Towards Successful Software Process Improvement Initiatives: Experiences from the Battlefield

Full paper

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Abstract (Required)

Over the past years Brazil has done significant investments in software process improvement. Among them, the long term MPS.BR program focuses on improving the software process quality of Brazilian companies. This paper describes the successful software process improvement (SPI) initiative that is being developed in Brazil, called the MPS.BR program, including its software process improvement reference model (MR-MPS-SW) and the most important results accomplished to date. Our results include the analysis of the iMPS family of surveys, and lessons learned that are valuable to the SPI community. The results and benefits presented can be useful to researchers, practitioners and decision makers in Government, University, and Industry interested in SPI and software industry competitiveness. Moreover, the benefits presented can motivate organizations to engage on MPS model SPI initiatives as a mean to improve the quality of their software.

Keywords (Required)

Software quality, software process improvement

Introduction

One key expression of the Brazilian government effort to promote software quality assurance in the IT industry is concerned with the MPS.BR Program (acronym of the Portuguese expression "*Melhoria de Processo do Software Brasileiro*" or Brazilian Software Process Improvement) (Monton, Rocha & Weber, 2009). This nationwide program was created in December 2003 by the Association for Promoting the Brazilian Software Excellence (Softex) – a private nonprofit organization aiming at promoting Brazilian software industry competitiveness. The MPS.BR program main goal is to establish and disseminate a software process reference model – the MPS model – allowing both SME (small and medium-sized enterprises) and large software organizations, to achieve the benefits of software process improvement (SPI) aiming at increasing competitiveness. More than 650 MPS model appraisals have been conducted, most of them (70%) on SMEs.

A common criticism about SPI is the lack of quantitative evidences its benefits to software organizations. Therefore, this paper main goal is to present objective evidence characterizing the performance results of organizations that have been appraised in the MPS model along the years concerning with increasing of revenues, productivity, quality, schedule estimate precision, overall satisfaction with MPS model, number of clients and number of employees of organizations. That way we show the effects of long term adoption of SPI initiatives based on the MPS model by Brazilian organizations. We also describe the Brazilian experience with MPS.BR program that involves a great industry-university-government collaboration towards successful implementation of software process improvement initiatives. Since the last years MPS.BR Program best practices are being replicated in other Latin America countries. We also present lessons learned we believe are valuable to the SPI community and to those interested on engage in similar initiatives. Moreover, we believe the experience presented in this paper can also be replicated in other countries around the world.

This paper is structured as follows: we first present the background on software process improvement. We then present the results of iMPS surveys concerning benefits to the organizations that adopted the MPS.BR model, followed by the MPS.BR Program lessons learned. We then present the conclusions of the paper.

Background

According to van Soligen & Rico (2006), Software Process Improvement (SPI) is the discipline of characterizing, defining, measuring, and improving software management and engineering processes. SPI is based on the assumption that there is a causal relation between process and product, and that the product can be determined through its creation process. The goal of SPI is often to achieve better business performance in terms of cost, time-to-market, innovation, and quality.

Different approaches have been proposed to improve and assess software development capabilities motivated by the need of better techniques to select software suppliers (Rout et al, 2007). Many SPI initiatives are based on the ISO/IEC 15504 standard (ISO/IEC, 2003) and on the CMMI maturity model (Chrissis, Konrad & Shrum, 2011). Studies have been conducted to evaluate the costs, benefits and impacts of SPI initiatives based on CMMI and ISO/IEC 15504 (Goldenson & Gibson, 2003; Tuffley, Grove & McNair, 2004). Some authors have also investigated the difficulties organizations have when adopting such models (Wilkie, McFall & McCaffery, 2005; von Wangenheim, Varkoi & Salviano, 2006). von Wangenheim, Varkoi & Salviano (2006) and Cater-Steel, Toleman & Rout, 2006) report that one of the most important challenges regarding small and medium-size enterprises (SME) is to show them the expected business results. These studies help to understand the difficulties on adopting CMMI and ISO standards in software organizations, especially SMEs. According to Staples *et al* (2007), SPI approaches should focus on SMEs, have low costs and short implementation time. This was the motivation for the deployment of the MPS.BR Program.

