Software Process Improvement in Small Organizations Using Gradual Evaluation Schema

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Abstract

This paper relates a technology transfer experience which aims at supporting the introduction of software process improvement in small businesses, small organizations and/or small projects. The experience is born from a European interregional collaboration between two university research teams (France and Belgium) and a public technology center (Luxembourg). One of the contributions of this experience is the design of a Software Process Improvement approach particularly adapted to small units on the one hand, and to regional context, on the other hand. The proposed approach is gradual. It is based on three nested evaluation models ranging from an extremely simplified model (the micro-evaluation model) to a complete standard model supporting SPICE. The intermediate model, called the mini-evaluation model, can be viewed as a tailoring of SPICE and can be used by itself as a definitive model by small businesses and small organizations.

1. Context and Motivation

The project is mainly addressed to the Small and Medium Enterprises (SMEs) and small public organizations of the Walloon region, i.e., the French speaking part of Belgium, which is one of the oldest industrial region in Europe. Similarly to other old European industrial basins, the region suffers from heavy aged industrial structures, e.g., iron and steel industry, coal-mining… The region is achieving a phase of slow conversion to modern industrial structures including small businesses which are active, among other, in the domain of Information Technology (IT).

The main characteristics of the regional environment are the persistence of some old-fashioned bureaucratic management style, the coexistence of new small dynamic businesses and old big industries, the small size of IT businesses and the very small size of the majority of IT units in other industries and in public organizations. A regional study made by the Technology Assessment Group (CITA) of our university about Walloon SMEs [1] gives some significant data: in about 30% of businesses, only one person has software (in general) in his charges; and among the SMEs developing and/or managing Information Technology, 60% achieve these tasks with less than 5 persons. Such a very small size makes businesses highly dependent on some projects, some actors and/or on some technical capabilities, though they could be sometimes very innovative in their domains.

Another characteristic of the SMEs of that region lies in the fact that they are surrounded by rapid growing dynamic regions (French Lorraine Region, Grand Duchy of Luxembourg,…) and they evolve in a European context where the market is more and more open, and consequently, with an increasing competition. In this context, it is obvious that software quality in general becomes a crucial issue for Walloon SMEs even though their resources are very limited.

The OWPL[1] project, supported by a public funding of the Walloon region, aims at assisting SMEs in their Software Process Improvement (SPI). In particular, the main goal is to provide SMEs and small public organizations with very simplified adequate models to initiate SPI approaches.

In fact, standard models like CMM were initially designed for bigger structures. So, they should be, more or less deeply, tailored and/or adapted to very small organizations like our target SMEs. The first reason is the cost of an evaluation process (+/- 25000$) and its duration (+/- 8 month) [2] which are disproportional to the available resources. In addition, the maturity level our target SMEs would get according a general assessment model like CMM, would be very low. Brodman and Johnson ([3],[4]) show that a great number of process improvement plans based on the CMM encountered problems and that an important rate of those problems (53%) were related to the size. The success of a CMM process improvement plan actually grows with the number of people having software process in charge.

There is also a similar need of adaptation with the SPICE model, even though this model is intended to be suitable to SMEs. The cost and effort remain too much important for very small organizations. A very simple adapted model would be more suited for them (at least) as a starting point.

Another important point, lies in that the number of actors involved in software process is very small. Several roles can be in charge of the same single person . This makes the use of such models very complex for small organizations.

In addition, actors in SMEs are far from being all Software Engineering specialists ; so adapting the vocabulary is necessary to allow the model to be used for self- assessment or for an assessment with a light support.

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[1] The acronym OWPL stands for *Obsrevatoire Wallon des Pratiques Logicielles*, i.e., Walloon Observatory for Software Practices .

In summary, regional SMEs have a critical lack of software process improvement in order to be competitive in a short or medium term. But, due to their very small sizes and their limited resources, they need an adapted model they can put in practice immediately and in a simple way.

The remainder of this paper describes the experience of the OWPL project whose aim is namely to produce and experiment such a tailored model. The project is undertaken by the Technology Transfer Center of the university of Namur and funded by the Walloon Region (Belgium). Meanwhile, our center collaborates with the University of Nancy (France) and the Center of Public Research of the Grand-Duchy of Luxembourg in a European ESSI project SPIRAL*NET[2]. This project has the more general goal to increase the visibility of regional SMEs and to improve the SMEs software process in general by the generalization of their best practices. The target of the European project is the French speaking area composed of the Grand Duchy of Luxembourg, the Walloon part of Belgium and the French Lorraine.

