Understanding the Perception of Very Small Software Companies towards the Adoption of Process Standards

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Abstract. This paper is concerned with understanding the issues that affect the adoption of software process standards by Very Small Entities (VSEs), their needs from process standards and their willingness to engage with the new ISO/IEC 29110 standard in particular. In order to achieve this goal, a series of industry data collection studies were undertaken with a collection of VSEs. A twin track approach of a qualitative data collection (interviews and focus groups) and quantitative data collection (questionnaire) were undertaken. Data analysis was being completed separately and the final results were merged, using the coding mechanisms of grounded theory. This paper serves as a roadmap for both researchers wishing to understand the issues of process standards adoption by very small companies and also for the software process standards community.

Keywords: SPI, VSE, process standards, ISO/IEC 29110.

1 Introduction

In the current economic environment software quality is increasingly being seen as a subject of concern for growth and evolution of software companies in general, no matter what the size or type of products and services. In particular, Very Small Entities (VSEs) have a pressing need to develop their products efficiently, effectively, and with high quality. With the current trend of outsourcing, it is critical for customers to be able to depend on these enterprises to deliver their expected products on time or the business will go elsewhere. It is equally important that the businesses perform well while making a profit. Of course, all companies have these needs but the limited resources of the VSEs, even a small problem occurred, can have huge repercussions. Thus it is particularly important that management identifies resource issues before they turn into major difficulties. Most software development and maintenance time is spent on new product and feature development, not fixing old bugs that were never noticed until they became big problems.

Quality orientated process approaches and standards are maturing and gaining acceptance in many companies. Standards emphasise communication and shared

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understanding more than anything. Examples are: any documentation is consistent and what is needed to meet the needs of the organisation; all users understand the same meaning of words used - if one person says, 'Testing is completed!', all affected bodies understand what those words mean. This kind of understanding is not only important in a global development environment; even a small group working in the same office might have difficulties in communication and understanding of issues shared by all. Standards can help in these and other areas to make the business more profitable because less time is spent on non-productive work.

However, at a time when software quality is becoming key to competitive advantage, the use of ISO/IEC systems and software engineering standards remains limited to a few of the most popular ones. However a new process standard has been developed by ISO/IEC JTC1/SC7 [1] known as ISO 29110 Software process lifecycles for very small entities. This has the objective to assist and encourage small software organization in assessing and improving their software process and it is predicted that this new standard could encourage and assist small software companies in assessing their software development process.

This paper is concerned with understanding VSEs issues regarding adoption of standards, their needs from process standards and their willingness to engage with the new ISO 29110 standards' in particular.

This paper is divided into 5 sections. Section 2 presents the background study of the present issues including the concept of VSE and describes the characteristics that distinguish a VSE from other organizations. Section 3 explains the overall research processes that have been applied in this study. A section 4 discusses all the findings and results of the study. Section 5 presents some concluding remarks and discusses future work.

2 Background

2.1 Very Small Entities (VSEs)

The definition of "Small" and "Very Small" Entities is challengingly ambiguous, as there is no commonly accepted definition of the terms. For example, the participants of the 1995 Capability Maturity Model (CMM) tailoring workshop [2] could not even agree on what "small" really meant. Subsequently in 1998 SEPG conference panel on the CMM and small projects [3], small was defined as "3-4 months in duration with 5 or fewer staff". [4] define a small organization as "f*ewer than 50 software developers and a small project as fewer than 20 software developers*". Another definition for VSE introduced by [1] as "*any IT services, organizations and projects with between 1 and 25 employees*".

To take a legalistic perspective the European Commission defines three levels of small to medium-sized enterprise (SME) as being: Small to medium - "*employ fewer than 250 persons and which have an annual turnover not exceeding 50 million Euro, and/or an annual balance sheet total not exceeding 43 million Euro*"; Small - "*which employ fewer than 50 persons, and whose annual turnover or annual balance sheet total does not exceed 10 million Euro*" and Micro - "*which employ fewer than 10 persons and whose annual turnover*"[28].

