

OWPL: A Light Model & Methodology for Initiating Software Process Improvement

ANABEL STAMBOLLIAN
*École de technologie supérieure,
1100 Notre-Dame Ouest, Montréal,
Québec H3C 1K3, Canada
anabel.stambollian.1@ens.etsmtl.ca*

NAJI HABRA
*University of Namur
Institut d'Informatique, Rue Grandgagnage,
21 5000 – Namur, Belgium
nha@info.fundp.ac.be*

CLAUDE Y. LAPORTE*,
JEAN-MARC DESHARNAIS**,
*École de technologie supérieure,
Department of Software and IT Engineering
1100 Notre-Dame Ouest, Montréal,
Québec H3C 1K3, Canada
*Claude.Y.Laporte@etsmtl.ca
**Jean-Marc.Desharnais@etsmtl.ca*

ALAIN RENAULT
*Public Research Centre Henri Tudor
29, avenue John F. Kennedy
L-1855 Luxembourg-Kirchberg, Luxembourg
Alain.Renault@tudor.lu*

Abstract

For many years, industry and research communities have studied Software Process Improvement in organizations. However, that research applied mainly to large organizations. In 1998, the University of Namur (Belgium) began a research project on Software Process Improvement in small settings (fewer than 60 employees), mainly in Wallonia to begin with, where there has been clear improvement. Experiments were then conducted in several dozen organizations in three countries by the ÉTS (École de technologie supérieure, University of Québec, (Canada)), and the CETIC (Centre d'Excellence en Technologies de l'Information et de la Communication). The research remains ongoing at this time.

Keywords: Software Process Improvement, Maturity Model, Process Evaluation, CMM[®], CMMISM¹, SPICE, OWPL, Micro-Evaluation, Small Settings.

1. Introduction

In the global market context, large organizations involved in Information Technology (IT) products and services are aware of the importance of performance, quality and development time. As a result, many invest

time and resources in improving their software product quality and development processes. Some have created their own reference model for that purpose, but most use models such as the CMMISM [15] of the Software Engineering Institute (SEI) or the ISO/IEC-15504 standard of the International Organization for Standardization (ISO) [9], commonly known as SPICE.

However, those models are not readily usable by small or very small organizations (with fewer than 25 IT employees), as they are much too complicated and too expensive to implement. A solution to this problem was needed. Though there are small organizations in every country, our study is limited to those in Wallonia (Belgium), Québec (Canada), Rhône-Alpes and Provence-Alpes-Côte d'Azur (France). At the University of Namur, a Software Process Improvement (SPI) [5] approach dedicated to small organizations was developed during the 1998-2000 period. It has been used, and is still being improved, in collaboration with the CETIC (Wallonia, Belgium) and the ÉTS (Québec, Canada). This paper presents the results obtained with this approach in several small settings. Section 2 presents the framework used. The experience, of several dozen small organizations (from three countries) with respect to its use, is set out in section 3. Then, the lessons learned from its use are presented in detail in section 4. Finally, conclusions drawn from the experiment are presented in section 5.

¹ CMM and Capability Maturity Model have been registered with the U.S. Patent and Trademark Office. CMM Integration and CMMI are service marks of Carnegie Mellon University.

