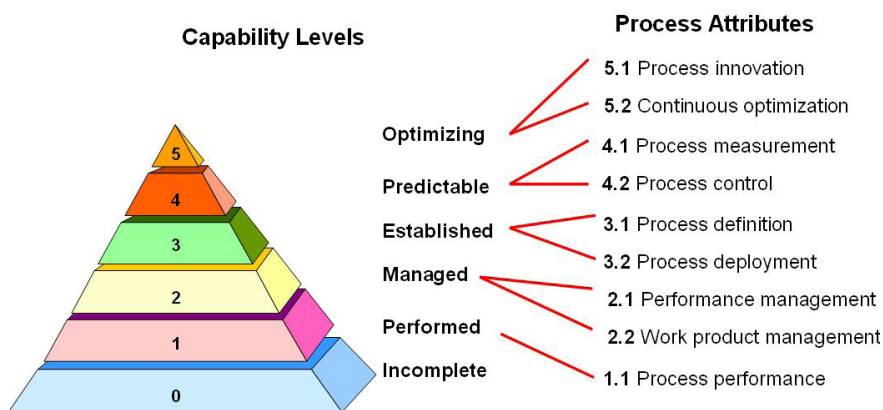
The Assessment Method

The Mexican standard also proposes Guidelines for Process Assessment, EvalProSoft, based on ISO/IEC 15504-2. The process assessment model defines five levels of capability and their associated attributes, as illustrated in Figure 6. For VSEs, WG24 will develop profiles, guides, and templates for capability levels 1 and 2. After reaching level 2, a VSE should be mature enough to make appropriate decisions about future improvement activities.

The Association of Thai Software Industry (ATSI)

The Association of Thai Software Industry (ATSI) developed the Thai Quality Software (TQS) standard⁹ (2005) to provide Thai VSEs with a way to improve their process quality using a standard as a reference model. TQS is a staged

Figure 6. Capability dimensions of ISO/IEC 15504-2



implementation of ISO/IEC 12207, where different processes are implemented at each of five capability levels, and each level has different requirements (L1=records; L2=procedures, plans; L3, L4, L5=more processes).

TQS was developed to respond to the following issues:

- Thai SMEs are not ready to implement the entire ISO/IEC 12207 standard.
- Not all ISO/IEC 12207 activities are suitable for SME operations.
- There is no assessment model for the ISO/IEC 12207 standard.
- Most software developers are not document-oriented.

To address those issues, ATSI proposed the following guidelines for the creation of a framework:

- Break down the ISO/IEC 12207 standard into stages or levels in order to fit all sizes of SMEs.
- Modify ISO/IEC 12207 activities to suit SME operations: product and project based on type of business.
- Develop a set of checklists for use by assessors.
- Provide templates and examples.

The TQS standard has the following characteristics:

- It has been adapted from the ISO/IEC 12207 Software Life Cycle Standard.
- It is divided into five stages.
 - Each stage ensures that software organizations use international standards for producing software.
 - Software organizations are assessed for certification at each stage.
- It comprises three main processes:

- Primary Life Cycle Process
- Supporting Life Cycle Process
- Organizational Life Cycle Process

Table 2 illustrates the breakdown, from level I to level V, of the development process.

By March 2005, 43 Thai software organizations had already been certified at TQS level 1, and 11 software organizations had been certified at TQS level 2. However, in spite of the effort made to stage the standard and make it a step-by-step approach, most companies (VSEs) still found it too complicated and difficult to implement, and few of them managed to do so.

Centre d'Excellence en Technologies de l'Information et de la Communication

The Centre d'Excellence en Technologies de l'Information et de la Communication (CETIC),¹⁰ located in Wallonia (Belgium), focuses on applied research and technology transfer in the field of software engineering and electronic systems. CETIC is a connecting agent between academic research and industrial companies. At the University of Namur, a software process improvement approach dedicated to small development structures has been developed. The method, called Micro-Evaluation, has been used and improved in collaboration with CETIC and the Department of Software and IT Engineering at the École de Technologie Supérieure (ÉTS, Québec, Canada).¹¹

Gradual Framework

At the first stage, a very simplified questionnaire, called the Micro-Evaluation, is used to collect information about the current software practices in small structures and to make people sensitive to the importance of software quality aspects. The questionnaire was mostly designed based on the Software Capability Maturity Model

Table 2. Breakdown of the development process

12207	12207 Processes & Activities	Level I	Level II	Level III	Level IV	Level V
5.	<i>Primary life cycle processes</i>					
5.3	Development process	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

(Paulk, Curtis, Chrissis, & Weber, 1993) and on the ISO/IEC 15504 (SPICE) reference model and uses an interview method. It covers six key axes selected on the basis of former experience with SME and VSE evaluation as the most pertinent and the most important to the targeted organizations. These axes are quality management, customer management, subcontractor management,

development and project management, product management, and training and human resources management.

