Software Process Improvement in Very Small Organizations

Xabier Larrucea

Rory V. O'Connor

Ricardo Colomo-Palacios

Claude Y. Laporte

Big software companies are flooding markets with an evolving collection of products and services. But there is also an unlimited flow of offerings coming from smaller enterprises, many of them considered Very Small Entities (VSEs) given that these organizations (enterprise, public and not for profit, project and department) have up to 25 employees. Literature reported extensively that small organizations are the dominant form of business organization in the software industry around the world [1]. Moreover, most of the products and services offered by the big names in the software industry are dependent on third party components and other forms of collaboration performed by VSEs or developed by small departments or projects within a large organization. Thus, these small organizations are crucial to sustain the level of competitiveness of the whole industry but also to uphold innovation in the software plateau; not in vain, most of the software start-ups can be considered VSEs [2].

The study of software process is one of the leading concerns for software engineering academia, but also the management of this knowledge area is one of the main challenges for practitioners around the globe. Traditional models for software process improvement like CMMI (Capability Maturity Model Integration) and ISO/IEC 15504 (SPICE) models have been typically applied in big organizations, with smaller organizations often missing out on these initiatives for several reasons. Literature reported many reasons like the perception of smaller organizations that these efforts have been developed by large organizations and orientated towards this kind of adopters, negative views of cost, documentation and bureaucracy and lack of clear benefits in establishing software processes as defined by current software engineering standards [3].

For many small and very small software companies, implementing controls and structures to properly manage their software development activity is a major challenge. In a time when software quality is a key to competitive advantage, the use of ISO/IEC systems and software engineering standards remains limited to a few of the most popular ones. Research [4] shows that small and very small companies can find it difficult to relate ISO/IEC standards to their business needs and to justify the application of the standards to their business practices. Most of these companies don't have the expertise or can't afford the resources - in number of employees, cost, and time - or see a net benefit in establishing software life-cycle processes.

Driven by the increasing importance of VSEs in business and the need for a specific and globally accepted initiative to guide these organizations, back in 2011, a new software life cycle process standard, supported with a set of management and engineering guides, was released for VSEs: the ISO/IEC 29110. There are other initiatives devoted to small entities, some of them coming from Latin America, like COMPETISOFT [5] and others from Europe, as ITMark, but the vision of ISO/IEC 29110 is becoming the widely adopted standard for VSEs [6].

ISO/IEC 29110

All software companies are not the same and vary according to factors including size, market sector, time in business, management style, product range and geographical location. According to the Organization for Economic Co-operation and Development (OECD) SME and Entrepreneurship

Outlook report ‘SMEs constitute the dominant form of business organization in all countries world-wide, accounting for over 95% and up to 99% of the business population depending on country’. In Europe, for instance, 85% of the Information Technology (IT) sector’s companies have 1 to 10 employees. Therefore in 2011 the ISO/IEC 29110 standard introduced the definition of a Very Small Entity (VSE) as ‘an enterprise, an organization, a department or a project having up to 25 people’.

To address the specific needs of VSE, a set of guides has been developed based on a set of VSE characteristics. The recently published set of ISO/IEC 29110 international standards (IS) and technical reports (TR) are aimed at addressing the specific software process needs of VSEs. The engineering standards and guides developed by an ISO working group (ISO/IEC JTC1/SC7 WG24), are targeted at VSEs which do not have experience or expertise in selecting, for a specific project, the appropriate processes from lifecycle standards such as ISO/IEC 12207 or ISO/IEC 15288, to be tailored to the needs of a specific project.

At the core of the ISO/IEC 29110 standard is a Management and Engineering Guide (ISO/IEC 29110-5) focusing on Project Management and Software Implementation. The purpose of the Project Management process is to establish and carry out in a systematic way the tasks of a software implementation project, which complies with the project’s objectives in terms of quality, time and cost.