ISO/IEC 15504

Back in the 1990's, the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC) initiated an effort (named SPICE project) to develop an internationally recognized software process assessment framework that culminated in the publication of the ISO/IEC 15504 International Standard on software process assessment (ISO/IEC, 2003). This standard provides a generic approach for the model-based assessment of process capability (Rout et al, 2007). It defines requirements for performing process assessment aiming to achieve a greater degree of uniformity in the approach to process assessment, so as to maximize the reliability of different approaches and provide a degree of comparability between the results of different assessments (ISO/IEC, 2003). The processes that are defined as a comparison target for a particular assessment are defined in a Process Reference Model (PRM). ISO/IEC 15504-2 specifies the contents and basic structure of PRMs. Each process in a PRM is described in terms of its purpose and outcomes of its implementation (Rout et al, 2007; ISO/IEC, 2003). This standard provides a comprehensive group of life cycle processes, activities and tasks for software products and services.

CMMI

The Capability Maturity Model Integration (CMMI) is another important internationally recognized model for SPI (Chrissis, Konrad & Shrum, 2011). CMMI is a process improvement maturity model for development of software products and services developed by the Software Engineering Institute (SEI). CMMI is consistent with the international standard ISO/IEC 15504. Moreover, the official CMMI appraisal method named SCAMPI can also be executed in conformance to the assessment requirements levied by ISO/IEC 15504-2. CMMI provides two representations for SPI. The continuous representation enables organizations to incrementally improve individual processes in a scale of "capability levels" ranging from 0 through 3. The staged representation enables the improvement of a set of related processes by incrementally addressing successive set of process areas aiming to improve organizational processes in a scale of "maturity levels" ranging from 1 through 5. CMMI has three models: CMMI for acquisition (CMMI-ACQ), CMMI for services (CMMI-SVC), CMMI for development (CMMI-DEV).

MPS.BR Program

Government, academics institutions and professional organizations in many countries have established strategies aiming to impulse the development of their software industry for the domestic market and to export services (Hawk & McHenry, 2005. Chudnovsky & López, 2005; Ania & Mejía, 2007; Nicholson & Sahay, 2009). In Brazil, a major initiative is under way since December 2003: the MPS.BR Program. Approximately 73% of the Brazilian software industry (more than 6,000 organizations) is constituted of SMEs (fewer than 50 employees in small organizations and between 51 and 100 people in medium-size enterprises) (MCTI, 2014). From the Government viewpoint, the quality of Brazilian software is a strategic issue, which aims to put Brazil on another level of competitiveness (Santos et al, 2010). Nevertheless, studies in the early 2000s showed that software process reference models have been adopted by very few Brazilian organizations (Veloso et al, 2003). This was the motivating scenario for a joint mobilization of the triple-helix (Academia, Industry and Government) towards the improvement of software processes in Brazil (Etzkowitz & Mello, 2004; Kalinowski et al 2010). From December 2003 many activities and actions have been executed by the Association for Promoting the Brazilian Software Excellence (Softex), with the cooperation of the Government and Academy, to establish and sustain SPI approaches with special focus on SME.

The MPS.BR Program main goal is to develop and disseminate a Brazilian software process model (named MPS Model) aiming to establish a feasible pathway for organizations to achieve benefits from implementing SPI, especially SMEs, by reducing the SPI implementation and assessment costs, and providing means for obtaining SPI benefits in a shorter time frame. The model was developed based on international standards and internationally recognized models and best practices for SPI implementation and assessment, and also on the business needs of both SME and large organizations. The MPS model is constituted of three main components: i) MR-MPS-SW Reference Model; ii) MA-MPS Assessment Method, and; iii) MN-MPS Business Model. The MR-MPS-SW and MA-MPS are: (i) conformant with ISO/IEC 12207 and ISO/IEC 15504; (ii) CMMI-DEV compatible; (iii) based on software engineering best practices; and (iv) in accordance with both SME and large enterprise realities and needs.