To better understand the dichotomy between the definitions above it is necessary to examine the size of software companies operating in the market today. In Europe, for instance, 85% of the Information Technology (IT) sector's companies have 1 to 10 employees. In the context of indigenous Irish software firms 1.9% (10 companies), out of a total of 630 employed more than 100 people whilst 61% of the total employed 10 or fewer, with the average size of indigenous Irish software firms being about 16 employees [5]. In Canada, the Montreal area was surveyed, it was found that 78% of software development enterprises have less than 25 employees and 50% have fewer than 10 employees [6]. In Brazil, small IT companies (companies with less than 50 employees) represent about 70% of the total number of companies [7].

Therefore based on the above discussions and the debate within the ISO community, for the purposes of this paper we are adopting the definition for VSE introduced in [6] as "*any enterprise, organisation, department and project having up to 25 people*".

The unique characteristics of small enterprises as well as the uniqueness of their needs, make their business styles different [8]. These unique characteristics and unique situations have influenced VSEs in their business style compare to large companies [8]. In addition, their constraints in financial and resources also give an impact to companies' process infrastructures [9] [10] such as limited training allocation, limited allocation in performing process improvement, low budget to response the risk and may other constraints. Moreover due to the small number of people involved in the project and the organization, most of the management processes are performed through an informal way and less documented. This situation shows that human-oriented and communication factors are very important and significant in VSEs [1]. Despite constraints in resources, difference in business style and diversity in level of software development process among VSEs, there are some common characteristics in VSEs software development processes [11]:

- The software development lifecycle is often highly simplified and some of the development phases (e.g. analyzing, implementation and testing) are not formalized.
- The maturity levels of processes within the same company can be mixed up between very good processes and low level processes.
- In general, quality control procedures are not very formalized.
- In general, most of the project management and planning practices in VSEs are not standardized across organization and always depend on the project, clients, teams and project manager.
- The resources allocated to training and human resources are very limited because of strict financial allocation.
- Most of the software projects are driven by a short term strategy and rarely driven by a long term strategy.
- Due to the size, VSEs have difficulties to impose a standard methodological approach in their software project.
- In general, the issue of risk management is less important and not taken seriously. This is due to the short term strategy in VSEs software development project.
- Quality issues are not addressed explicitly with an actual involvement of management.

2.2 SPI Models and Standards

There are a number of SPI models and standards developed by the international organizations, industry consortia, large software purchasers and software developers. Capability Maturity Model Integration (CMMI) [13] and Trillium [12] are among the SPI models that have been produced. In addition, The International Organisation for Standardisation (ISO) also embarked on the programme to create a range of standard for software companies such as ISO 9000, a series of standards used to certify the quality system used by an organization [25] and ISO/IEC 15504 also known as SPICE (Software Process Improvement and Capability dEtermination) [14].

In general, it is reasonable to say that most process standards and models were initially created with larger organization in mind and have slowly being adopted by medium and small organization (SMEs) [15]. In addition, some organizations create their own in-house software development process model, mostly by tailoring / adapting commercial standard such as CMMI and SPICE [6] [16]. However, this situation is different in the majority of small software organization which is not adapting any standard and perceived that those models as being oriented toward the large organization [6] [17]. Some studies have shown that this negative perception on the software process model is driven by a negative view of cost, documentation and bureaucracy [5] [18]. Moreover, it has been reported that the small software organization found that it is difficult to relate the existing standards (e.g. CMMI, ISO 12207) to their business need and justified the international standard in their business operation [5]. [1] added that most of the small software organization which have few employees cannot afford to establish and follow the software process as defined by the current standard.

Therefore to overcome the above issues, ISO is currently developing a new standard to encourage small software organization to actively assess the development process [5]. This proposed international standard is ISO/IEC 29110 software process lifecycles for very small entities [1]. This new standard has been specifically developed for VSE, with an objective to assist and encourage small software organization (which has less than 25 employees) in assessing and improving their software process.

3 Research Process

In order to assess the perception of VSEs towards the adoption of process standards and ISO/IEC 29110 in particular it is necessary to engage with VSE. A twin track approach was decided, composed of a qualitative data collection (interviews and focus groups) and quantitative data collection (questionnaire), with data analysis being completed separately and finally the results were merged. The overall data collection process is shown in Figure 1.