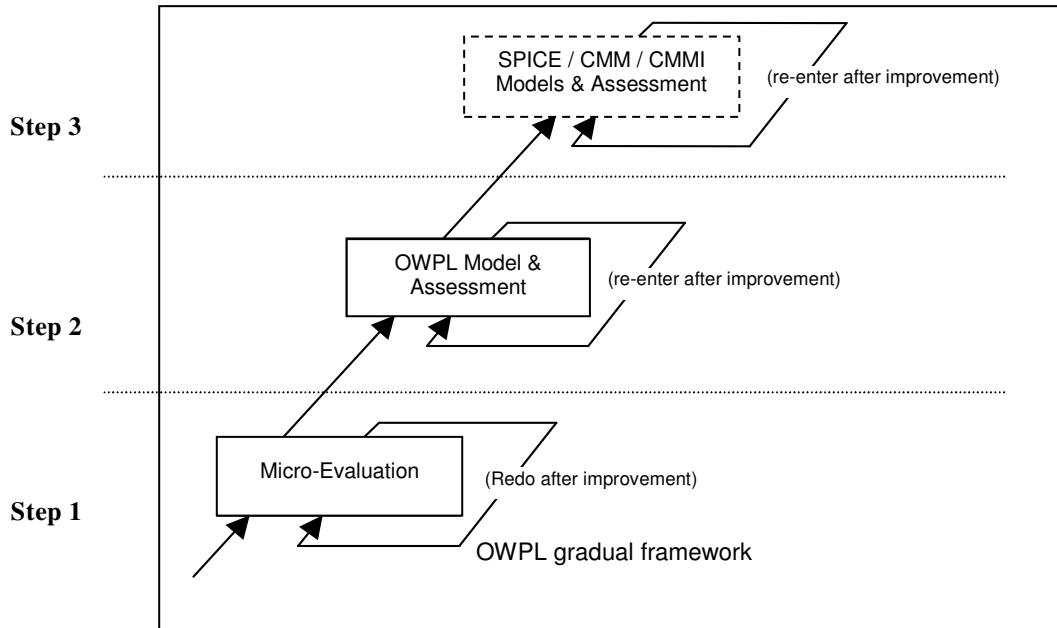


Fig. 1, The OWPL Gradual Framework

2. Approach and Methodology

The majority of the organizations targeted have little or no experience with quality concepts or with Software Process Improvement (SPI) [5]. They also generally have limited resources, in terms of staff, time and budget. Moreover, the typical weaknesses noted in small settings are related to the fact that, within a single organization, the software processes and practices that are applied have uneven maturity levels. These maturity levels also fluctuate greatly according to differences in projects, clients, decision makers and development teams. Fortunately, it is often possible to identify efficient and effective software practices applied within these organizations, which can easily be generalized throughout teams and projects.

That said, the chosen methodology (and corresponding assessment method) must take into account the particular context of the small setting in order to quickly progress, within a limited time and budget, to eventually reaching a higher maturity level [6]. The scope of this paper limits itself to the experiments on the three-step Software Process Improvement Framework: *OWPL*² and its corresponding assessment method, *Micro-Evaluation* (see Fig. 1).

² *OWPL* stands for Observatoire Wallon des Pratiques Logicielles (Walloon Observatory for Software Practices)

2.1. The OWPL Gradual Framework

The objective in using the *OWPL Gradual Framework* [5] (Fig. 1) is twofold: first, to make the organization aware of the quality aspects of software, and second, to initiate a continuous SPI mechanism that will produce rapid, but tangible results, and all that with a minimum of resources.

2.1.1 Step 1: the Micro-Evaluation

The first step in the framework proposes an assessment of the small organization, conducted through a simplified questionnaire called the *Micro-Evaluation* [14], which first assesses the current software practices in the small setting, and then makes the organization aware of the quality aspects of software. This questionnaire covers six key practice areas which have been selected as the most pertinent to the targeted organizations (based on previous experience with small-setting assessments). These are:

1. Quality assurance
2. Customer management
3. Supplier management
4. Project management
5. Product management
6. Training and human resources management

The questionnaire is used by an assessor to interview a representative of the organization being evaluated. Note that the assessor must have sufficient expertise in software quality and software process improvement and the individual interviewed should have sufficient knowledge of the organization's IT activities.

The questionnaire itself contains exactly 17 open-type questions, one of these relating to a brief description of

the organization being assessed, and another pertaining to the interviewer's remarks concerning the questionnaire itself. The remaining 15 questions cover all 6 practice areas mentioned earlier, the responses being evaluated according to systematic analysis grids. The organization's practices are rated according to a 4-point scale (0 being the lowest score). The scores are given according to the quality level of the assessed practices and to the degree to which they have been implemented in the organization. Note that these scores are no indication of the maturity level as CMM[®], CMMISM or ISO/IEC-15504 define them. That said, the terms "maturity level" and "capability level" are still used in the *OWPL* Gradual Framework vocabulary, in reference to the scores (0 to 4) obtained using the *Micro-Evaluation* assessment method (see figures 2 to 5).