The MPS.BR program management structure comprises: (i) MPS.BR Program Team: responsible to manage the program activities; (ii) MPS Technical Model Team (ETM): responsible to develop and maintain the MPS model, and to prepare MPS training materials and execute MPS trainings; and (iii) MPS Accreditation Forum (FCC): responsible to accredit organizations to provide MPS model-based implementation and assessment services, to evaluate and control implementation and assessment results, and to ensure that these accredited organizations execute their activities within expected ethical and quality limits. In order to guarantee the MPS model success, it is essential that organizations can effectively adopt it and obtain benefits from conducting software process improvement initiatives. Therefore, the MPS Business Model (MN-MPS), describes all business rules (Santos et al, 2012). It aims at improving commitment of all MN-MPS participants to foster continually the program success..

Table I shows the structure of the MR-MPS-SW maturity levels (ML) which are defined in two dimensions (based on the requirements of ISO/IEC 15504): process dimension and process capability dimension (process attributes). The initial MR-MPS maturity level is the level G constituted of the two most critical software processes to SMEs: Requirements Management and Project Management. Levels A and B are the highest MR-MPS-SW maturity levels focusing on continuous process improvement. All processes were defined based on their ISO/IEC 12207 counterpart and were supplemented by additional additions from CMMI-DEV as needed.

ML	Processes	Process Attributes
A	(*no new processes are added*)	1.1, 2.1, 2.2, 3.1, 3.2, 4.1*, 4.2*, 5.1*, 5.2*
B	Project Management (*new outcomes*)	1.1, 2.1, 2.2, 3.1, 3.2, 4.1*, 4.2*
C	Decision Management, Risk Management, and Development for Reuse	1.1, 2.1, 2.2, 3.1, 3.2
D	Requirements Development, Product Design and Construction, Product Integration, Verification, and Validation	1.1, 2.1, 2.2, 3.1, 3.2
E	Human Resources Management, Process Establishment, Process Assessment and Improvement, Project Management (*new outcomes*), and Reuse Management	1.1, 2.1, 2.2, 3.1, 3.2
F	Measurement, Configuration Management, Acquisition, Quality Assurance, and Project Portfolio Management	1.1, 2.1, 2.2
G	Requirements Management and Project Management	1.1, 2.1

** These Process Attributes (PAs) are applicable only on selected processes. The others PAs must be applied on all processes.*

Table 1. MR-MPS-SW Maturity Levels (ML) Structure

The MPS Assessment Model component (MA-MPS) is depicted in the MPS Assessment Guide. Its goal is to verify the maturity of an organizational unit in the execution of its software processes. It describes the requirements for accreditation of organizations to provide MPS assessment services (MPS Assessment Institutions, a.k.a. AI), MPS Competent and Provisional Assessors, and also describes the assessment process defined to support the application of the MA-MPS method. This component was defined based on ISO/IEC 15504 requirements and best practices

Research Methodology and Results

In our study, we planned to answer the following research question: What are the impacts of the MPS.BR Program in the quality improvement of the Brazilian software industry? To answer this question, we collected historical and archival data from MPS assessments conducted from 2005 to 2014. We also analyzed the iMPS survey data (as explained in the next paragraph). From 2005 to 2014, there were more than 840 maturity models assessments in Brazil: 650 MPS assessments and 200 CMMI appraisals. Among these there are complementary MPS Assessments after CMMI Appraisals and also joint MPS-CMMI Appraisals (Rocha et al, 2009) which are possible because the models are compatible). The MPS model adoption by Brazilian organizations led to the interest in understanding the benefits brought to the Industry by qualitatively and quantitatively observing the performance results obtained by these organizations. The iMPS project started in 2008 and aimed at periodically monitor and provide evidence, based on surveys, regarding the performance of software organizations that adopted the MPS Model (Kalinowski, Weber & Travassos, 2008).

Following the GQM paradigm (Basili, Caldera & Rombach, 1994) and in order to avoid possible threats to validity, different sets of follow-up questionnaires were developed to be applied at the following moments: (i) when organizations are starting to implement the MPS model, (ii) when organizations are in the official assessment procedure, and (iii) periodically for organizations with unexpired MPS assessments (which are valid for only 3 years). A comprehensive view of all iMPS trials can be accessed in: http://www.softex.br/mpsbr/performance-results/.

