

Organizational Commitment Towards Software Process Improvement

An Irish Software VSEs Case Study

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Abstract— This paper presents a study of the software development processes of very small software companies, with a focus on the company's Software Process Improvement (SPI) activities. SPI has gained an increasing importance in software engineering domain. However, recent studies show that the obligation and commitment towards SPI especially in small companies is weak and not always taken seriously. This situation is often related to insufficient availability of resources either in term of financial, human and time in this type of companies. Accordingly, this paper explores the current situation in very small companies and gauges their acceptance levels towards SPI actions and the underlying reasons behind this. In this research we carried out a survey which contains open and close ended questions in a series of very small software development companies in Ireland. A quantitative analysis; that use a statistical analysis, and qualitative analysis; that adopt the qualitative content analysis method have been followed throughout this study. The results indicate that the SPI initiatives in very small software development companies are done on a small scale manner, informally and indirectly. In addition, the results also indicate that commitment and involvement of people in these organizations towards SPI is high.

Keywords-component; Software Process, Software Process Improvement; SPI; Commitment; VSE.

I. INTRODUCTION

In the software business the pressure to produce a software product that is relevant with the market needs and the necessity to stay competitive is a major challenge. The productivity of the organization is heavily influenced by the effectiveness of their software development process, with many researchers agreed there are a very significant relationship between the quality software process and producing a quality product [1] [2]. In current dynamic software business environment, improving the current software process is a necessity for all software companies to cope with frequent changes in customer needs and technology advances [3]. However this situation is more difficult for very small companies due to limited resources, both financial and human, are often limited, and the management, work and organizational culture may be different from the large companies [4].

Considering their lack of resources especially in term of employee and unique management, work and organization culture, the organizational commitment in small software companies for SPI has to be taken into account as an important factor for successful improvement initiatives and implementation. Their commitment to improve their practices in software development work and process are significant for the SPI success. Moreover previous studies on these issues mostly concentrate on the larger companies [5] [6], with less research effort directed towards small companies and very small companies in particular. In this paper, we will present a study of SPI commitment in very small software companies that is companies who employ less than 25 people. The focus in this study is considering the organization, management and development team commitment towards SPI. In addition the study is concerning the organization goal and planning issue in very small software companies towards the study issues. Therefore, this paper aims at presenting a more comprehensive perspective of very small software companies' commitment and planning towards SPI. The paper is organized as follows: In Section 2, a brief background of VSEs is presented. In Section 3, research background studies are discussed. In Section 4, the research methodology is described. In Section 5, the study finding and results is discussed. Finally, in Section 6 we present some limitations and in Section 7, we conclude and discuss the overall finding and issues.

II. VERY SMALL ENTERPRISES (VSEs)

The definition of "Small" and "Very Small" Entities is challengingly ambiguous, as there is no commonly accepted definition of the terms. For example, 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 does not exceed 2 million euro".

The term “*very small entity*” (VSE) had been defined by the ISO/IEC JTC1/SC7 Working Group (WG) 24 and subsequently adopted for use in the emerging ISO/IEC 29110 software process lifecycle standard [8], as being “an entity (enterprise, organization, department or project) having up to 25 people”.

Most of the software industries especially in Europe, Brazil, and Canada are fall under VSEs [7]. For example, in the context of software companies in Ireland, shows that the majority of indigenous software companies employ between 10 to 99 employees [8, 9]. In addition the average size of these indigenous companies is 16 employees [10]. Furthermore the issues of limited resources in VSEs always become a constraint in producing a competitive product in today’s dynamic software business. [11] stated that micro enterprise including VSEs whose have limited resources, particularly in financial and human resources, are practicing unique processes in managing their business. These unique characteristics and situations have influenced VSEs in their business style by comparison to larger companies [12]. In addition, their constraints in financial and resources also give an impact to companies’ process infrastructures [11, 13] 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 [4, 7].