The Micro-Evaluation was first tested on a sample of 20 organizations in Wallonia (Laporte, Renault, Desharnais, Habra, Abou El Fattah, & Bamba, 2005). Figure 7 shows the global maturity profile of the small enterprises involved in the first

Micro-Evaluation round. Subsequently, 7 of the 20 companies reevaluated their practices and one performed a third Micro-Evaluation.

In 2004, 23 micro-evaluations were performed in Quebec, Canada. The average number of employees in the companies concerned was about 13, and the average number of years the companies had been producing software was about 12. Figure 8 shows that small organizations were performing, with a score of about 3 out of a maximum of 4, requirement formalization, project planning, problem management, and verification and versioning activities. A number of weaknesses can also be noted: very low scores on commitment to quality, change management, product structure, human resources management (i.e., training), and project tracking. It is also interesting to note that project planning scored significantly higher (3.0) than tracking. It seems that VSEs develop a plan, and then, once in development, the plan is forgotten while the “fire” of the day is put out.

The ÉTS is currently conducting experiments with some of its graduate software engineering students. As part of their academic courses (Software Quality Assurance and The Case Study), they are required to perform evaluations, identify one or two practices to improve and transfer the practice(s) to the organization. Since some of the students already work for VSEs, it is easy for them to sell their management on the idea of a small team of two or three students investing a few hundred hours of their own time into improving an area of the VSE development process.

The second step of the OWPL (Observatoire Wallon des Pratiques Logicielles) gradual approach is the OWPL assessment based on a light reference model adapted from SW CMM. The OWPL model has been designed with respect to the particular context of small businesses, to help them improve their software practices. The structure of the OWPL model involves processes, practices, and success factors. It defines

Figure 7. Evolution of profile over three micro-evaluations

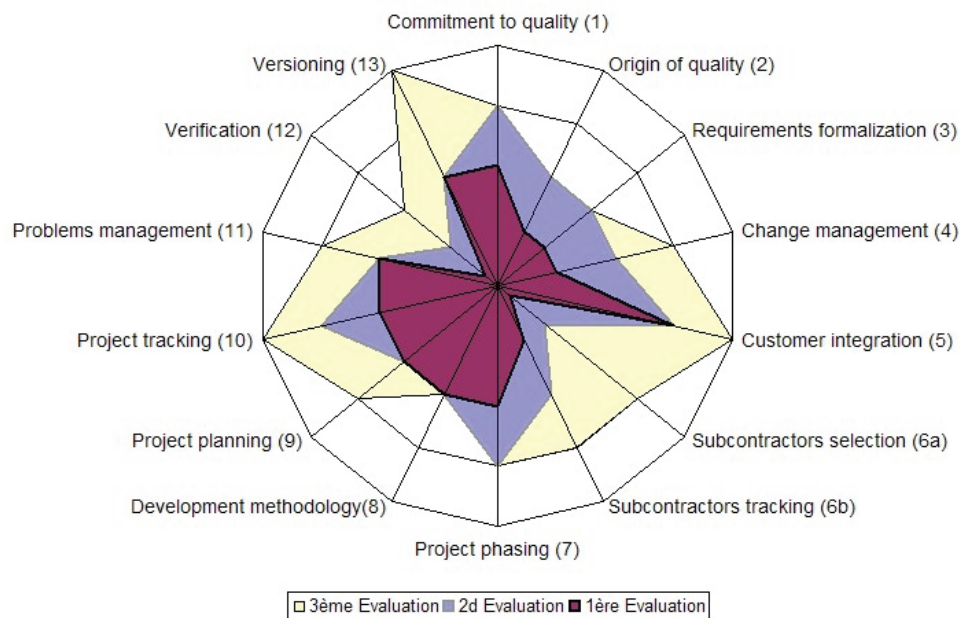
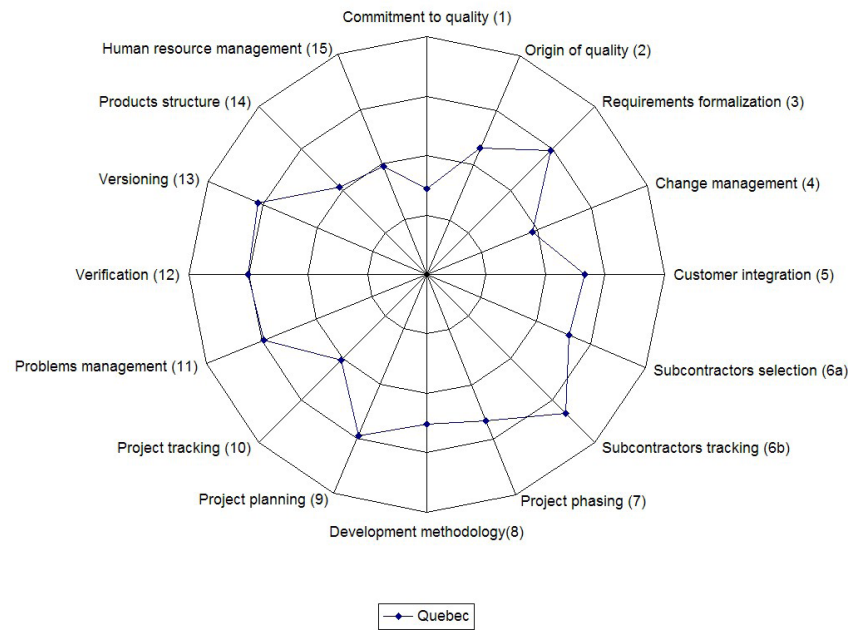