The context for this research has limited its scope only to the software product companies whose primary business is software development. Software product companies are companies whose primary business is software development and performed task by a group of software developers. As a software developer, they would be familiar with several software development processes and considerable

awareness about the process development models. The context has also been decided to confine the study to Irish Software product companies. The reasons are based on the geographical location of the researcher, practicality and ease of access to those software companies and comparability of research data due to companies same jurisdiction, same economic and regulatory regimes governing their operation. Moreover, based on a European Software Institute (ESI) report which stated that, in Europe, 85% of the Information Technology (IT) sector companies have 1 to 10 employees [4]. In the context of Irish software firms, 61% of indigenous Irish software firms which employed 10 or fewer, with the average size of indigenous Irish software firm being about 16 - 22 employees [5] [19]. This has shown that most of the Irish software companies belong to Very Small Entities (VSEs) category.

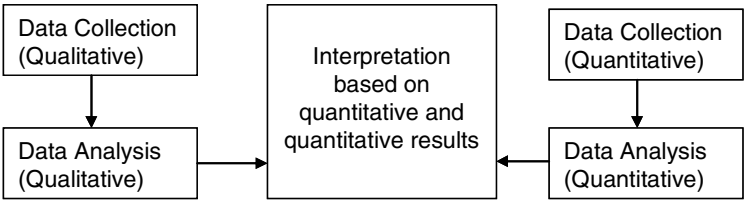

Fig. 1. Research Concurrent Design- Data Collection

For quantitative data collection two complimentary data collection methods, (i) individual and focus group interviews, and (ii) survey questionnaire have been adopted in this study. The individual interview approach was used in this study in order to discuss the topics in depth, to get respondents' candid discussion on the topic and to be able to get the depth of information of the study situation for the research context [20][21]. This process followed by semi-structured interviews approach which includes the open-ended and specific questions. This approach allowed us to gather not only the information foreseen, but also unexpected type of information [22]. The respondents for the individual interview session are the managers from the identified Irish Software VSEs and went around 20 to 30 minutes in duration. The second interview method is the focus group interview. The focus group interview approached was used in this study because team members develop the software and the existence team interactions helped to release inhibitions amongst the team members and are from the same company as the individual interviews participants. Focus group interviews were also chosen because it was the most appropriate method to study attitudes and experiences; to explore how opinion were constructed [23] and to understand behaviors, values and feelings, [24].

We followed the qualitative contents analysis method [25] and adopted the Grounded Theory (GT) [26] data coding process to analyse all collected data and have a systematic data coding activities. In this part all qualitative data gathered from individual interviews and focus group interviews were analyzed and coded. This process involves the development of the codes, code-categories and inter-relationship of categories based on the GT process and coding strategy [26].

In order to gain more input and also to validate the above qualitative data for this study, we have developed and distributed a survey questionnaire to several Irish

software VSEs. These companies were selected using personal contacts and were all directly involved in software product development, for a variety of business domains. The survey consists of 12 close-ended questions that use 5 – point response scale. The close-ended questions examined the level of agreement of the related to companies acceptance and views on software quality standard issues as found in the literature, applied in their organization. Moreover in order to gain more input from the respondents regarding the study issues, several open ended question that are related to the close-ended question have been asked in the survey. The purpose was to understand more thorough respondents' perceptions, experiences and understandings in their organization.

Each received and completed questionnaire are compiled and analysed. The close-ended questionnaires were grouped according to the issue and analyse using a statistical analysis. Three main statistical analysis were run in processing the data, which are the frequency, mean and descriptive analysis. For this purpose, we use a statistical tool (SPSS) in processing the data. Meanwhile, on the open ended data, we analyze and categories the data according to the category that this study intends to understand. The answers were group, coded and list into a table in respect to the study category issues. In overall we adopted the qualitative contents analysis approach in analyzing the open-ended answer [27]. In addition, we have merged the both analysis results in order to gain more understanding and validate the results. Moreover, in order to produce details analysis result, we have divided the survey respondents into 2 main group namely the Micro VSE (1-9 employees) and Larger VSE (10-25 employees) [1].

4 Study Findings and Discussion

From the qualitative data analysis process which adopted the GT coding approach, we categorise the issues into several identified categories as shown in table 1.

Table 1. Software Quality Standard

Sub Category	Category	Main Category
Low Acceptable	Level of Acceptance	Quality Standard Acceptance Level
Less Priority		
High Awareness on Standard	Level of Interest and Awareness	
Standard Benefit Awareness		
New Standard Guideline	New Standard Criteria	

4.1 Acceptance and Awareness

The first category in this part is to understand the level of acceptance of standards amongst VSEs. Based on the analysis of the data the researchers found that none of the VSEs are or have plans to adopt or accredited any particular standard in their software development process. Interview data analysis identified several reasons that

have been divided to 2 subcategories (*Low Acceptable* and *Less Priority*) in order to understand the problem in adopting standards.

