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Delivering Software and Systems Engineering Standards for Small Teams

Feedback from Very Small Entities, their customers, auditors and academia on ISO/IEC 29110

Claude Y Laporte
École de technologie supérieure

Jezreel Mejía
Centro de Investigación en Matemáticas A.C.

Abstract: A mandate was given in 2005 to an ISO working group to develop standards and guides to help very small entities (VSEs), i.e., an organization having up to 25 people, develop software or systems. In 2006 a survey collected data to identify problems and potential solutions that would help VSEs apply standards. The ISO/IEC 29110 series provides standards and guides to help VSEs in improving their competitiveness in quality, cost, and schedule. Recently, a survey was conducted to obtain feedback from VSEs, their customers, auditors and educators about the use of the ISO/IEC 29110. The responses received showed that the series of standards and guides are providing many benefits. Academia in over 20 countries are teaching or using the ISO/IEC 29110 in students' projects. New ISO/IEC 29110 standards and guides are being developed to meet the needs of 6 space agencies and Agile and DevOps developers.

Keywords: survey, very small entities, ISO/IEC 29110, software developers, benefits, enterprises, academia, software and systems engineering, VSE

Editor's Note: ISO/IEC 29110 offers a customized set of standards and guides for very small entities to help them improve their competitiveness in quality, cost, and schedule. Many in the IEEE Computer Society have partnered with the ISO/IEC JTC 1/SC7 (Software and systems engineering) standards committee to develop a common library of software and systems engineering standards. This column has tracked the work on ISO/IEC 29110 by publishing a 2008 column at the beginning of the development of ISO/IEC 29110 and then a 2016 column providing an overview of standard and the team's accomplishments. This final column on ISO/IEC 29110 closes the loop as the team reports on a survey of the users and customers of users of this standard.

Background

A mandate was given in 2005 to an ISO working group to develop a series of standards and guides to help very small entities (VSEs) to develop quality software or systems, having hardware and software elements, within budget and schedule. The ISO/IEC 29110 series defines a VSE as "an enterprise, an organization, a department, or a project having up to 25 people" [1]. An organization could be a development team within a government agency or within a non-for-profit organization.

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A survey had been conducted in 2006 by the ISO WG to collect data to identify problems and potential solutions that would help VSEs apply standards and become more competitive. The survey was intended to validate some of the hypotheses of the ISO WG, including the following [2]: VSEs did not see the benefits of using the current set of engineering standards, they required light and well-focused standards and guides adapted to their size, VSEs did not have the expertise or resources to adapt large standards to their needs, VSEs wanted ways to be recognized (e.g., conformance audit) as producing quality products.

VSEs expressed their needs for assistance to adopt and implement engineering standards. More than 62 percent of respondents indicated that they would like more guidance with examples, and 55 percent asked for lightweight and easy-to-understand standards. Concerning the weak use of standards by VSEs, the following reasons predominated: a lack of resources second, that standards are not required and the nature of standards themselves. More than 15 percent of the respondents considered that the engineering standards were difficult and bureaucratic and did not provide adequate guidance for use in a small environment. Finally, a majority of VSEs felt it was important to be evaluated or certified against a standard to increase competitiveness, customer confidence and satisfaction, software product quality, facilitation of marketing and higher potential to export and to decrease development risk.

The ISO working group (WG) used the data of the survey to develop a set of requirements to develop a series of software and systems engineering standards and guides. Since 2011, hundreds of private and public organizations worldwide implemented the software ISO/IEC 29110 series [3], [4], [5] as well as the systems engineering guides [6], [7]. For instance, in Thailand over 450 public and private organizations had been certified to the ISO/IEC 29110 standard [8]. Finally, over 20 countries are teaching the series [9]. Since the publication by ISO of the first standards and guides in 2011, over 200 papers have been published in peer-reviewed publications [10].

Overview of the ISO/IEC 29110

The ISO WG developed a four-step roadmap, called profiles, targeting VSEs, ranging from start-ups to grownups (e.g., with little or no experience or expertise in selecting the appropriate processes from systems or software engineering standards and tailoring them to a project's needs [9]):

- (1) The Entry Profile should be selected if the VSE is a start-up or if it works on small projects such as six person-month effort;
- (2) The Basic Profile should be selected if the VSE develops a single product by a single team;
- (3) The Intermediate Profile should be selected if the VSE develops more than one project in parallel with more than one work team; and
- (4) The Advanced Profile should be selected if the VSE wants to grow and maintain as an independent competitive system and/or software development business.

The core of ISO/IEC 29110 is a set of pre-tailored management and engineering guides focusing on project management and software or system development. The ISO/IEC 29110 is intended to be used with any lifecycle such as waterfall, iterative, incremental, evolutionary or agile. To further illustrate process detail, Table 1 presents the validation task in the requirements analysis activity of the software implementation process where CUS stands for customer and AN stands for analyst.