III. BACKGROUND STUDY

A. Why Software Process Imporvement (SPI)?

The primary goal of software development has changed from “conforming to plan” to “satisfying the customer- at time delivery, not a project initiation” [15]. Therefore the software industry must improve development process in order to be able to handle the rapidly changing environment and customer requirements. In addition the involvement in SPI has demonstrated to enhance the quality of the development process and therefore the quality of the product being developed using that process [1]. In term of small companies, [2] found that small companies are more successful in producing a quality product if SPI fundamentals are observed closely. Beside that the variety of implementation factors can cause the failure of a well planned SPI initiative. Therefore action plans are needed after the assessment, and SPI should be treated as a project [16]. Nevertheless, it is also important to ensure that the new processes are institutionalized [17] and not affected with a process erosion problem [18]. Over time, a company’s existing software development process experiences *Process Erosion* where the current process is ignored or not used (eroded) and staff reverts back to the practices of the previous (older) process [20]. Creating an SPI implementation methodology [6] and setting realistic objectives which can be achieved in the foreseeable future [17], will promote and provide coordination on these critical issues [19]

B. SPI Influence Factors

In the literature there are 4 categories that influence organization in seriously involved in SPI as listed by Hall et al. [19]: economic, people, organization and implementation factors. Below we briefly explore each of these:

- *Economic factor* – [21] and [19] claim that high costs and inadequate resource have been found to be the greatest impact to SPI success. This is also supported by [22] who provided a convincing argument of financial benefit of software process improvement. In very small teams studied which implemented SPI, found that over 12 months, monthly cost decrease by 33% while monthly benefits increased by 17% of their monthly value [23]. Moreover the late impact of SPI programs on projects as a very important issue. They stressed that action time frames must plan carefully in which an assessment should cover a three to five months in average [24]. They added that planning that have a longer time period will made a management tends to lose patience and practitioners lose their interest in SPI.
- *People factor* – The contribution software development team in software development project and SPI have been discussed seriously in literature. The success of software project and process is determined by the interest of software team on the project and process itself [25]. In specific the small firms rely greatly on key individual, human factors is particularly important to them [31]. In detail that in small software organization; the influences of key individuals, such as the company founder or a talented are not enough without sufficiently educated developer [32]. He added that the reluctant of the key player in small establishments can effectively sabotage the chance the success of improvement scheme. Moreover staff participation also is essential in improvement activities and should be involved in improvement initiative because they have detailed knowledge and firsthand experience of strength and weakness of the current process [17].
- *Organisation factor* - The ability to manage organizational change as a prerequisite for meeting competitive demands is very important. Several authors emphasize that organizational change management is one of the key issues to achieve success in software process. In this issue the developer opinion and management commitment plays a vital role in the implementation of the SPI programs [6] [26]. Moreover the lack of adequate management commitment is the first trap to avoid when starting to improve software process. Even in software project the lack of management commitment to the project is considered to be risk number one [27].
- *Implementation factor* - There are variety of implementation factors can cause the failure of a well planned SPI initiative. According to [16], an action plans are needed after the assessment and SPI should be treated as a project. It is also important to ensure

updated software development processes are institutionalized in organization [17]. This action will help to prevent the developer turning back to the not updated process [17] [16]. [6] agreed that there is a need to create a SPI implementation methodology that guides SPI practitioners in implementing SPI initiatives. In addition, SPI also should have realistic objectives which can be achieved in the foreseeable future and it is important that improvement objectives should be ambitious and the SPI goals were well understood [17] [28].

IV. RESEARCH STRATEGY

In order to carry out this study, we developed and distributed a survey questionnaire to the Irish software VSEs in Ireland. These companies were selected using personal contacts of the researchers and were all directly involved in software product development, for a variety of business domains.

The development of the survey questionnaire have adopted the Goal, Quality and Metric (GQM) approach [29] in order to ensure the survey validity and suitability. 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 SPI process and activities as proposed 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 related to the close-ended question have been asked in the survey. The purpose was to understand more thorough respondents’ experiences and understandings in their organization. The process took some time to receive back the completed questionnaires from the respondents. Therefore we regularly contacted the respondents via email and phone in order to ensure their reply.

Each received and completed questionnaire were compiled and analysis. The close-ended questionnaire were grouped according to the issue and analyze 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 [30]. In additional we have merged the both analysis result 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) [7].

V. FINDINGS AND DISCUSSIONS

A. SPI –Process Improvement and Assessment

In analyzing the close-ended data in the survey questionnaire, we have regrouped the questions according to the categories of analysis as shown in table I.

The results from the analysis as shown in table II indicated that in general respondents are agreed that their software

development processes rapidly change and evolve overtime. They also claimed that their development process are regularly assesses and staffs always followed or applied the latest development process method. Table II also indicates that respondents claimed that they are following an agile development philosophy in their development process.