Figure 8. First micro-evaluation round in Québec



10 processes (requirements management, project planning, project tracking and oversight, development, documentation, testing, configuration management, subcontractors management, quality management, and experience capitalization), each of which is decomposed into a number of practices (from 3 to 12). It is also supported by success factors. Each of the above processes is assigned a general goal in accordance with the organization's defined objectives. It involves a number of practices and is supported by a number of success factors. Each practice is defined by its goal, its inputs and outputs, the resources assigned to support it and its weight. This last attribute is an indicator of the importance of the practice to improving the process as a whole.

Software Engineering Institute

The Software Engineering Institute (SEI) has launched a project titled "Improving Processes in Small Settings (IPSS)."¹² For this project, small settings are defined as companies with fewer than

100 employees, organizations with fewer than 50 people, and projects with fewer than 20 people (Garcia, 2005). The IPSS project will assemble small businesses, governments, large businesses, advocacy organizations, universities, and industry associations from around the world to jointly explore the unique challenges and opportunities of applying process improvement strategies in small businesses. The SEI seeks to achieve the following objectives:

- Increase awareness of process excellence as an enabler of global competitiveness
- Demonstrate effective approaches to process improvement for the small business
- Provide tools for process improvement that are easily applied by small businesses

The ParqueSoft Organization of Columbia

The Software Technology Park Foundation¹³ (Fundación Parque Tecnológico del Software),

ParqueSoft, is a not-for-profit organization established in December 1999 for the purpose of creating and developing enterprises providing goods and services to the IT market. ParqueSoft is consolidating Southwestern Colombia’s Science and Technology Corridor, integrating 12 software technology parks located in Cali, Popayán, Pasto, Buga, Tuluá, Palmira, Buenaventura, Roldanillo, Cartago, Armenia, Manizales, and Pereira.

To date, ParqueSoft and its network of software technology parks house more than 200 VSEs where more than 800 software engineering professionals specializing in the industry’s latest technologies, along with 200 other professionals, provide support in administrative and business development processes. These VSEs have, on average, six employees each.

ParqueSoft has created an innovative support model encompassing five macro objectives supported by 16 synergistic strategies to promote enterprise development and research and development (R&D). The macro objectives and their

corresponding strategies are listed in Table 3.

ParqueSoft has completed the implementation of its quality management system based on ISO 9001:2000. This certification turns ParqueSoft into the first enterprise incubator in Colombia to certify its quality processes. This is also being achieved by 14 of its VSEs. The next goal is to certify all ParqueSoft VSEs in the next four years.

Common Features of These Initiatives

Dozens of universities, research centers, and associations have tried to find their own answers to one issue facing most VSEs. However, at this point, no one has been able to propose an answer that fits whatever the context and taking into account all previous experience and knowledge as valuable input.

Obviously, all the VSE initiatives listed had the following statements in common:

Table 3. ParqueSoft’s objectives and strategies

<ul style="list-style-type: none"> • Objective 1. To provide an infrastructure for business development and support <ul style="list-style-type: none"> o Competitive infrastructure o Technological support (Telco, networking, videoconferencing, data center) o Effective communications (Internet, Intranet, and media) o Intellectual property and legal support
<ul style="list-style-type: none"> • Objective 2. To develop the best people in the industry <ul style="list-style-type: none"> o Empowerment of human talent o Preparation for the software industry o Develop seedbeds of research and entrepreneurship
<ul style="list-style-type: none"> • Objective 3. To become more innovative and provide reliable and competitive products <ul style="list-style-type: none"> o Build with quality (products, processes)
<ul style="list-style-type: none"> • Objective 4. To develop a financial strength <ul style="list-style-type: none"> o Entrepreneurship promotion funds o Risk-capital funds o Savings
<ul style="list-style-type: none"> • Objective 5. To support enterprise development <ul style="list-style-type: none"> o Market intelligence o Creative marketing o Business knowledge o Business development o Business support and updating

- VSEs require low-cost solutions.
- VSEs require additional effort in communications, in standardizing vocabulary.
- VSEs require a staged approach.
- VSEs require ways to identify potential quick wins.