ISO/IEC 29110 Management and Engineering Guides are organised as a set of Profile Groups, where a Profile Groups is a collection of Profiles which are related either by composition of processes (i.e. activities, tasks), or by capability level, or both. Currently there are 4 main profiles: Entry, Basic, Intermediate and Advanced, each of which builds on the previous process, adding more process supports for larger or more complex project and/or as the VSE grows and matures.

As a novel approach taken to assist VSEs with the deployment of ISO/IEC 29110 and to provide guidance on the actual implementation of the Management and Engineering Guides in VSEs, a series of Deployment Packages (DPs) have been developed to define guidelines and explain in more detail the processes defined in the ISO/IEC 29110 profiles (available from http://profs.etsmtl.ca/claporte/English/VSE/index.html). The elements of a typical DP are: description of processes, activities, tasks, steps, roles, products, templates, checklists, examples, references and mapping to standards and models, and a list of tools. DPs were designed such that a VSE can implement its content without having to implement the complete framework, i.e. of the management and engineering guide, at the same time.

Our experiences

Drawing on the vast reservoir of experience of the authors in the arena of assessing and guiding VSEs in the adoption of various standards and initiatives, more than one hundred papers have been written by the authors in the broad field of software process applied to the scope of small and very small entities. Decades of author’s experiences in the software industry in different counties, particularly in VSEs, enabled us to join forces, experiences and reports to provide an overview of the state of the practice of software processes in VSEs.

In detail, these efforts stem from ISO working groups such as WG24, conferences series such as SPICE conferences (http://goo.gl/B2OBGz) or EuroSPI (http://goo.gl/I6Rmqw) and other certification initiatives such as ITMark (http://goo.gl/SYL4T6). Our aim is not to provide an exhaustive systematic literature review regarding ISO/IEC 29110, an effort performed back in 2013 [7] that underlined the pale results of its adoption. Instead, authors are summarizing these experiences in order to highlight barriers and opportunities regarding software process improvements in VSE contexts.

The following tables summarize our experiences as a focus group working with and for VSEs. There are several ways to report experiences, but we want to summarize the most common hurdles VSEs are facing, and to highlight opportunities offered to VSEs according to author´s joint experiences.

Barriers

Type	Name	Description
Financial	Deployment Costs	There is no consensus on how much a deployment of this kind of initiatives can cost. Total costs include effort, tool support as well as consultancy costs including accreditation and certification costs.
	Resources prioritization and business continuity	Everyday activities are affected by SPI efforts. In a scenario of tight resources, task prioritization is an issue that could threaten SPI projects, normally under-prioritized with regards to business tasks.
Skills	Accurate external support	There is a need for specific technical and general competences in VSEs to apply these kinds of models in real settings. These kind of competences are not common.
	Internal support	VSEs are reluctant to devote efforts to train internal resources on how to implement this kind of initiative.
	Sponsor	There is a lack of continuity of key leaders in VSEs. Stable sponsorship is required in order to assure a successful deployment of this kind of initiative. The continuity of sponsors is key to assure leadership and a shared vision of the initiative.
	Business Knowledge	This kind of initiatives should be adapted to each VSE business domain. For example, safety critical systems related companies, such as the automotive sector, require stressing or emphasizing product quality instead of just focusing on process improvement. This requires specific skills in the external team.
Culture	Organisational behaviour	Cultural impact and change resistance are aspects to be managed by the initiative and these facets are also present in heavier initiatives like CMMI or SPICE.
Reference Models	Models diversity	There is a wide set of reference models that can be applied to a VSE in a specific domain. The appropriate selection of what is applicable to each case is not a straightforward activity.
	Models adaptation	Models adaptation to VSE settings (functional and technical) is a keystone.
	Models complexity	One of the main purposes of the ISO/IEC29110 is to reduce the complexity of current reference models. In spite of that, given the restrictions in resources, it is still an obstacle to be surmounted.