Following the assessment, the results are set out in a report. The report includes a brief presentation of the approach, a description of the organization being assessed, the collected, analyzed and summarized results according to the six axes, a list of the main strengths and weaknesses according to SPI principles, and, finally, the practices recommended to help the assessed organization improve its existing practices and processes. The conclusions drawn from the *Micro-Evaluation* responses lead to the production of an action plan. A second *Micro-Evaluation* can be performed a few months after the first one, to evaluate progress made.

2.1.2 Step 2: the OWPL Model

The second step consists of an examination of the information collected from the *Micro-Evaluation* and the conclusions drawn from the analysis of the results. This will to help determine the business scope and goals of the organization for a more accurate evaluation and, eventually, improvements to them.

The second stage represents the central component of the framework in which the *OWPL Model* [7] is applied. This model has been designed to respect the particular context of small and/or low maturity level organizations, with a view to helping them initiate action for improving their software processes and practices, and attaining better overall performance. The model's construction has been influenced, at the time, by existing standards (or technical reports) and models, like ISO/IEC TR-15504 [10] (SPICE), and CMM[®] [16]. It now offers an analogous approach to the most recent standards and models (e.g. ISO/IEC-15504:2003-06 [9] (SPICE) [9] and CMMISM [15]), but, unlike them, it has been profoundly influenced by experiments carried out in small organizations (with the help of the *Micro-Evaluation*), resulting in a strong knowledge base on software development practices, contexts, objectives and maturity levels in small settings.

Thus, the *OWPL Model* offers these five characteristics:

- a) It uses a simplified vocabulary and avoids the use of technical terminology of the type used in standard models.
- b) It proposes the implementation of a reduced number of processes and practices.
- c) It allows the organizations that have reached a sufficiently high maturity level, to perform an ISO/IEC-15504 [9] (SPICE), a CMMISM [15] or a CMM[®] [16] evaluation.
- d) The practices proposed in it are considered light enough to be implemented by a single staff member (but still stress that different roles should be assigned to different staff members).
- e) It is goal-oriented, similar to the "The Goal/Question/Metric Method" (GQM) [2], this emphasis on goals raises the importance of explicitly defining the organization's global objectives, and, more precisely, its software process improvement objectives.
- f) It provides methodological guidelines to help carry small software process evaluations and awareness actions, to make sure that the evaluation results are communicated throughout the organization, and to promote process improvements.

The *OWPL Model* proposes 10 processes, each composed of several practices (between 3 and 12). These processes are:

1. Requirements management
2. Project planning
3. Project tracking and oversight
4. Development
5. Documentation
6. Testing
7. Configuration management
8. Supplier management
9. Quality management
10. Experience capitalization

The traceability between the above processes and the *Micro-Evaluation's* key practice areas is noticeable and deliberate. The *OWPL Model* also proposes 30 *success factors*, which enable the capture of objective elements of the organization's particular context and projects currently being assessed.

Following an *OWPL Model* assessment, a report must be written containing a summary of all the information collected the data analysis and recommendations for an appropriate improvement plan. The report must follow these important rules:

- Long-term goals are to be defined and kept in mind. It is a fact that most small settings have a day-to-day management policy (or at least a very short-term one), so it has to be taken into account.



Fig. 2. Results of the first round of *Micro-Evaluations* in Wallonia

- The improvement recommendations are to help the organization reinforce its flexibility thanks to a short-term, low-cost and easy-to-implement action plan.
- The improvement recommendations are to focus on a short-term and low-cost return on investment (quick wins).
- The recommended processes are to prevent excessive bureaucratic tasks, while ensuring an adequate formalization level.
- Recommended improvement actions are to be prioritized according to the organization, its context and its identified objectives and goals. The software lifecycle is to be defined in the early process implementation phases, as they are the foundations of any software project.

The *OWPL success factors* help the assessor gain a better understanding of the organization's particular context and propose an appropriate improvement plan, which takes this context into account.