FINDINGS OF THE IEEE STANDARDS SURVEY

In 1997, the Technical Council on Software Engineering responsible for the IEEE Software Engineering Standards (SES) conducted a survey to capture information from software engineering standards users in order to improve those standards (Land, 1997). They gathered 148 answers, mainly from the USA (79%) and large companies (87% of them having more than 100 employees). The main application domains of the survey respondents were IT (22%), military (15%), and aerospace (11%). (It should be noted that the purpose of this section is not to systematically compare the two sets of survey results.)

Even though the IEEE survey objectives differ from those of the ISO/IEC survey, there are some interesting common findings. In response to the question concerning the reasons why their organization does not use standards, 37% said that the standards were not available in their facilities, while 37% explained that they use other standards. In fact, the IEEE survey underscores the fact that ISO/IEC standards are often used in organizations, rather than the IEEE standards.

The IEEE survey underlined the difficulties regarding IEEE standards use reported by the respondents. The two main difficulties were a lack of understanding of the benefits (28%) and a lack of useful examples (25%). The survey also revealed how IEEE standards are used in organizations. Most of the organizations (35 answers) claimed to use IEEE standards for internal plan elaboration.

The IEEE survey gathered several new requirements about IEEE standards being requested by the respondents. These were principally examples and templates of deliverables (about 32 responses), support for metrics and measurement (about 30 responses), help on life cycle process definition (about 23 responses), and a training course and support for small, rapid application development efforts.

ANALYSIS OF SURVEY DATA CONDUCTED BY WG24

The WG24 survey was developed to question VSEs about their use of standards and widely recognized documents, such as the CMMI, and to collect data to identify problems and potential solutions to help them apply the standards and become more competitive. From the very beginning, the working group drew up several working hypotheses regarding VSEs. The survey was intended to validate some of these, such as:

- 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 25 people and an IT department of the same size in a large company.
- VSEs are limited in both time and resources, which can lead to a lack of understanding of how to use the standards for their benefit.
- Benefits for VSEs may include recognition through assessment or audit by an accredited body.

The working group also wanted to know: the reasons for using standards, or for not using them, which standards were used, the problems/barriers

encountered when using them, and how we can facilitate their adoption and utilization.

An introductory text (see Appendix A) and a questionnaire were developed by a graduate student and members of WG24 and translated into nine languages: English, French, German, Korean, Portuguese, Thai, Turkish, Russian, and Spanish. The survey (see Appendix B) is made up of 20 questions structured in five parts: general information, information about standards utilization in VSEs, information about implementation and assessment problems in VSEs, information about VSE needs, and information about justification for compliance to standard(s).

A Web site, hosted by the École de Technologie Supérieure,¹⁴ was developed to maximize the number of responses and facilitate data collection and analysis. A mailing list was created using WG24 members' contact networks. We also contacted centers and software engineering professors focusing on the concerns of small software enterprises, such as the CETIC¹⁵ Center in Belgium, the Centre de Recherche Public Henri Tudor in Luxembourg,¹⁶ the Thai Software Industry Promotion Agency (SIPA¹⁷), The European Software Institute (ESI¹⁸), the Colombian Parquesoft¹⁹ organization, the Japan Information Technology Promotion Agency (JITEC²⁰), the Irish Enterprise Ireland,²¹ and the Software Process Improvement Networks (SPIN²²) worldwide. Access to the Web-based survey was protected, as suggested by Kasunic (2005), to prevent unauthorized individuals from participating and to prevent duplicate submissions by a single respondent. The survey software, produced by Quask,²³ was satisfactory. Its weakness was that it was not capable of supporting double characters. These characters are used in languages such as Thai, Korean, and Russian. To remedy this problem, we provided the survey questionnaire to the respondents from these countries as a Word document.

One of these organizations, Thailand's SIPA, also acted as a host for the 2006 ISO/IEC JTC1/SC7 plenary meeting. The SIPA organized a series of

free tutorials for their members the week before the SC7 meeting. One condition for a SIPA member to participate in the tutorials was to respond to the survey. This resulted in over 58 responses from Thai VSEs (see Table 4). In Colombia, Parquesoft designated an individual to solicit VSEs and help them complete the survey. Since there are over 100 VSEs in the Parquesoft group, this explains the high number of responses received from that country.