2. The OWPL Approach

The main original idea of the OWPL approach of software process evaluation and improvement is to proceed using three nested models which can be used either separately or as successive stages in the SPI.

1. A first extremely simplified model (called the micro-evaluation model) which is designed to have as lower cost as possible but also to allow giving a first pertinent diagnostic to the assessed organization. The rationale is twofold, to make the assessed SME aware of its weakness but also of the potential effective improvement it can expect, on the one hand, and to determine the priorities of subsequent stages of evaluation and improvement procedures, on the other hand.

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[2] SPIRAL*NET is the ESSI ESBNET project 27884.

2. An intermediate model (called the mini-evaluation model) which is the core of the OWPL approach. This model can be viewed as a tailoring of SPICE model (with significant influence of CMM and Bootstrap) particularly adapted to the context described in the above section. This model can be used by itself and would be sufficient for the majority of small businesses and small organizations. It can also be used as a stage that prepares a full evaluation according to one of the standard models.

3. The third model is the evaluation model we propose to organizations having a certain maturity level and seeking for a more in depth evaluation of one or more selected processes in reference to an international standard . In such cases we propose the use of the SPICE model.

Hereafter we give some details about the three nested models we propose.

2.1 The micro-evaluation model

The aim of the micro-evaluation is to give a first outlook of the evaluated organization, to make a diagnostic and guide the next steps of software process improvement. The main requirement that drives the design of this model is to be as less costly as possible, in time and money.

So, the designed model corresponds to a half an hour interview based on a well-prepared questionnaire. The questionnaire covers six key axes we select as the most pertinent and the most prior to our target organizations on basis of former experience with SMEs evaluation.

These axes are the following:

1. quality assurance,
2. customers management,
3. subcontractors management,
4. project management,

5. product management, and
6. training and human resources management.

The questionnaire includes a few dozens of questions covering the axes above. Questions are open, and each of them is associated with one or more sub-questions allowing the interviewer, if need be, to adjust and refine the information he gets. Evaluations are performed by members of our software quality team, the interviewed person should be the one who has the software quality in his charges in the evaluated organization ; this corresponds usually to one of the executive staff members or to the quality engineer, if this function exists.

Answers are interpreted according to a fixed grid. Two types of questions can be distinguished. On the one hand, questions that concern essential practices related to the general organization are rated on a linear scale according to the quality of the practice assessed. On the other hand, questions that concern the software practices are rated in a double-entry grid according to the quality of the practice and to its effective implementation in the evaluated organization (only for some critical projects, for all projects,...). Detailed description of the micro-model can be found in [13].

The result of the micro-evaluation is drawn up in a report of a dozen of pages. A typical report first presents briefly the approach, then it develops the results of the questionnaire and summarizes them according to the six axes, then it analyses those results according the situation of the evaluated organization (the age, the history, the declared goals,..) and finally gives some recommendations to help the assessed unit to improve.

The micro-model has been experimented on a sample of two dozens of representative organizations (IT small companies, IT services in other businesses, public administrations using IT). Figures 1, 2 and 3 below give examples of the resulted grids for three different situations. The first grid is the detailed evaluation results according to the selected practices while the second one is a summarized pictures according to the six selected axes.

One can notice, that the first two cases show an evident weakness in the process of software development itself. This corresponds actually to an amateurish development without any well-distinguished phases or even any notion of a lifecycle. Though, these two units have some strengths in the subcontractor management, for example. A software process improvement for these units should obviously start by the elaboration of a lifecycle and of a development methodology.

The third example corresponds to a more mature unit which can expect, in the short or the middle term, a good evaluation according to a more complete model. Some weaknesses in the given assessment correspond, in fact, to some good practices which are applied only to some projects but not generalized to all the projects.