All appraised organizations in the MPS model, being software development houses or organisations with organic software business units, are in the scope of iMPS trials. Most organizations, however, are software development houses. Besides that, although all organizations with a valid appraisal at the time each survey is conducted are invited to participate, the participation is voluntary, as sensitive data is provided by the organizations involved. Moreover, we only consider in the survey those organizations with valid answers in the years comprised in the analyses. For instance, for the iMPS results discussed in this paper (2009, 2010 and 2011) we only considered organizations that provided valid information at least in years 2008/2009, 2009/2010 and 2010/2011, respectively.

The confidence level for each indicator was calculated considering the population as the total number of valid questionnaires for each group and the sample the number of valid answers for each question. The purpose of this confidence level is trying to show how much the behavior described by the indicator may represent the behavior of the specific group under study. All indicators are presented in the iMPS reports although we consider as valid only those with confidence level higher than 85%. Nonetheless we consider the results meaningful to the SPI community.

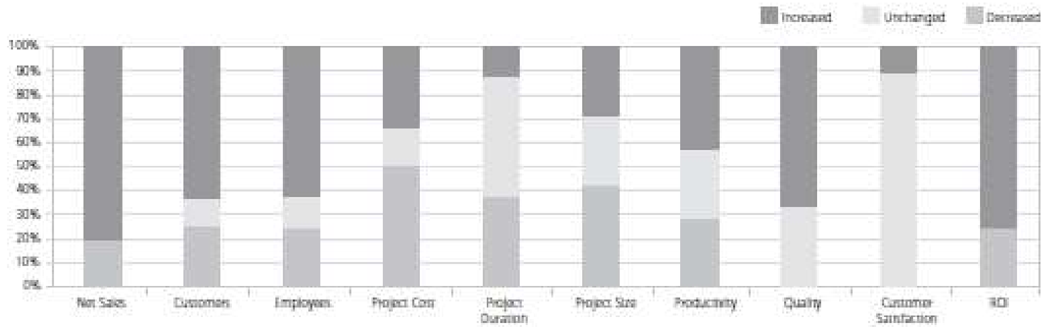
Over the years the iMPS project have collected and aggregated more and more explicit information regarding the benefits the MPS model adoption can bring to the industry. At this point, it has been possible to observe that as organizations become more mature in MPS they also increase the number of customers, the number of projects, the number of employees, the size of projects and improve their estimation accuracy. In contrast, there was a slight increase in the project duration average that may be a consequence of the additional management effort to deal with all these positive changes.

Characterization and Performance Variation Analysis

In 2008, 123 questionnaires from different organizations were analyzed (43 starting the MPS implementation, 19 in assessment process, and 61 assessed in one of the MPS Model levels). Customer satisfaction has been reported higher for organizations that adopted the MPS Model. For organizations starting the MPS implementation, 68.4% reported to have fully or largely satisfied customers. For organizations between levels E-A, customer satisfaction reaches more than 70%. Although we survey the organizations and not their customers and we do not know how customer satisfaction is perceived by or reported to each organization, we do not have means to doubt the informed values or that the perception is better than real. Organizations also were asked to characterize their overall satisfaction with the MPS Model according to the following options: Fully Satisfied, Partially Satisfied, Not Satisfied and Unknown satisfaction. A organization is considered satisfied if its answer is Fully Satisfied or Partially Satisfied.

42 organizations reported measuring the size of their projects in functions points (FP). For the organizations starting the implementation, the median of project size is 275 FP. The median for organizations in levels E-A is 475 FP. Productivity is higher for organizations that adopted the MPS Model, highest median was in the group of level E-A organizations. However, productivity should not be observed in isolation, since it may vary for different project types and different quality and cost expectations. Additionally, productivity calculation use base measures, which may be more reliable for organizations with maturity levels F or higher due to their need to institutionalize measurement process. The 2008 survey indicated that organizations that adopted the MPS showed greater customer satisfaction, greater productivity and capacity to develop larger projects, when compared to organizations that were starting the MPS Model adoption.