TABLE I. PROCESS IMPROVEMENT AND ASSESSMENT

The software process changes / evolves overtime	1-5
Management regularly assess software development process	1-5
When software processes are updated / changed, software developer always follow the new process.	1-5
We are follow an ‘agile’ type of software development methodology.	1-5

TABLE II. SPI- PROCESS IMPROVEMENT AND ASSESSMENT

Employee Size Group		Change and Evolve	Regular Assess	Follow Update Process	‘Agile’ Type development
Micro VSE	Mean	3.80 (0.447)	3.40 (0.894)	3.20 (0.837)	4.20 (0.447)
Larger VSE	Mean	4.00 (0.707)	3.60 (0.548)	3.20 (0.837)	4.20 (1.304)
Total	Mean	3.90 (0.568)	3.50 (0.707)	3.20 (0.789)	4.20 (0.919)

In relation to the above, the analysis on the open ended question that related to the same issues has highlighted that 90% of respondents felt that their development process evolve overtime. They stated that following the best practice, client requirement, team size growth, new idea and keep up with the technology change are the reasons for the improvement and evolution of development process. The following three extracts from the open-ended questions give an indication as to how the development process have been improved and evolved with a company:

“Software process change is due to growth of the organization. We started out as 2 people 4 years ago and now have 11, so things had to change along the way”

“It will evolve as we grow in size and get more applications in production environment”

“Not really. We still do the same basic thing in software process; we change some aspects of how we work. It’s a little bit ad-hoc... We follow agile method... I suppose”

Moreover that in question on related to the process loss issues shows that almost all or 80% of respondents’ claimed that their software development processes are not affected by the process loss problem. They claimed that by using standard development tools, similar development process, having frequent guidance and mentoring activities, active in knowledge sharing and proactive coaching could avoid the process loss problems in software development process. The following extracts from the open-ended questions illustrate this situation:

“As a manager, I don’t believe in using the latest and greatest techniques for the sake of it. We’ll use something that fits our team dynamics and we’ll spurn something that doesn’t... whether that counts.”

“Our document process mostly electronically...we always sharing knowledge informally. Since this is family business, we always having informal regular meeting”

“Not really, we still do the same basic things in our software development method. We change some aspects of how we work. It’s a little bit ad-hoc... Agile method... I suppose”

However the respondents also admitted that “laziness” attitudes among the staffs and practicing informal and rapid changes in software development process are among the factors that could lead the process loss problem in software development process.

B. SPI–People and Management Involvement and Commitment

The questions on this part are stress particularly on the level of team involvement in planning and setting the development process and procedure in the software development projects as shown in table III and IV.

TABLE III. PEOPLE INVOLVEMENT AND COMMITMENT

Software development staff are directly involved in planning and improving software development processes	1-5
Software developers have freedom in planning and managing their work.	1-5
Software development staffs are actively involved in setting goals for SPI activities.	1-5
Software development staff are actively involved in creating process and procedure for software development	1-5

TABLE IV. MANAGEMENT INVOLVEMENT AND COMMITMENT

Software development staff regularly receives guidance and support from management.	1-5
Software development staff are highly motivated.	1-5
Software development staff receive recognition for their work	1-5
Senior management actively supports SPI activities.	1-5

The results from the analysis as shown in table 5 and 6 indicates that the respondents agreed that the level of development team involvement in software development process and planning are very significant. This could be identified with the average mean score for this question is relatively high. Moreover, table V also indicates that even though the development staff working autonomously but they are also actively involved in setting goals, planning and procedures in the company’s software development process.

TABLE V. SPI- PEOPLE INVOLVEMENT AND COMMITMENT

Size Group		Direct Involvement Dev Process Planning	Autonomous Work	Team-SPI Setting Goals	Direct Involve Development Process and Procedure
Micro VSE	Mean	4.20 (0.837)	4.20 (0.447)	3.80 (0.447)	4.00 (0.000)
Larger VSE	Mean	4.40 (0.548)	4.40 (0.548)	3.40 (0.548)	4.00 (0.707)
Total	Mean	4.30 (0.675)	4.30 (0.483)	3.60 (0.516)	4.00 (0.471)

Meanwhile, table VI shows the level of management commitment in the improving current software development process. From this table, researchers could indicate that the management has provided their full support in SPI process. This situation is shown in the total mean score for each questionnaire on this issues which more on the positive rather than negative. Therefore, this gives an indicator of the seriousness and high commitment of management in software development process.

