Applying ISO/IEC Software Engineering Standards in Small Settings: Historical Perspectives and Initial Achievements

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Abstract

The software industry recognizes the value of very small enterprises (VSEs) in contributing valuable products and services. As software quality increasingly becomes a subject of concern, and process approaches are maturing and gaining the confidence of companies, the use of ISO standards is spreading in organizations of all sizes. However, these standards were not written for small projects, small development organizations, or companies with between 1 and 25 employees, and are consequently difficult to apply in such settings. Moreover, the current international Life Cycle Standard ISO/IEC 12207 and its associated guide do not explicitly address the needs of VSEs. This new international standardization project proposes to address some of those difficulties by developing profiles and by providing guidance for compliance with ISO software engineering standards such as ISO/IEC 12207 and ISO 9001.

1 Introduction

This paper presents a new project, which proposes to facilitate access to, and utilization of, ISO software engineering standards in very small enterprises (VSEs), which include small software development departments and small projects within larger organizations. VSEs are typically organizations and projects with between 1 and 25 employees.

In Europe, for instance, 85% of the Information Technology (IT) sector's companies have between 1 and 10 employees [11]. In Canada, the Montreal area was surveyed, as illustrated in Table 1, and it was found that close to 80% of IT companies have fewer than 25 employees [7]. Another study conducted by the Technology Assessment Group (CITA) of Wallonia [2] has published similar data, which reveal that about 60% of IT companies there have fewer than 5 employees. In Brazil, small IT companies represent about 70% of the total number of companies [1]. Finally, in Northern Ireland [8], a survey reports that 66% of IT organizations within companies employ fewer than 20 employees.

There is a need to help these organizations understand and use the concepts, processes and practices proposed by the ISO's international software engineering standards.

The current ISO software engineering life cycle standards, ISO/IEC 12207 and the associated guide, are not easily applied in small settings. Although efforts to add a process to adapt this standard to varying project situations has been made, compliance is still difficult for them to achieve, and further guidance is required.

Size (employees)	IT 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%

Table 1: Size of IT companies in the Montreal area

This paper is divided into four sections. In section 2, the ISO/IEC SC7 organization mandate in software engineering standards development is described. In section 3, a history of the recent events that led to an ISO/IEC SC7 Project Proposal for small settings is presented. Then, in section 4, the text of the final

proposal, tabled at the last ISO/IEC SC7 plenary meeting, is summarized. Section 5 describes the last meeting of the Special Working Group to prepare and facilitate the start-up of WG24, described in the final, sixth section.

2 Overview of the ISO/IEC SC7 mandate

During 1987, the International Organization for Standardization and the International Electrotechnical Commission 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.*"[3] 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 number of ISO/IEC standards that are maintained and published under the responsibility of SC7.
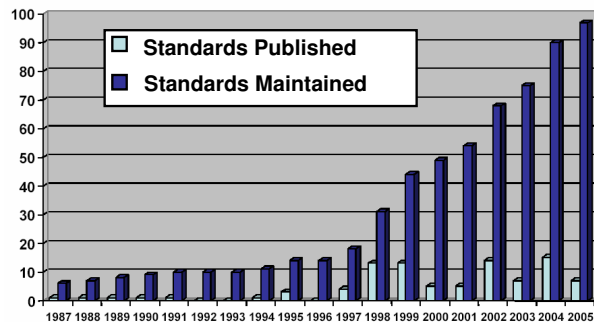

Figure 1: Evolution of published ISO/IEC Software and Systems Engineering Standards

Within the portfolio of SC7 standards, a number of international standards are grouped together in a category called "Software and Systems Engineering Processes". These are international standards describing good software and systems engineering practices, as well as international standards assessing software and systems engineering practices. Within this grouping, there are four key ISO/IEC international standards:
- ISO/IEC 12207 Software Life Cycle Processes;
- ISO/IEC 15288 Systems Life Cycle Processes; Developed with the strong participation of the International Council on Systems Engineering (INCOSE);
- ISO/IEC 15504 Software Process Assessment series.