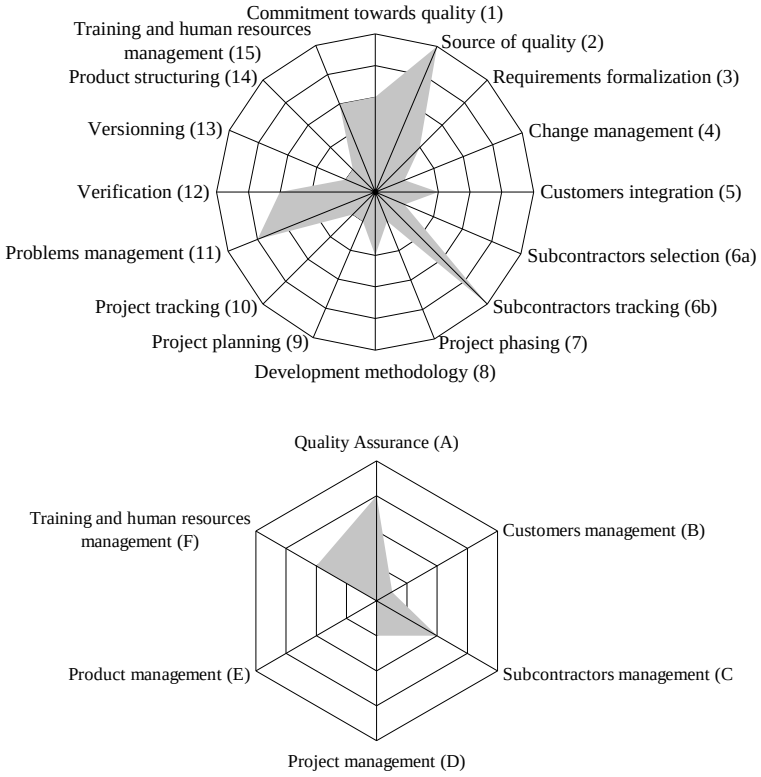
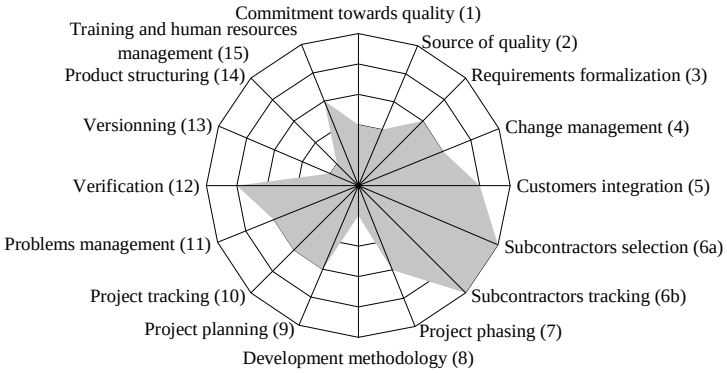


Figure – 1


Commitment towards quality (1)
Source of quality (2)
Requirements formalization (3)
Change management (4)
Customers integration (5)
Subcontractors selection (6a)
Subcontractors tracking (6b)
Project phasing (7)
Development methodology (8)
Project planning (9)
Project tracking (10)
Problems management (11)
Verification (12)
Versionning (13)
Product structuring (14)
Training and human resources management (15)

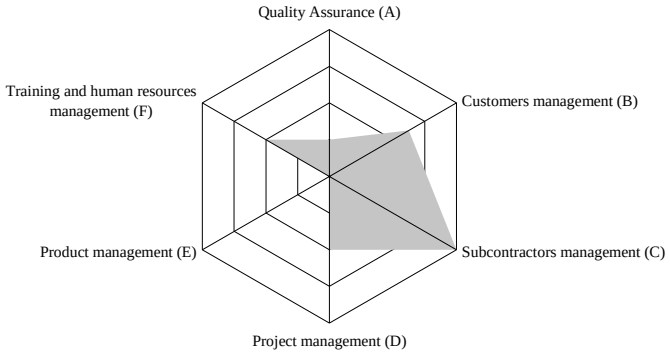
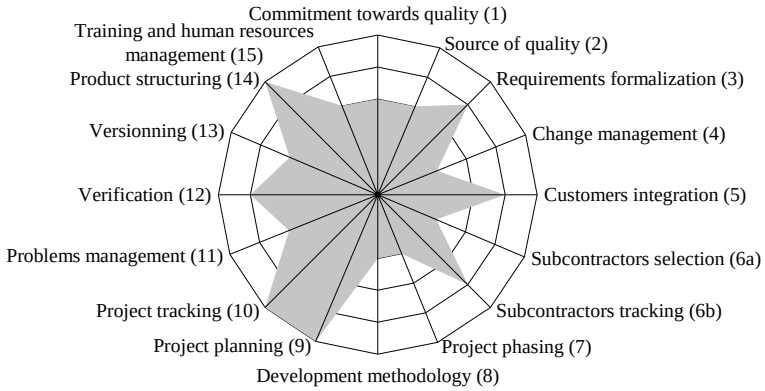

Quality Assurance (A)
Customers management (B)
Subcontractors management (C)
Project management (D)
Product management (E)
Training and human resources management (F)