Like the *Micro-Evaluation*, the *OWPL Model* also provides an evaluation that can be carried out several times to measure improvement, and can serve as an entry point for the next and final step of the framework.

2.1.3 Step 3: the SPICE / CMM / CMMISM Models

Only at the third step can the small settings justify the need for standard labelling, that is, when the organization has reached a sufficiently high maturity level. Only then

can a ISO/IEC-15504 [9] (SPICE), CMMISM [15] or a CMM[®] [16] evaluation may be undertaken. The improvements will then be implemented according to the chosen reference model. Though this approach may seem linear, an organization may jump from one step to another, depending on its size and maturity level.

3. The OWPL Gradual Framework Results and Case Study

The case studies discussed in this section have been carried out in small organizations that provide computer-related services or products, and/or electronic components.

The organizational samples that are examined in this paper include organizations from: Wallonia (Belgium), for whom results have been discussed in previous papers [4] [12], Québec (Canada), where the number of assessed organizations have been increased from 21 in 2004 [11] to 46 (in this study), and finally, from Rhône-Alpes and Provence-Alpes-Côte-d'Azur (France), which represents a completely new sample [17].

3.1. The *Micro-Evaluation* results

Even though the sample does not claim to be representative of all the world's small organizations, the particular features that characterize small settings are the same and remain consistent throughout the selected

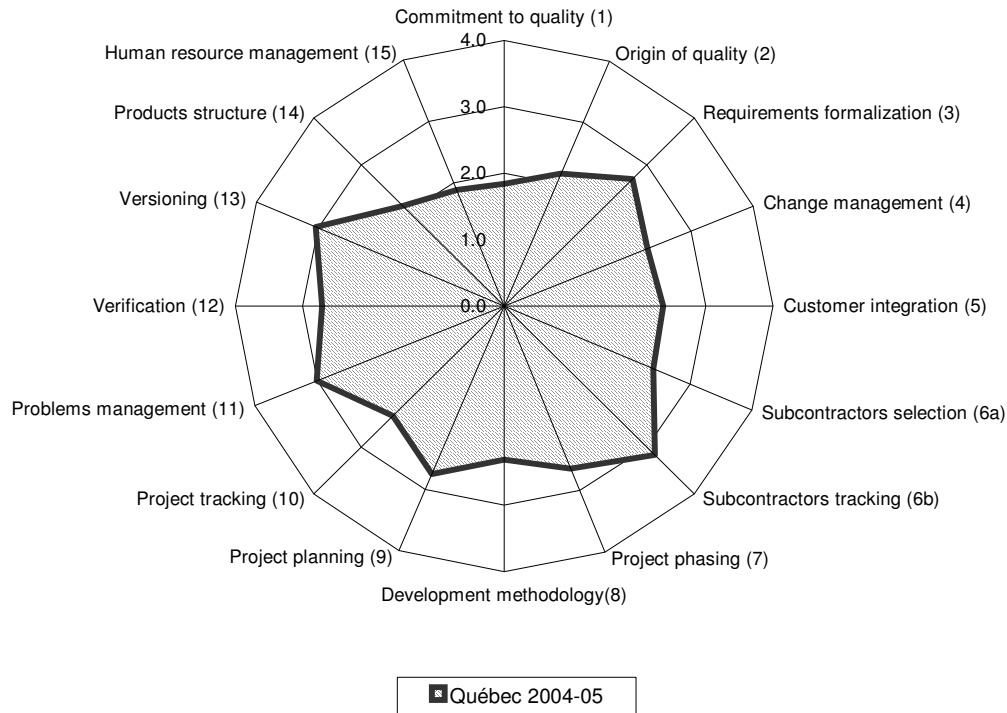


Fig. 3. Results of the first round of *Micro-Evaluations* in Quebec

sample (see Section 2.1 for details on small-setting characteristics). Below is a summary (by country) of the results collected.