As an example, the Capability Maturity Model[1] Integration[SM][2] (CMMI[®]) conforms to ISO/IEC 15504; and
- ISO/IEC 90003 Guidelines for the Application of ISO 9001 to computer software.

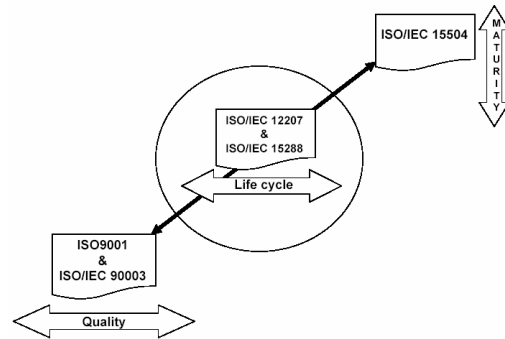The relationship between these standards is illustrated in Figure 2.

Figure 2: Relationship between key SC7 Standards

These key standards are well known in the software and systems engineering community. However, harmonization of the standards is still a topic of discussion, and is included among the newest ISO/IEC SC7 work items. Although ISO 9001 and maturity model usage in small settings is the subject of a debate which has already been initiated, life cycles need to be addressed more deeply.

3 Recent history leading to an ISO/IEC SC7 Project Proposal for small settings

In this section, a history of recent events leading to the creation of a new ISO/IEC SC7 Working Group (WG) is presented.

3.1 First meeting of ISO/IEC SC7 in Australia

At the Brisbane meeting of the SC7 in 2004 [9], Canada 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. Australia supported Canada's 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,

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[1] CMMI, CMM are registered with the US Patents and Trademarks Office by Carnegie Mellon University.
[2] Capability Maturity Model Integration is a service mark of Carnegie Mellon University.

the Czech Republic, South Africa and Thailand) where 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, if desirable, profiles 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 achieve:

- 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.

3.2 First Special Working Group meeting in Thailand

In March 2005, the Thailand Industrial Standards Institute (TASI) 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, USA and Thailand.

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 [8] to help define the size of small organizations. McFall presents the various perceived priorities and concern areas for different organization sizes.

As illustrated in Figure 3, the priorities and concerns for 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 it ranks as priority number 8 only. Conversely, for small organizations, consistency across teams is less of a concern, while for larger organizations, this issue is the top priority.

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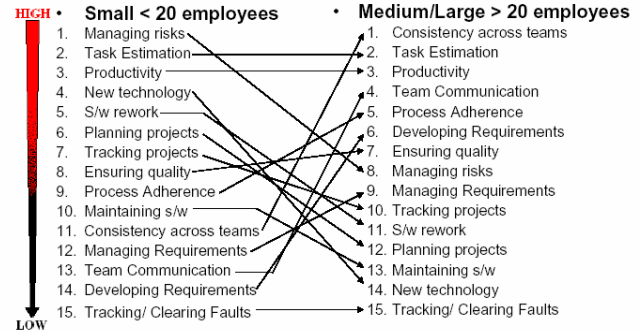

Figure 3: Priority and concern differences based on organization size (McFall)

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. To validate the Work Products produced by the working group;
2. To prepare, conduct, analyze and communicate survey results;
3. To search for other centers/organizations focusing on SMEs and VSEs;
4. To assemble a complete list of characteristics of VSEs and projects;
5. To generate multiple *profiles* from the standards mentioned above (A profile is a set of one or more base standards or ISPs, or both, and, where applicable, the identification of chosen classes, conforming subsets, options and parameters of those base standards, or the ISPs necessary to accomplish a particular function [4]);
6. To prepare communication material to inform VSEs about the work performed by the WG;
7. To develop business cases for the adoption and deployment of work products developed by the WG;
8. To develop one or more ISO 12207 roadmaps;
9. To pilot roadmaps (using an approach similar to the trials conducted by the SPICE project).