Figure – 2



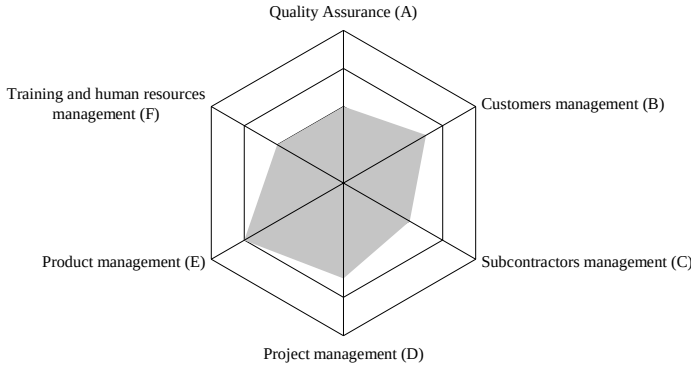


Figure – 3

2.2 The mini-evaluation model OWPL

The mini-evaluation model is the main task of the project OWPL which aims at adapting quality models, e.g., CMM and SPICE, to the context of the regional SMEs described in Section 1. The micro-evaluation model above could be viewed as a preparatory phase preceding the use of the

mini-evaluation model. This latter one should be sufficient by itself for the majority of small organizations.

2.2.1 The adaptation principles

The adaptation of standard models that underlies the elaboration of the OWPL tailored model follows the key ideas below.

- The OWPL model is mainly based on a tailoring of SPICE but it is also influenced by CMM and Bootstrap. A certain traceability between the tailored model and SPICE is preserved.
- The tailored model focuses on *evolution* aspects rather than *evaluation* ones. In fact, our target SMEs would probably get a very low CMM maturity level, for example. Though, they need to know their strengths and weakness and they particularly need guidelines to improve their process.
- The tailored model uses a simplified vocabulary and avoid as much as possible the use of technical terminology. In fact, certain terms used in the classical models (or at least in their translation to French) appear too technical and troublesome.
- More generally, forms and questionnaires are simplified to avoid the model utilization to appear as a cumbersome task which involves extra bureaucratic work (see e.g., [5]). Small business resources are too few and necessary to their immediate production tasks.
- Different tasks in the different practices of the model are considered to be possibly (and even likely) assigned to the same person. So, the model clearly indicates that the different terms used for the tasks description designate different roles but not necessarily different persons. The fact that two different tasks are (or must be) assigned to different persons should be given explicitly.
- The model emphasizes the importance for an organization to define explicitly its objectives in general and those of its software process in particular. The model invites the assessed organization to refine its

objectives into goals and sub-goals and to relate them to the processes and the practices of the OWPL model. We believe that making explicit the relationship between the outcomes of processes and practices on the one hand, and the declared goals of the organization on the other hand, would be motivating in the improvement process. The importance of making explicit the definition of goal is pointed out by the GQM approach [6][7].

– The model is associated with methodological guidelines concerning the action of software process evaluation as well as the awareness actions, the communication of results,..

2.2.2 The structure of the mini-evaluation model OWPL

Practically, the structure of OWPL model involves processes, practices and success factors (see Figure-4 below).

The mini-evaluation model OWPL defines 8 processes each decomposed into a number of practices (between 3 and 12) and is supported by some success factors. The OWPL processes are issued from the SPICE and CMM ones by assembling and simplification. In particular, a number of high-level practices are regrouped in a process called “capitalization and leveraging”. This process actually includes all practices related to the generalization of acquired basic practices and their utilization in order to improve in the medium term and the long term.

The identified processes are thus the following ones:

1. quality assurance process,
2. requirements management process,
3. configuration management process,
4. subcontractors management process,
5. development process,
6. project planning process,
7. project tracking and oversight process,
8. capitalization and leveraging process.

Each of the above processes is assigned a general goal in accordance with the organization defined objectives. It involves a number of practices and is supported by a number of success factors. One can notice the traceability between the above process and the key axes used in the micro evaluation model (Section 2.1).

Each practice is defined by its goal, its inputs and outputs, the resources assigned to support it and its weight. This last attribute is an indicator of the importance of the practice for the whole process improvement, its possible values are *normal*, *high* or *critical*.

Success factors are general requirements related to the environment of the process which determine its effective success. They correspond in fact to CMM *Common Features*, or to SPICE *Attributes*. They includes organizational, management, technical and human resources factors. A detailed description of the OWPL model can be found in [8].