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Table 1. An example of one task of the requirements analysis activity [1].

Roles	Task	Input Work Product	Output Work Products
CUS AN	<p>SI.2.4 Validate and obtain approval of the Requirements Specification.</p> <p>Validate that Requirements Specification satisfies needs and agreed upon expectations, including the user interface usability.</p> <p>The results found are documented in a Validation Results and corrections are made until the document is approved by the CUS.</p>	<p>- Requirements Specification [verified]</p>	<p>- Requirements Specification [validated]</p> <p>- Validation Results</p>

Results of Latest Survey

In 2018, a survey was conducted by the members of the ISO WG in English, Spanish and French of 29 countries to obtain feedback from VSEs, their customers, auditors and assessors and educators. Over 96% of respondents are working in enterprises while only 2% are working in government organizations and 2% in not-for-profit organizations.

VSEs were asked if they were satisfied with their overall ISO/IEC 29110 implementation. As illustrated in Figure 1, over 88% of the respondents indicated that they were completely or largely satisfied. Only 11% indicated that they were partially satisfied. VSEs were also asked if they noticed improvements to quality and productivity: improvements in productivity (64%), in quality (58%) and process (73%) were observed in the first six months after the implementation of ISO/IEC 29110. Only 4 respondents (7%) did not observe an improvement to productivity or quality.

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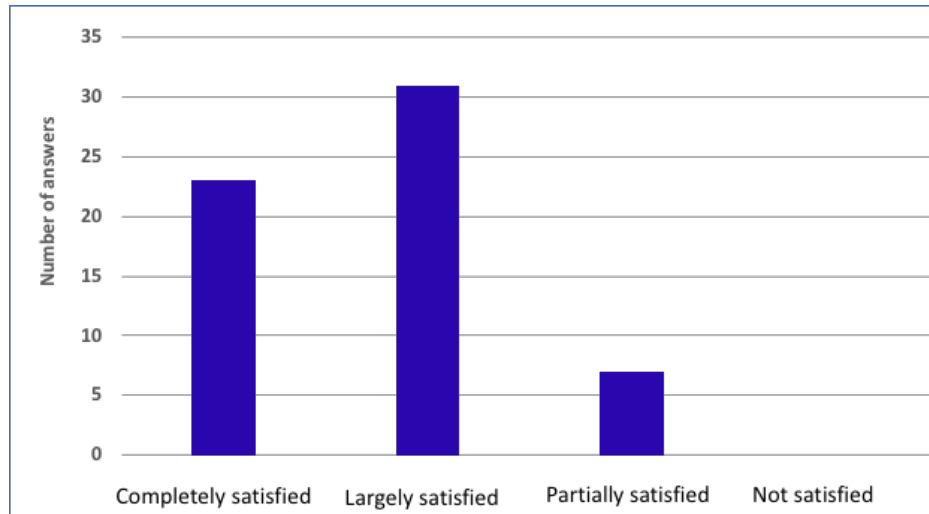


Figure 1. Answers from VEs about their satisfaction of their ISO/IEC 29110 implementation

Another question asked of the VEs was about the support they need in the implementation of the ISO/IEC 29110. According to their responses 56% required support, the type of support they used are: from consultant/coach (40%); course of workshops (33%); information of web (21%) and others (6%). It is important that they can use more than one support means.

It is interesting to know that VEs are satisfied, but we also wanted to know the satisfaction of customers of these VEs. As Figure 2 illustrates, close to 80% of customers that responded were completely or largely satisfied with their suppliers.

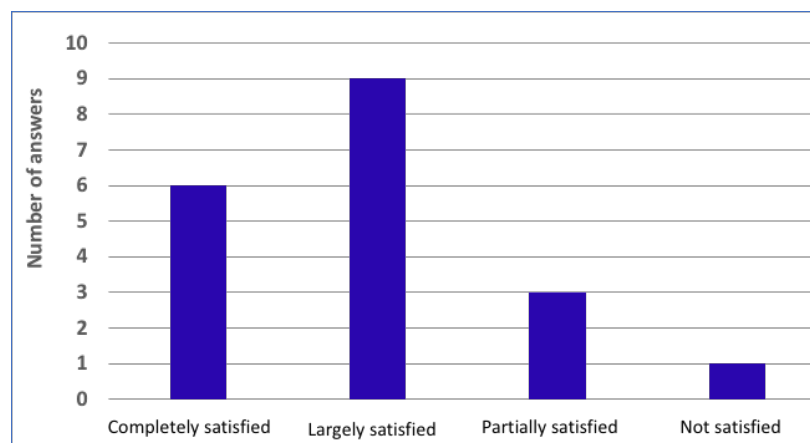


Figure 2. Answers from customers of VEs about their satisfaction of VEs

Since the ISO/IEC 29110 series is taught in over 20 countries, the WG wanted to obtain feedback from professors. The fact that ISO/IEC 29110 guides are easily understandable and many are freely available has greatly helped their adoption by professors. For instance, in Thailand over ten universities are teaching and in Mexico over 10 universities have even obtained a formal ISO/IEC 29110 certification for

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their internal software development centers (SDCs) where teams of students execute their capstone projects [8, 9].