The major output of this one-week meeting was a draft of the New Work Item described in section 4.

3.3 SC7 meeting in Finland

The document developed in Thailand was reviewed during a meeting of one of the WGs at the 2005 SC7 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 Profiles and Guidelines for use in Very Small Enterprises (VSE) by 20 June 2005 [6].

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

As a result of this vote, the Project was approved and the new working group, WG 24, 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.

4 Proposed project tabled at ISO/IEC SC7

The document, tabled at the ISO/IEC SC7 Helsinki plenary, describes the scope, purpose and justification, and vision statement of the proposed working group. In the following paragraphs, each element of that project is presented. The text below has been extracted from the document balloted by the ISO [5].

4.1 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 International Standardized Profiles (ISP) 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 being to improve the competitiveness and competence of VSEs.

4.2 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, it is clear that the current SC7 Life Cycle Standards (ISO/IEC 12207 and associated Guide) are a challenge to use in these organizations, compliance with them being difficult (if not impossible) to achieve. Consequently, VSEs have few, or very limited, 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 use of ISO/IEC 12207 processes and ISO9001:2000, 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). Liaison will be established between the proposed work and other SC7 work; specifically, the progress of the ISO/IEC 12207 will be tracked.

4.3 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 use of 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 builds on or improves a VSE's existing processes, or provides guidance in establishing those processes.
- Address the market needs of VSEs by allowing domain-specific profiles and levels.
- Provide examples in order 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 becomes possible with a minimum of redesign of the VSE's processes.

Referenced documents

As illustrated in Figure 4, 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 (CMMI) and Software Capability Maturity Model (SW-CMM). Other standards, such as the ISO/IEC 15939, could also be used.
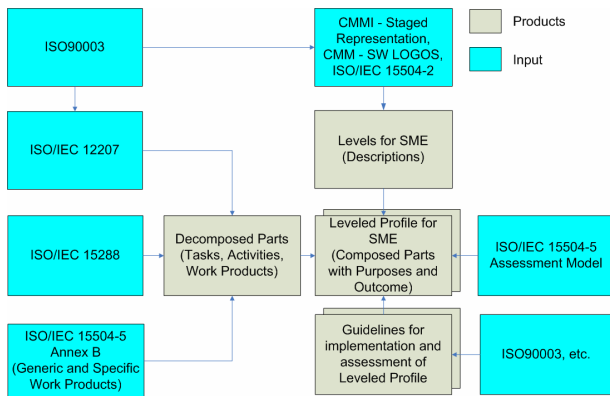

Figure 4: Referenced documents

5 Second Special Working Group meeting in Thailand

In July 2005, the Thailand Industrial Standards Institute (TASI) sent out a second invitation to participate in the Special Working Group (SWG), to be held in September 2005 in Bangkok. The main objective of the meeting was to prepare material that would be presented to WG 24 in order to facilitate the start-up of the working group. The main outputs of the meeting were:

- Proposed requirements for International Standard Profiles (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 profile architecture;
- Proposed business models;
- Proposed agenda for the first WG 24 meeting;
- Proposed draft strategic plan for WG 24;

6 SC7 Meeting in 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 in order to:

1. present the project to the official members of WG24;
2. finalize project requirements to be the project baseline;
3. gain consensus and commitment of the 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. identify lists of situational factors and business models;
8. build survey material in order to validate project requirements and to 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 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 have been 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 Working Group 24: Belgium, Canada, the Czech Republic, Ireland, Italy, Japan, Korea, Luxemburg, South Africa, Thailand, UK and USA.

The next WG 24 Meeting will be held at the SC7 Plenary Meeting in Thailand in May 2006.

Acknowledgments

Additional Information

The SC7 Web site www.jtc1-sc7.org provides more information. All JTC 1/SC7 standards can be purchased directly from the ISO (www.iso.ch) or from the national standards bodies.

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