TABLE VI. SPI- MANAGEMENT INVOLVEMENT AND COMMITMENT

Employee Size Group		Management-Guide and Support	Management- Staff High Motivated	Management- Staff Recognition	Management – High Support in SPI process
Micro VSE	Mean	4.20 (0.447)	4.80 (0.447)	4.40 (0.548)	3.00 (0.707)
Larger VSE	Mean	4.20 (0.447)	4.20 (1.304)	4.00 (1.225)	3.00 (0.707)
Total	Mean	4.20 (0.422)	4.50 (0.972)	4.20 (0.919)	3.00 (0.667)

From the feedback indicated by the respondents as in questionnaire, we could understand more details about the above issues. The following extracts from the open-ended question show support of this situation:

“Explicit requests for input and feedback on any thoughts/ideas for changing the way things are done”

“I welcome input from developers on what we are doing and how to make it better”

“Direct on the best way to develop, easiest processes”

The results in this part of analysis gave a pattern and indication that in VSEs development and management team are very supportive and serious in improving their development process in order to produce a quality product

C. SPI – Goal and Planning

In order extend our understanding on software development process activities in VSEs. We have grouped all the questions that are more specific towards the companies’ goal and planning toward SPI as shown in table VII.

TABLE VII. SPI– GOAL AND PLANNING

We have established Software Process Improvement (SPI) goals.	1-5
There is a broad understanding of SPI goals and policy within our organization.	1-5
Our SPI goals are closely aligned with organizational business goals.	1-5
We have a good balance between short term and long term SPI goals.	1-5
Software development staffs always understand projects goals.	1-5

Table VIII indicates that the respondents agreed that in general they are clear about the specific goal of the companies’ software development projects. This can be identified with the high score in mean analysis regarding these issues. However, table 8 also highlights that VSEs do not have a proper plan and well understand on software process improvement issues. In

details, the analysis in table 8 shows that all respondents agreed that the companies do not have a proper SPI goal either for short term or long term. They also admitted that the companies SPI goals are not aligned with their business goals. It is also indicates that the size of the companies give an influences in setting and planning companies SPI goals and objectives.

TABLE VIII. SPI- GOAL AND PLANNING

Employee Size Group		Establish SPI Goal	Broad Understand SPI Goal	SPI Goal Align Business Goal	Balance Short & Long Term SPI
Micro VSE	Mean	2.00 (1.000)	2.60 (0.548)	2.60 (0.894)	2.60 (0.548)
Larger VSE	Mean	3.60 (0.548)	2.80 (0.447)	3.00 (1.000)	2.80 (0.837)
Total	Mean	2.80 (1.135)	2.70 (0.483)	2.80 (0.919)	2.70 (0.675)

The comparison between table 2 and table 8 provides an indication that in VSEs the improvement process has been done in a rapid way but in a small scale and informal process. It is also showed that VSEs did not have a specific procedures or documented specific plans in improving their development process but more toward informal and direct improvement of the process. These findings also aligned with the first stage analysis which stated that the improvement processes are performed in an informal way or have been done at a small scale but in a rapid process.

VI. LIMITATION

As with any research project we have identified some limitations and constraints within the study. In conduct the data collection process, the researchers encountered some difficulties getting a full commitment and good response from the identified Irish Software VSEs. Limited number of staff, busy with current project, economy situation, project deadline, low level of interest and inappropriateness are among the reasons given by those companies. However, a low return rate of the questionnaire is a well known and understood research problem and is not specific to this study. In addition the issue of generalisability is common to many research studies of this type. The small research sample size does some limitations in the research results. However, with appropriate companies which have been selected and responded, have assisted this study to produce a valid indicator of the study result. Therefore the results could represent the VSE environment as a whole. These have been demonstrated from the consistent research results which were produced in the analysis process.

VII. CONCLUSION AND FUTURE WORK

In the study present, the commitment of Irish Software Development VSEs was studied and analyzed. The findings indicated that respondents agreed that their software development process frequently change and evolved over time. They also agreed that they regularly assess and update their development processes. However the finding showed that the changed and evolved processes are informal, indirect and very reactive which depends or is linked to customer requirements, developers' initiatives and technology changes. In terms of

development process methodology, 100% of the respondents stated that they had adopted an agile development approach philosophy in the company's projects. This could be identified from the analysis which showed that the development processes are very informal, less documentation, customer oriented and active in communication. Overall, although the results show the high informal and indirect culture in VSE in most of their development activities, the results also indicates that VSEs commitment towards SPI is very high and positive. Meanwhile, with regards the future work, we plan to wider our research participation through identifying more VSEs which located in Ireland in order to understand the issue more detail and to identified the constraints that prevent them from actively involved in SPI. In addition, since the majority of software developments companies in Malaysia are also belong under the small and medium size category [33], we plan to replicate the same study in order to see if there any comparison with the existing results. This could enhance our understanding regarding this issue and could be relate with the Global Software Development (GSD) issues.

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