3.1.1. The Micro-Evaluation in Wallonia (1998-99)

The *Micro-Evaluation* was first tested by the University of Namur on a sample of 20 small organizations in Wallonia in 1998-99 [4]. Figure 2 shows the global profile of the small organizations involved in the *Micro-Evaluation* [11] [12].

The following conclusions were drawn from a first round of the *Micro-Evaluation*:

- In most of the organizations assessed (2/3), there was a lack of formalism, more particularly poor planning processes, or none at all. For the majority of them, there was no training program, and their success was highly dependent on individual skills.
- In the remaining organizations (1/3), there was an awareness of the quality aspects of software development: quality improvement processes were already in place with well-defined and well-documented procedures. Some were preparing for ISO:9001 certification [8] and several of their practices were highly efficient, notably those related to customer/client management and product management.

3.1.2. The Micro-Evaluation in Québec (2004-05)

In the summer and fall of 2004 [11] and 2005, 46 *Micro-Evaluations* were performed in Montréal, where the average number of employees in the targeted organizations was 16, and the average number of years the companies had been producing software was 8.

Figure 3 shows that small organizations were performing, with a score of about 3 on a 4-point scale: subcontractor tracking, problem management, versioning activities. A certain number of weaknesses can also be noted: very low scores were obtained on commitment to quality (score=1.8), origin of quality (score=2.2), product structure (score=2.1), human resources management (i.e. training) (score=1.9).

It is interesting to note that the scores obtained for Québec do not fluctuate significantly, which corroborates the finding of maturity level evenness within the organizations. For 2006, a second round of *Micro-Evaluation* is planned on a number of the organizations that were evaluated in 2004, in order to measure improvement.

3.1.3. The Micro-Evaluation in France (2005)

In the summer of 2005, 9 *Micro-Evaluations* were performed under professors' supervision by a graduate student in software engineering at the ÉTS (co-author of this paper). The average number of employees in that sample was 13 and the average number of years they have

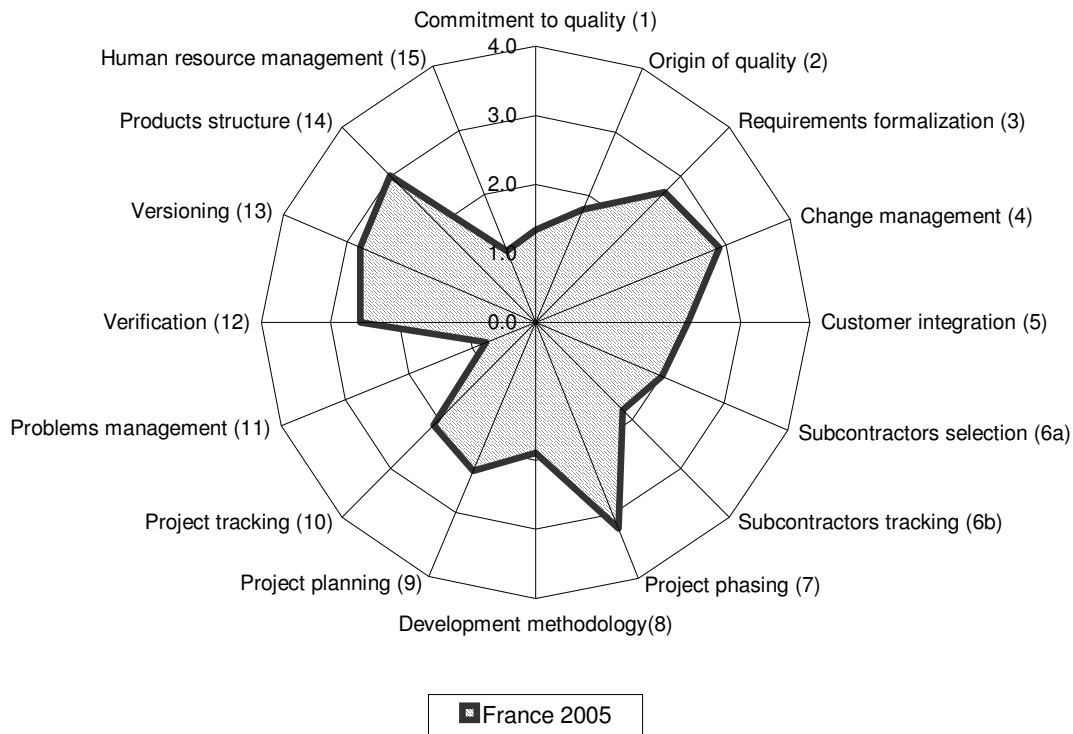


Fig. 4. Results of the first round of *Micro-Evaluations* in France

been in the software development business was 6 to 7 years. Among them, only one was significantly different with 20 years of age.