Respondents were informed that it would take a maximum of 15 minutes to complete the survey. They were also informed that all data would be kept confidential and that only summary results and project data that could not be matched to a specific VSE would be included in the published results.

In order to increase participation in the survey, WG24 promised to send all respondents a report presenting, on an anonymous basis, the survey results. The survey was launched in February 2006, and, as of as of June 2006, over 392 responses had been collected from 29 countries.²⁴

Categorization of the Sample According to the Size Criterion

In order to avoid developing profiles that would not meet the needs of VSEs, WG24 defined what VSEs are in terms of size. At the time, there was no official definition of the VSE, while the concept of the small- and medium-sized enterprise (SME) had already been clearly defined in Europe (fewer than 250 employees or with a turnover \leq €50 million) and in the United States (fewer than 500 employees). The Organization for Economic Cooperation and Development (OECD) subdivides the SME category into several subcategories: micro (0²⁵-9 employees); small (10-49 employees); and medium (50-250 or 500 in the United States). In Europe, micro enterprises represent 93% of the total number of companies (56% in the United States) and 66% of total employment [9].

Of the 392 responders, 228 were enterprises

with 0 to 25 employees (58%), as illustrated in Figure 9. These 228 VSEs constitute the sample for this study. The following paragraphs present findings common to the 228 VSEs, identifying correlations inside the sample and findings that differ from those of the bigger companies that contributed to the survey.

This categorization and several studies underscore the differences between micro-, small-, and medium-sized enterprises in terms of available resources. WG24 decided to focus on the first category (micro enterprises with 0-9 employees) and on a subpart of the small enterprise category (10-25 employees).

General Characteristics

Here, we draw attention to some weaknesses of the sample itself. Since the survey was initiated through WG24 contacts without building a true random sample, the survey results may have been impacted. The first observation about the respondent sample, as illustrated in Table 4, is

the geographical distribution of the responses. We collected a high number from Latin America (46%), mainly from Colombia (22%) and Brazil (17%).

At the same time, we received only a few responses from European countries (48), Japan (3), and the United States (3). Possible reasons for this are:

- The invitation to participate in the survey was not distributed in some countries.
- Many SPIN members are employed in larger companies not directly targeted by this survey.
- Most SPIN members already use CMMI, and they may not be interested in ISO standards.
- Most VSEs do not care about IT standardization, so only those aware of it took the time to contribute.

Our results might, therefore, only generalize to the broader populations of projects in each region

Figure 9. Number of employees in the enterprises surveyed

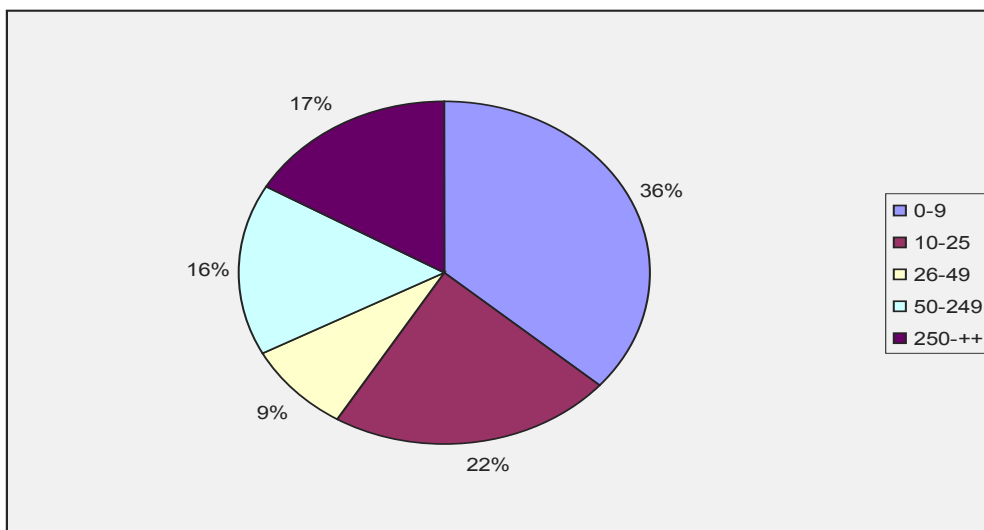


Table 4. Number of survey responses per country, as of June 2006

Country	Number of Responses	Country	Number of Responses
Argentina	2	Italy	2
Australia	10	Japan	3
Belgium	10	South Korea	4
Brazil	70	Luxembourg	2
Bulgaria	3	Mexico	20
Canada	9	New Zealand	1
Chile	1	Peru	4
Colombia	109	Russia	4
Czech Republic	3	South Africa	10
Dominican Republic	1	Spain	3
Ecuador	9	Taiwan	1
Finland	13	Thailand	58
France	4	Turkey	1
Germany	1	United Kingdom	2
India	57	United States	3
Ireland	10		

to the extent that this sample represents them. Moreover, we have no evidence that participating companies are representative of the situation in their own countries. Conclusions drawn from these survey results should be confirmed with additional responses. To achieve this objective, WG24 plans to keep the survey Web site online and launch another survey blitz.