Opportunities

Type	Name	Description
Financial	Return Of Investment	VSEs benefits are more visible in the short term. Benefits should not just be measured in economic terms. For instance, engagement is improved when waste is reduced.
Culture	Organisational behaviour	A simpler guide to the process will lead organizations by means of a smooth transition.
Reference Models	Personalised models	VSEs can develop their own reference models fitting exactly their own requirements. It is widely known that "one size does not fit all".
	Ease of access	ISO/IEC 29110 presents deployment packages that are easy to use and enable flexible deployment of processes in VSEs. Therefore facilitating an easier to roll out.
	Progression from small to bigger standards	ISO/IEC29110 entry profile is a stepping stone to basic, intermediate and advanced. Also 29110 as a family is a stepping stone to 15504 / 33000 standards and even CMMI constellation models.
Market	Clear recognition	ISO29110 provides a Management and Engineering Guide defining clearer terms. This guide provides a mutual recognition between companies instead of heavyweight reference models which require more aspects than those required for a VSE.
	Supply chain	The life cycle processes defined in ISO/IEC 29110 highlight a process related to negotiating and agreeing a service or product to be provided.
	Deployment timeline	Deployment line is reduced because artificial work products are set aside.

These experiences are building an Experience Factory [8] for helping VSEs in the process to start an improvement initiative. Authors are still gathering more experiences in VSE contexts, so this is not finalized yet and it is not the end of the improvement journey. However VSEs can benefit from best practices and performance indicators included in this experience factory right now. In fact, as an example, authors analysed 74 VSEs and did their corresponding 74 assessments based on ISO/IEC29110 basic profile (project management and software implementation processes) [9]. The result follows a normal distribution (Figure 1) in terms of achievements or requirements satisfaction. The related mean is 46.99%, and its standard deviation is 0.15. These values are part of the Experience Factory as we said, and they indicate that most of VSE already have artefacts and processes satisfying some basic requirements. Therefore the remaining distance (delta) between their situation and a fully compliant situation is not too complex. During this experience, the areas with more problems for the VSEs are the ones related to Software Implementation (SI): SI.O7. Verification and Validation, SI.O5.Test Cases and Test Procedure, SI.O4. Software components, and SI.O3. Software architectural and detailed design.

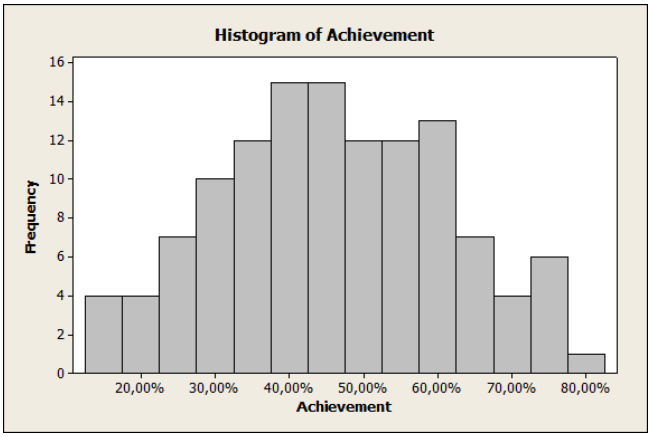

Figure 1: 74 VSEs basic profile assessments [9]

Conclusions

VSEs have different options when facing an improvement initiative. The first step before starting any kind of improvement journey is to decide what the objective is. They can opt for traditional or more innovative approaches depending on different factors. Some organisations are steered by the latest fashionable trends or by new models' names. But the more important aspect is to decide why they are embarked on this journey and, from the beginning, to have a clear objective. Otherwise, these initiatives are doomed to failure.

An experience factory containing a wide set of industrial experiences from several VSEs helps them with launching and promoting improvement practices. Authors want to get rid of the stigma indicating that enhancing an organization or adopting a quality model means adopting practices that are not really necessary.

Being part of a community, sharing experiences and practices, are aspects that could lead VSEs to take advantage of others experiences and knowledge. VSEs can benefit from these experiences and can select the most appropriate deployment packages which best fit to their needs.

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