The first subcategory is on the low standard acceptable issues, which is due to the perception that process standards are overly involved / complicated and lacking in detailed implementation guidance. In addition, the adoption of standards would require additional resources which would have an additional cost to the company. Participants also believed that the processes as described in software standards are not easy to actually tailor and implement in these organizations. For example, the view was consistently expressed that current software quality standards such as ISO9000 cannot be adapted and followed. In relation to that, all the interviewees believed that involving or adapting software quality standard in their process will increase the project cost and delay the project delivery. Meanwhile, they argue that the process involved software quality standards are not tailored with the current development process, which are more brief, informal and very light in process. The following interview extracts describe this situation:

"In a company of our size they [standards] would not necessarily add value… we would need more sophisticated process if we were a larger company."

"Too much documentation and you need somebody to just work on the software process alone. Because our developers are busy with coding, documentation is the last thing they do."

In addition, the analysis also indicates that the lack of requirement from the market in general and their customer in particular has contributed to low acceptance of such standards. During the interviews it was also shown that accreditation against software quality standards is only important when companies involved or plan to work with the government bodies or state agencies that have such a requirement. Contributing to this is the fact that most VSEs clients are private, small or individual companies which do not have a standards accreditation requirement. Below interviews quotes explains the above situation. The following interview extracts best describe this situation:

"We had never had a problem selling our stuff or not selling our stuff because of an ISO standard. Microsoft Windows standard are sometimes important, but ISO who cares!"

"I never heard anything from sales that we couldn't sell anything because of lack of ISO standard."

The second subcategory in this part is on the low priority issues. The interviews analysis also indicates that a software quality standard is a low priority task in software development process and activities in VSEs. The interviewees have explained several reasons which indicate this situation. Not compulsory or low demand of the accreditation to standards from their client is the main reasons given by all the interviewees. Higher quality of code and delivery time are seen as more important that the evaluation of the development process. Software quality standards were seen as 'sale tool' only. They also responded that current software quality

standard objective such as encapsulated in standards such as ISO 9000 are more toward on the management and services of the software development process rather than a software technical issues and product. They also believed that the software quality standards are built for the big companies rather than for VSEs. This is illustrated in these interview extracts:

"If you want to get done quickly then what you need is focusing to the output not the process."

"A lot of process in quality standard is nonsense. Some ISO standards tell you to do XYZ steps but they may be not being beneficial to our business."

"We do informal research if we found something cool article I will try to followed to improve our process. But seriously standards quality is not on my list."

"Standard is just a sale tool."

The second category is level of interest and awareness category. This category explains VSEs level of interest and awareness regarding software quality standards. Even though in the first category they have shown low acceptance and priority level regarding software quality standard, this analysis has also shown that there is an indicator that VSEs are interested and are aware about software process standards and the potential benefits from having a quality standard especially the ISO standards. Leading to a quality product, create consistency, improve company image, create consistency in development work, improve work process and good for business are the main points that the interviewees gave, which indicates VSEs high awareness and interest about the benefit of having software quality standard. One company explicitly expressed that the company had planned to adopt the ISO 9000 but due to several constraints as have been discussed above made the plans to be put on hold. This situation shows that VSEs have an interest and are aware about the benefit adopting software quality standard. This level of interest and awareness is illustrated in the following interview extracts:

"Yes we do plan too, but since we started we have growth so quickly… we spend time learning how we want to do… we started to put those processes in place so when we grow we have a good platform."

"They [software quality standard] are nice. It would be great to have them in order to have a consistence software process up and running."

4.2 Requirements of a Standard

In order to understand more about software quality standards in VSEs, we asked the interviewees the criteria they considered important in a software quality standard. The purpose here is to understand in detail the criteria that should adopted in future software quality standard in order to encourage VSEs seriously involved standard quality process. From the analysis, researchers found several criteria to be criteria below:

- Align with current development process style
- Provide detailed guidelines and assistances
- Provide clear templates
- Provide workshop and/or training on how to actually apply it

In lightweight process subcategory, interviewees have proposed several criteria as:

- Minimum documentation requirement
- Easy to administer
- Less change from current development process
- Minimum overhead in terms of cost and resources

In business and technical process subcategory, interviewees have proposed several criteria below:

- Align with company existing business and development process.
- Align with others specific software technical standard and process.