The strong representation of Latin American countries in the sample has no impact on the final results of the study. These VSEs differ from the rest of the respondents in the types of development, that is, more specialized products and the application domain, as they are more involved in critical applications with almost 50% of VSEs working on these fields.

Among the respondents, the majority (79%) are private companies and 78% operate at the national level only. Regarding the application domain, as shown in Figure 10, almost half the respondents are working either on life/mission-critical systems or on regulated projects. Over 40% of the respondents are developing software

for life/mission-critical systems and 34% on regulated developments.

With regard to the types of software development, the majority control customized or tailor-made software and specialized products, as shown in Figure 11.

Features of the VSE Results

More than 70% of VSEs are either working on life- or mission-critical systems, or in a regulated market. This underscores our hypothesis concerning the awareness of the participating companies, as it is assumed that companies working on these particular contexts are prone to using standards for contractual reasons. An interesting finding of the survey is the difference in the percentage of certified companies with regard to company size: fewer than 18% of VSEs are certified, while 53% of larger companies (those with more than 25 employees) claim to be certified. Furthermore, among the 18% not certified, 75% do not use standards. In larger companies using standards,

Figure 10. Application domain

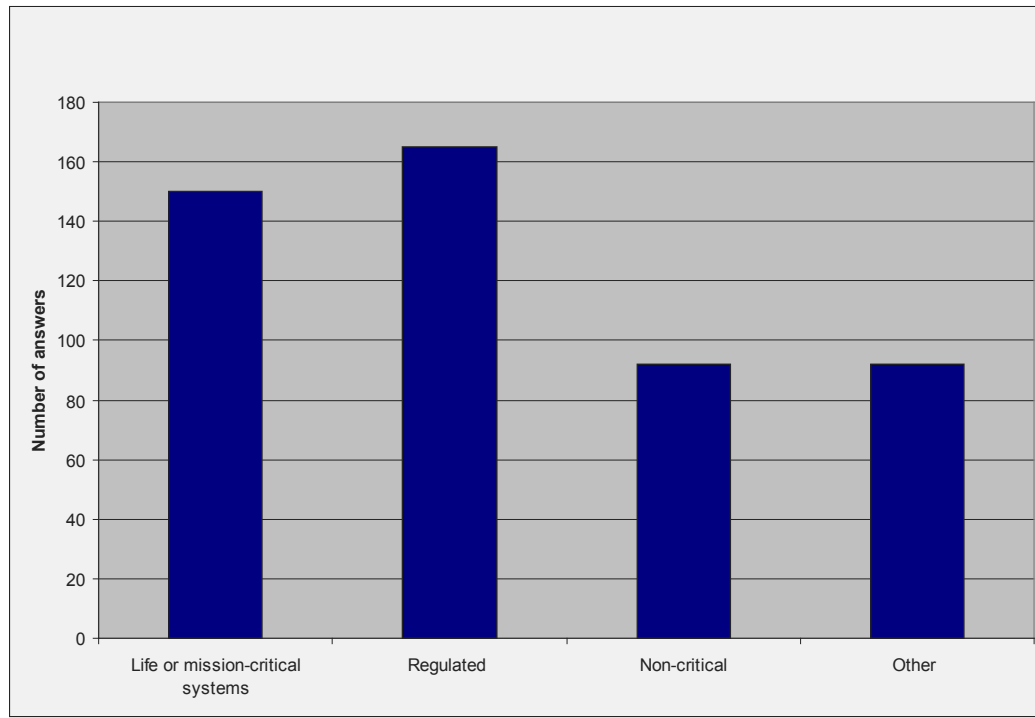
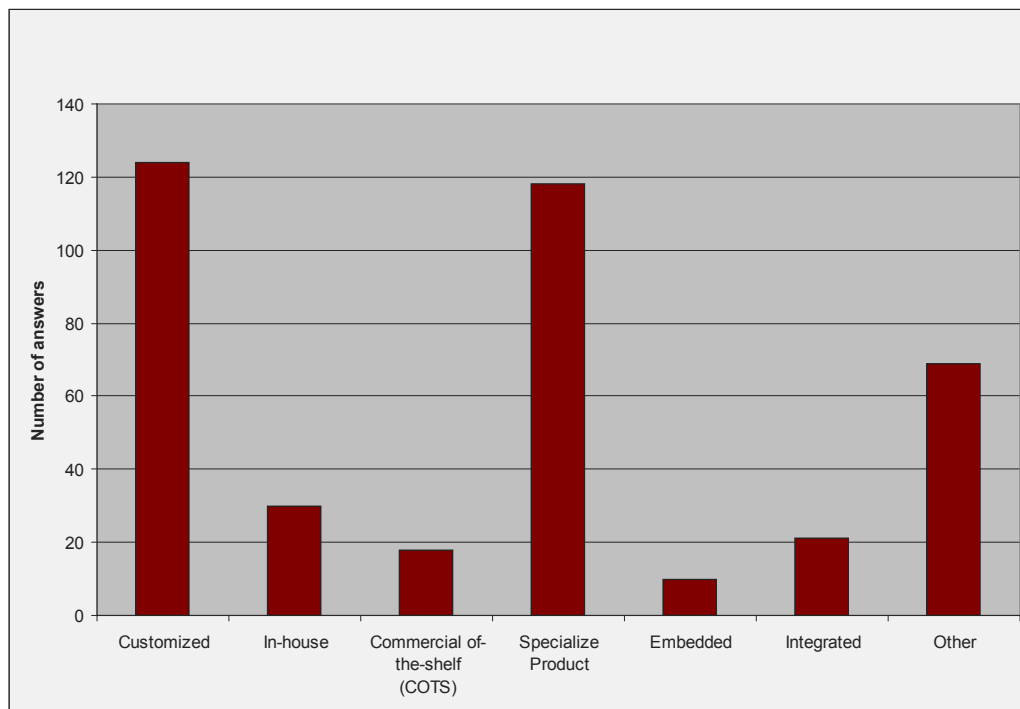