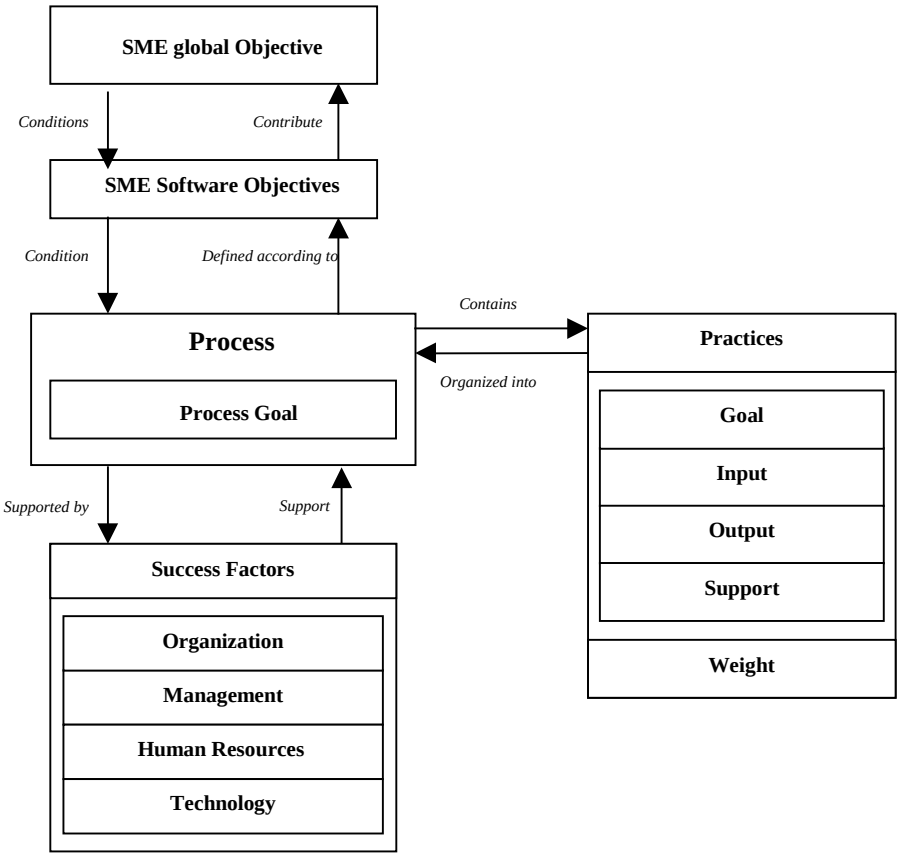


Figure 4 : OWPL Model Architecture

2.3 The complete evaluation model

Some evaluated organizations may have (or may reach) a sufficient maturity level that allow them to expect a good rating in the scale of recognized models; such rating could also be critical for them to maintain or to advance their situation in a highly competitive market. We do not actually develop a new complete model for such situations, instead we propose a SPICE evaluation focused on *some* processes which have been

identified (by means of the mini-evaluation) to be the most critical ones. SPICE , as an international standard, is attractive for those SMEs seeking for recognition. Actually, at this stage of our experience, a very small number of SMEs are already at such an appropriate level.

3. OWPL in Practice

This section summarizes our experience with the OWPL approach. In practice, the project duration is three years, the final goal is to provide the sought tailored model and to propose it as a candidate to become a standard with some regional recognition.
The strategy we adopted is cyclic. The idea is to produce a first release of the models (for micro and mini-evaluations), then to experiment them on some representative case studies, to refine them, to re-experiment them again, and so on.

Practically, we started with an awareness action where the regional SMEs were invited to a conference-debate on Software Quality. The important audience at this conference confirmed us in our believe about the situation of regional SMEs and their demand of software process improvement. The next step was the experimentation of the micro-evaluation model on the demanding organizations. The sample is composed of above 20 organizations and includes administrative units, IS services in medium size businesses, small companies providing computer related services and/or electronics components. The experience showed that the micro-evaluation model is very attractive as a tool to start with, mainly because of its extreme simplicity. All of the assessed organizations declared to be happy with the results and the great majority demanded to continue the SPI with our team, either through a second micro-evaluation, through personal guidance, through the supply of information on SPI subjects or through a mini-evaluation. We are now experimenting the OWPL mini-evaluation model on a number of organizations which have been evaluated according the micro-model. A new release of the model taking into account the current experimentation is planned for the next September.

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