4.3 Level of Acceptance and Knowledgeable of Standard

In the second analysis stage which was the analysis of the survey questionnaire stage and involved the qualitative and quantitative data analysis process as discussed in section 3. In this part, researchers would like to explore VSEs acceptance and views on software quality standard issues. From the survey researchers found that 60% of them pointed out that the companies did not have a plan in adopting any quality standard in the near future. No demand from the market and customer, no implied benefit and not important to their business are the mains reasons behind this issue. Therefore, in order to validate these issues researchers have asked several close ended questions in the questionnaire. The questions were group in 2 different segments; (i) reason of not adopted quality standard and (ii) the development process standard; in order to have a clear picture on this issue.

The main reason of not adopting standards is the lack customer requirement for standards accreditation. In addition, the time and effort involved and the perceived difficulties in defining an organizational process were important reasons of why the VSEs were not interested in adopting any quality standard. Based on our data analysis even though the respondents agreed that the development team and management people in the organization are knowledgeable in development quality standard but they did not refer to any development standard or model in improving the software development process quality.

In relation to the above, from qualitative contents analysis approach in analyzing the open-ended answer in survey questionnaire showed that there are some criteria that need to be considered to encourage VSEs to seriously take part in adopting software quality standard. Light weight process, low overhead, supplement of training, align with current development process, clear and simple template and rapid assistance from the expert are among the criteria that should be considered by the related body or institution in developing a new quality standard specifically to this size of organization.

The results of this part of analysis gave researchers a pattern and indication that the acceptance level of quality standard such as ISO among VSEs are still low even

though the staff and management are knowledgeable and aware the benefit about adopting quality standard. The main reasons are more related to the lack of the customer requirement and the limited resources in the company. Beside that the heavyweight process especially the documentation, cost and not align with current development process are among the reasons why the companies did not plan to adopt it. However from the analysis, VSEs may still be interested in quality standard if certain important criteria are met and they are closely related to their tasks.

5 Conclusions

As we discussed above, the software quality standard in VSEs issues could be divided into 3 categories which are the level of acceptance, level of awareness and new standard criteria. The first category has prevailed that the acceptance level of any type or model of software quality standard in VSEs is very low and less priority. The reasons are mainly related to the low level of customer or market requirement, lack of resources and, lengthy and difficult procedures. However, the analysis also showed that the level of awareness of software quality standards and its advantage are high and there are some initiatives or plans to adopt in the future. The third category indicates the criteria needed or proposed by the VSEs, which include the detail guideline and assistance, less overhead and resources and aligned with VSEs current process, that must be aware in order to encourage or to attract VSEs seriously involved in software quality standards.

Meanwhile, in quantitative data analysis we found that all respondents' software development process did not accredit with any type of software quality certification and 60% of them do not plan to adopt any kind of standard in the near future. As in the first stage in data analysis result, stage two data analysis result also agreed that customer requirement, length and difficult procedure and insufficient resources are the main reasons of not adopting any kind of software quality standard. In addition, the level of awareness and additional criteria needed results are aligned with the first stage data analysis results. Overall, both analyses have shown that the acceptance and priority on any software quality standard in VSEs is very low. This is due to the lack of resources (e.g. time, people and financial), lack of customer requirements, detail and difficult current software quality standard procedure and VSEs software development project priority are more towards quality product and delivery time rather than quality process. However, results from both analyses indicate that the level of awareness on advantages of having or being accredited with software quality standards and respondents knowledge in these issues is moderate and acceptable. Furthermore some additional criteria, as discussed in section 4, need to be present in any software quality standard in order to encourage them seriously participate in software quality standard.

With regard to future work, we plan to extend our study by identifying more suitable VSEs throughout Ireland and other European countries in order to gain more insight. This could help us in generalizing our results and findings in future. In addition, since majority of the software companies' fall in VSEs category, the adoption of this study in different continent (especially in Asia) could generate more understanding and could relate with the Global Software Development (GSD) Issues.

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