Figure 4 shows that the targeted organizations were performing quite well (3 points or more) in the practices related to: project phasing (score = 3.2) and product structure (score = 3.2). The assessed weaknesses (under 2 points) pertain to the activities related to: commitment to quality (score=1.3), origin of quality (score=1.7), change management (score=1.9), development methodologies (score=1.8), problem management (score=0.7), human resources management (i.e. training) (score=1.1). It is to be noted that half these organizations had no supplier, biasing the “Subcontractor selection” axis.

It is interesting that, while project phasing and product structure scored relatively high (assuming that a systematic approach or a certain structure or methodology has to exist to attain such scores), the practices related to the development methodology axis scored low. These results led us to believe that small settings may develop and use document templates that are traceable to project phases, but without making these practices official: They have the development methodology, but nothing in the organization confirms or institutionalizes it.

A second round of *Micro-Evaluation* is also planned in 2006 on a number of these French organizations.

3.2. An OWPL Case Study

The case study given in this section illustrates the experiment with the *OWPL Model*, which was applied on this small organization once it had been assessed with the *Micro-Evaluation*. This case study was arbitrarily selected from the samples described earlier. The only concern surrounding this selection was gaining the agreement of the chosen organization to participate in the study.

Created in July of 2000, *Organization A* is one that produces and commercializes software products which process natural written language. *Organization A* has a total of 9 employees, 7 of them working in the IT-specific field. Their mean education level in the software-specific field is equivalent to 2 years of university education. Their targeted clientele is mainly companies needing to automate responses to their clients’ e-mailed questions. *Organization A* has no supplier and does not plan to have any in the near future. The organization had no previous knowledge of improvement models or quality aspects.

Organization A was contacted by phone by an ÉTS graduate student, and was asked if the organization would participate in the experiment. The next step was to meet with this contact, who was *Organization A*’s CEO. The CEO agreed to answer the *Micro-Evaluation* questions himself. The results obtained are presented in Figure 5.

Obviously, many practices needed improvement. But, by respecting the organization’s immediate goals and