Figure 11. Types of software development



two families of standards and models emerge from the list: ISO standards (55%) and models from the Software Engineering Institute (47%).

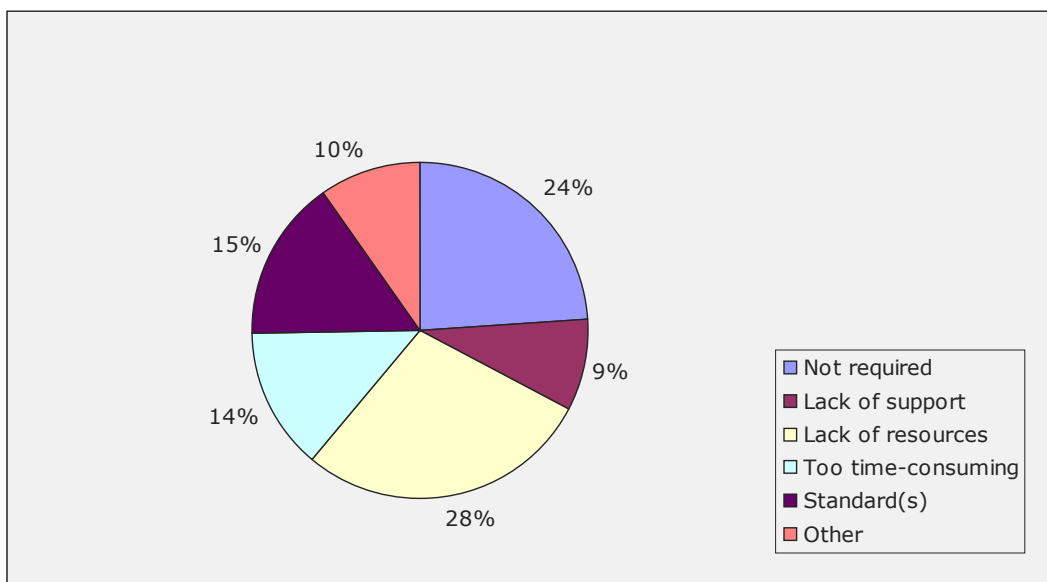
WG24 anticipated the limited use of standards by VSEs by asking questions designed to provide a better understanding of the reasons for this. There are three main ones, as shown in Figure 12. The first is a lack of resources (28%); the second is that standards are not required (24%); and the third derives from the nature of the standards themselves: 15% of the respondents consider that the standards are difficult to meet and bureaucratic, and insufficient guidance is provided for use in a small business environment.