Professors were asked about their motivation to teach ISO/IEC 29110. Figure 3 presents the reasons that motivated professors to teach ISO/IEC 29110 or to use it in students' projects. The management and engineering guides could be used 'as is' by students, many of them are freely available from ISO. Also, a few guides have been translated in Spanish, Portuguese, Czech and French. A motivation for academia to teach or use ISO/IEC 29110 in students' projects is the interest from local enterprises and government.

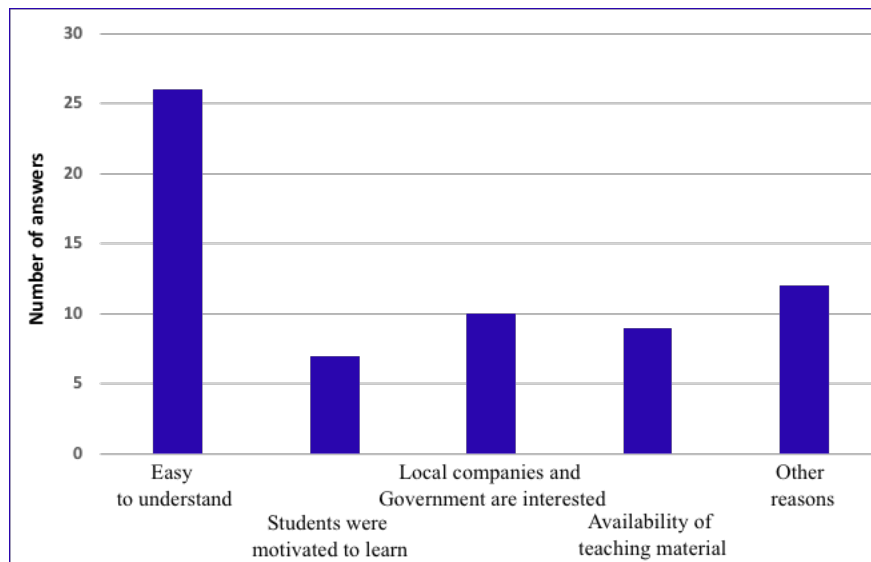


Figure 3. Motivations to teach or use ISO/IEC 29110 in students' projects

Over 200 papers have been written by researchers, mainly by academia, about the ISO/IEC 29110 series illustrating the interest about this new set of standards and guides developed specifically for very small entities [10]. English and French textbooks that include detailed descriptions of the ISO/IEC 29110 series are also available to academia [11, 12].

Next Steps

Respondents to the latest survey requested additional ISO/IEC 29110 guides. The co-authors are developing a first ISO/IEC 29110 Agile Guide [13, 14] that will facilitate the implementation of the processes defined in the ISO/IEC 29110 software roadmap. An ISO/IEC 29110 DevOps Guide is also under development [15]. In addition, to facilitate the implementation of quality requirements of the ISO/IEC 25000 series [16], such as security and usability, additional guidelines to help VSEs are under development.

The inputs received from VSEs and their customers, auditors and professors are used to improve the second edition of the ISO/IEC 29110 series. As an example, the Guide to the software Basic profile has been completely revised based on the comments received (e.g. ambiguities for developers and auditors have been removed, details were added to facilitate the implementation of tasks).

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An ISO/IEC 29110 specification [17] and a guide [18] are under development for VSEs developing non-critical software for the space domain. A group of space agencies have joined their effort to use ISO/IEC 29110 as a foundation, and added a few requirements from space standards, such as the ECSS standards (European Collaboration for Space Standardization), to meet their needs [19].

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Learn more about ISO/IEC 29110 at <http://profs.logti.etsmtl.ca/claporte/English/VSE/index.html>. A few management and engineering ISO/IEC 29110 guides are available for free from ISO at <http://standards.iso.org/ittf/PubliclyAvailableStandards/index.html>.

ABOUT THE AUTHORS



Claude Y. Laporte is an adjunct professor of Software Engineering at *École de technologie supérieure*. He is the Lead Editor of the ISO/IEC 29110 series of standards and guides for very small entities that develop systems or software. He is the IEEE liaison to ISO/IEC JTC1 Sub Committee 7, the committee responsible for systems and software engineering within ISO. Contact him at claude.laporte@etsmtl.ca.

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Jezreel Mejia Miranda is a professor of Software Engineering at *Centro de Investigación en Matemáticas A. C. (CIMAT)* of Mexico. He is the co-editor, with professor Mirna Muñoz of CIMAT, of the ISO/IEC 29110 Agile Guide. Contact him at jmejia@cimat.mx.