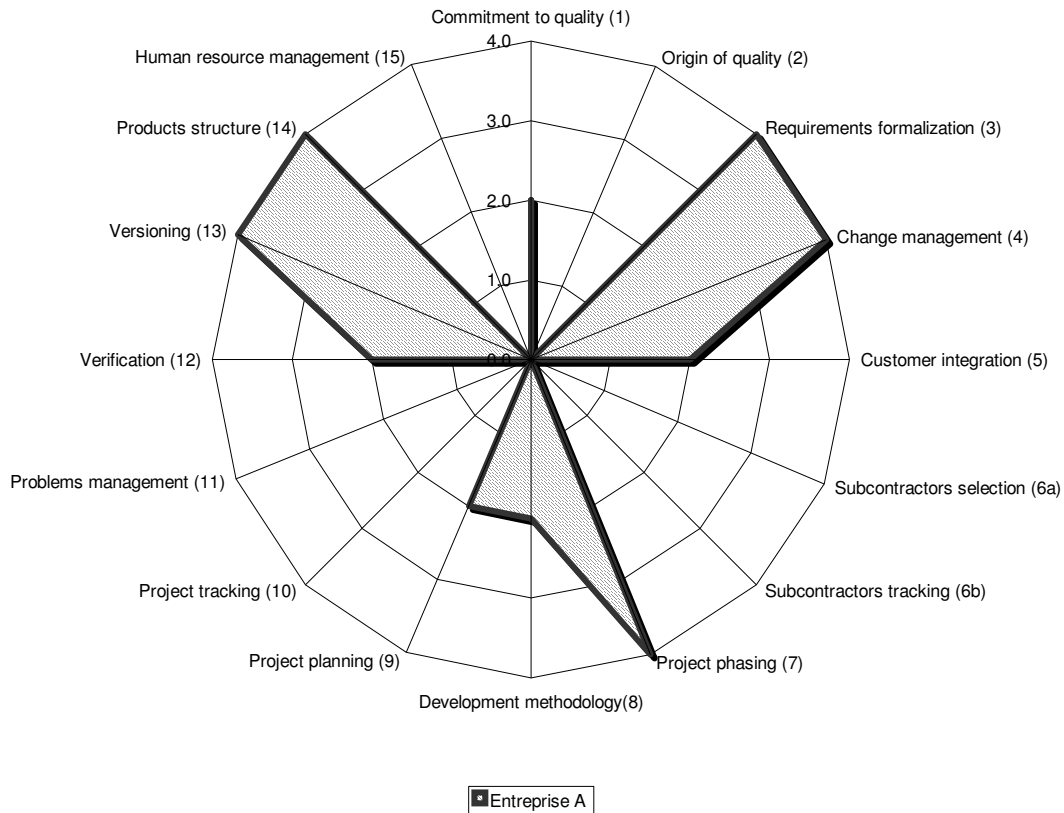


Fig. 5. Results of the first round of *Micro-Evaluations* in *Organization A*

wishes, and by examining the results, one axis was chosen for improvement: “Problem Management”. Only one process, easy to implement, was proposed to improve that practice area. There are many reasons why only one process was recommended: first, to make sure the organization would not be overwhelmed with new activities; second, an easy implementation would convince the organization that adopting a culture of quality (even with small steps) would prove to be profitable; and third, so that the organization would learn (through a small change) what process improvement is, and how to implement and control such a process.

The process that was provided to the organization was: P1_Effective_Meetings. This process includes sub-processes (or process activities), such as:

1. PA1_Plan an effective meeting
2. PA2_Open a meeting
3. PA3_Conduct an effective meeting
4. PA4_Close a meeting
5. PA5_Review the meeting

By detailing every step of these processes, by supporting the organization (e.g. answering questions that employees might have) and by giving the organization an implementation plan that they could follow, they would be

able to implement and try the new practices (at least once) within 2 months. After conducting 5 or 6 meetings, a second *Micro-Evaluation* could be conducted, to verify whether or not there have been improvements in the “Problem Management” practice area.

To date, *Organization A* has not yet implemented the new process (because of lack of time), but plans to do so in the coming weeks.

For more detail on this organization, results and proposed processes, refer to [18] [19].

4. Lessons Learned

Section 4.1 describes the highlights of the experiment with small organizations (in Belgium, Québec and France) once the *Micro-Evaluation* had been carried out. At the same time, the experiment has pointed up the weaknesses and strengths of the *Micro-Evaluation* itself, described in sections 4.2 and 4.3 respectively.

4.1. The organizations assessed

Below are listed some of the most obvious characteristics observed for the organizations assessed:

- Globally, these small organizations became aware of SPI topics following the *Micro-Evaluation* assessment.
- Fewer than a third of the organizations assessed were aware of the quality aspects of software.
- In most cases, there was no training program, making the organizations' success dependent on individual skills, which is typical of small organizations.

4.2. The *Micro-Evaluation*'s weaknesses

These weaknesses will be addressed in order to improve the *Micro-Evaluation*. Improvements will be made based on the following observations:

- Because of the lightness of the *Micro-Evaluation*, the questionnaire contains few questions, sometimes covering far too much terrain, which makes the scope of the evaluation too vague.
- Some of the *Micro-Evaluation*'s questions are redundant.
- The questions from the "Customer management" axis of the *Micro-Evaluation* are evidently not adapted to organizations that do not have direct clients (the concept of "client" not having the same definition for those who function on government funding, or for those who produce "off-the-shelf" or "R&D" software, for example). That said, the questions of this axis are mostly centered on managing needs and software requirements anyway, thus eliminating the need to include the "client" concept in this axis.
- The levels of formalism and objectivity of the acquired answers from a *Micro-Evaluation* assessment are quite low. A solution must be found to increase these levels, to provide more accurate, reliable and objective results.