However, for a large majority (74%) of VSEs, it is very important to be recognized or certified against a standard. ISO certification is requested by 40% of them. Of the 28% requesting official market recognition, only 4% are interested in a national certification. From the respondents of the survey, some benefits of certification are:

- Increased competitiveness
- Greater customer confidence and satisfaction
- Greater software product quality
- Increased sponsorship for process improvement
- Decreased development risk
- Facilitation of marketing (e.g., better image)
- Higher potential to export

However, VSEs are expressing the need for assistance in order to adopt and implement standards. Over 62% would like more guidance with examples, and 55% are asking for lightweight and easy-to-understand standards complete with templates. Finally, the respondents indicated that it has to be possible to implement standards with minimum cost, time, and resources. All data about VSEs and standards clearly confirm WG24's hypothesis and requirements, and WG24 will use this information to develop profiles, guides, and templates to meet VSE needs.

Figure 12. Why do VSEs not use standards?



FUTURE WORK AND CONCLUSION

The software industry recognizes the value of VSEs in contributing valuable products and services to the economy. As software quality increasingly becomes a subject of concern, and process approaches are maturing and gaining the confidence of companies, the use of standards is spreading in organizations of all sizes. However, existing standards were not written for small or very small organizations (development organizations with fewer than 25 employees), and are consequently difficult to apply in such settings, though small and very small companies can represent from 50 to 85% of a local economy in some regions of the world.

A large number of universities, research centers, and associations have tried to find their own answers to this issue being faced by most VSEs, and are proposing software process models dedicated to small companies. However, at this point, no one has been able to propose a one-size-fits-all solution for any context and taking all previous experience and knowledge into account. Most potential solutions are still too complicated and cannot be applied to VSEs as defined in the scope of this project.

A new ISO/IEC JTC1 SC7 Working Group, WG24, has been established to address those difficulties by developing profiles and by providing guidance for compliance by very small organizations with ISO software engineering standards. A survey was conducted to ask these very small organizations about their use of ISO/IEC JTC1 SC7 standards and to collect data to identify problems and potential solutions to help them apply standards. Over 400 responses were received from 30 countries. The survey was intended to validate working hypotheses regarding VSEs drawn up by the working group.

Based on this feedback, the working group will start tailoring existing solutions (i.e., the Mexican standard) to adapt them to the requirements expressed by VSEs taking part in the survey. This

will enable WG24 to propose profiles, guides, and templates for the 0-9 employee category and the 10-25 employee category that really take the concerns of VSEs into account and fit them into their particular context. The working group's key challenge will be the selection and tailoring of processes from existing standards (mainly ISO 12207) for VSEs.

The next stage will be to undertake pilot projects. These will be conducted within real projects to assess the artifacts developed by WG24, providing the working group with key information to update them and move towards international balloting and publication by the ISO. We will conduct pilot projects in different environments in order to gain confidence that their results will be applicable to a wide spectrum of VSEs. These projects will be coordinated and monitored by the members of WG24. The fact that the members of this working group are located on many continents should enable us to conduct pilot projects in different cultural contexts.

ACKNOWLEDGMENT

The authors would like to thank Mrs. Karine Bluteau, a graduate software engineering student at the ÉTS, who was instrumental in developing and conducting the survey and the establishment of the survey Web site. The authors would also like to thank all those who helped translate the survey and invited VSEs to respond to it.

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ENDNOTES

- 1 ISO/IEC JTC 1/SC7 stands for the International Organization for Standardization/International Electrotechnical Commission Joint Technical Committee 1/Sub Committee 7.
- 2 CMMI and CMM are registered with the U.S. Patents and Trademarks Office by Carnegie Mellon University.
- 3 Capability Maturity Model Integration is a service mark of Carnegie Mellon University.

- 4 <http://www.infclst.ac.uk/informatics/cspt/>
- 5 <http://www.softwareexcellence.co.uk/>
- 6 <http://www.esi.es/en/main/iitmark.html>
- 7 <http://www.tut.fi/public/>
- 8 <http://www.normapme.com/>
- 9 http://www.atsi.or.th/atsi_th
- 10 <http://www.cetic.be>
- 11 <http://profs.logti.etsmtl.ca/jmdeshar/SiteWQ/index.html>
- 12 <http://www.sei.cmu.edu/iprc/ipss.html>
- 13 www.parquesoft.com
- 14 www.etsmtl.ca
- 15 www.cetic.be
- 16 www.tudor.lu
- 17 www.sipa.or.th
- 18 www.esi.es
- 19 www.parquesoft.com
- 20 www.ipa.go.jp
- 21 www.enterprise-ireland.com
- 22 <http://www.sei.cmu.edu/collaborating/spins>
- 23 www.quask.com
- 24 As of October 2006, 430 responses had been collected from 32 countries.
- 25 Company formed by its founder without any additional employees (e.g., consultant).