4.3. The *Micro-Evaluation*'s strengths

The main lesson was that the *Micro-Evaluation* is a very attractive tool for use in small settings. It offers an optimum ROI (Return-on-Investment) for any small development team with low maturity levels. Below are the more specific positive characteristics:

- The *Micro-Evaluation* is a simple and low-cost assessment.
- The *Micro-Evaluation* gives an accurate insight into the organizations assessed.
- The *Micro-Evaluation* can be tuned to match the organization's available resources (big or small).
- A simplified vocabulary is used, making the *Micro-Evaluation* understandable to those who are not experts on the quality improvement aspects of software.
- The *Micro-Evaluation* is a very good starting point to SPI for small settings: it lets an organization start with a relatively informal assessment method that can

lead to a fully formal assessment method such as ISO/IEC-15504 [9] (SPICE) or CMMISM [15].

- The *Micro-Evaluation* complies with the more formal assessments, such as ISO/IEC-15504 [9] (SPICE) or CMMISM [15].

5. Conclusion and Future Work

5.1. Conclusion

Current software practices in most small organizations are far from well defined, and the lack of available resources compromises the success of any SPI approach based on models such as CMMISM or SPICE. However, it is possible to undertake an SPI process and to make real progress without investing a great deal of money: the *OWPL Gradual Framework* has been designed to do precisely that.

The studies show that the *Micro-Evaluation* (step 1 of the framework) is a very attractive assessment tool to start with, mainly because of its simplicity, and also because it helps draw attention to the problems related to the quality improvement aspects of software. For small organizations looking for a more exhaustive assessment and software improvement process recommendations, the *OWPL Model* (step 2 of the framework) should constitute the appropriate answer. It has been developed at the time, taking the ISO/IEC TR-15504 [10] (SPICE) and CMM[®] [16] models as references (and adapted to the more recent ISO/IEC-15504:2003-06 [9] (SPICE) and CMMISM [15] models) on the one hand, and the small setting's characteristics and context (which are highlighted by virtue of the *Micro-Evaluation*) on the other. Subsequently, a ISO/IEC-15504 (SPICE), CMMISM or CMM[®] evaluation can be undertaken at some point (step 3 of the framework).

5.2. Future work

The evolution of the *Micro-Evaluation* will be reflected in the next release, as follows:

- a) Refining the evaluation's questions and scales to attribute quality levels to each practice, making the mapping easier, between the answers collected and the practices evaluated
- b) Adapting the *Micro-Evaluation* in reference to those organizations that develop software products which exclude direct client stakeholders
- c) Modifying axis labels so that direct interpretation drawn from the charts themselves will be more understandable
- d) Refining (or adding) questions to the *Micro-Evaluation* to better assess the existing software practices.
- e) Finding a solution to increase these levels formalism and objectivity to provide more accurate, reliable and objective results

- f) Preparing a course on the *Micro-Evaluation* that targets assessors, to improve and normalize the assessment technique and, eventually, the responses collected

It is worth mentioning that the *OWPL Gradual Framework* represents one of the inputs currently considered by the new ISO/IEC SC 7 Working Group 24 [11]. Briefly, the working group is mandated to facilitate access to, and utilization of, ISO (the International Organization for Standardization) Software engineering standards in very small enterprises (VSEs), a term which includes small software development departments and small projects within larger organizations. VSEs are typically organizations (or projects) which have 25 or fewer employees.

Further research would include conducting more *Micro-Evaluations* to gather additional data on small settings, to improve the approach described here and to improve the performance of small organizations. So far, the results of this experiment are promising. Planned for 2006 are second rounds of evaluations to be conducted on a number of the organizations already assessed, in order to evaluate whether or not improvements to their software activities have been identified.

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