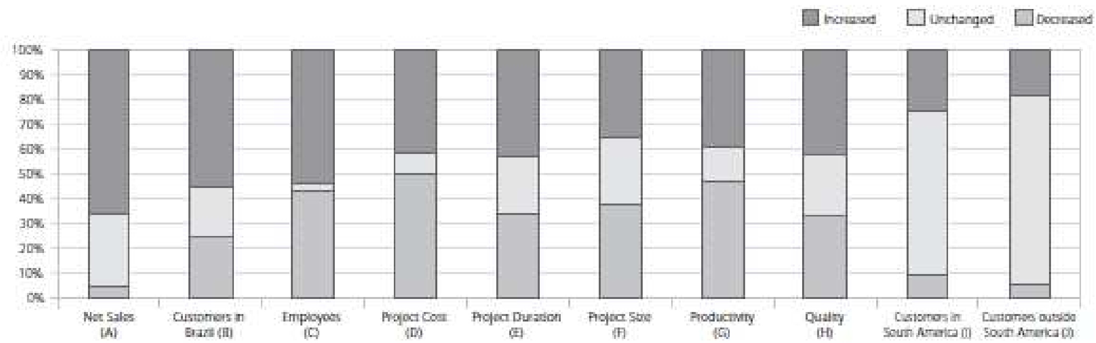
In 2009, 135 questionnaires were analyzed (20 starting the MPS implementation, 25 in assessment process, 57 assessed MPS level G, 26 assessed MPS level F, and 7 assessed MPS levels E-A). Customer satisfaction has been again reported higher for organizations that adopted the MPS Model. For organizations starting the MPS implementation, 50% reported to have fully or largely satisfied customers. For organizations between levels E-A, customer satisfaction reached more than 70%. Regarding software development project size, 44 organizations reported measuring the size of their projects in FP. For organizations starting the MPS Model adoption, the median of project size is 200 FP, while the median for organizations in levels E-A is 260 FP. Productivity were higher for organizations that adopted the MPS Model (the highest median was in the level G organizations). Moreover, organizations reported that the return on investment (ROI) was obtained and, for those organizations that have evolved or internalized the MPS in their processes, it was possible to observe improvement tendency regarding cost, project duration, productivity, and quality. To illustrate the performance variation analysis, Figure 1 shows the performance variation results of organizations that have increased or revalidated their MPS maturity level over the period. The main characteristic of these organizations, regardless of the level in which they were assessed, refers to MPS adoption and continuity in developing software following the model's guidelines. According to the data provided by the organizations, the indicators show consistent behavior with the assumptions regarding the use of software development processes combined with good software engineering practices. For instance, we can observe a tendency of cost and duration reduction and an increase of quality and productivity. We believe that this combination of events may be influencing positively the other indicators for these organizations, related to the increase of net sales, number of customers, employees, customer satisfaction, and ROI. Figure 1 (and also Figure 2 and Figure 3) shows the number of valid answers and the confidence levels associated to each indicator. The number of valid answers varies because no item in the questionnaire is mandatory.



Indicator	A	B	C	D	E	F	G	H	I	J
Valid Answers	5	8	8	6	8	7	7	3	9	4
Conf. Level(%)	70.2	88.2	88.2	76.4	88.2	82.2	82.2	52.3	100	62.7

Figure 1. iMPS 2009 Results: Performance Variation of Organizations that adopted the MPS and increased/revalidated their maturity level

In 2010, 156 questionnaires were analyzed (23 starting the MPS implementation, 11 in assessment process, 79 assessed MPS level G, 36 assessed MPS level F, and 7 assessed MPS levels E-A). Customer satisfaction has been reported higher for organizations that adopted the MPS Model. For organizations starting the MPS implementation, 62.5% reported to have fully or largely satisfied customers. Customer satisfaction of organizations between levels E-A reached more than 85%. Regarding software development project size, 50 organizations reported measuring the size of their projects in functions points (FP). For those organizations starting the implementation, the median of project size was 45 FP, while the median for organizations in levels E-A was 215 FP. There is a positive correlation between the median of project size and MPS level increasing. Productivity was higher for organizations that adopted the MPS Model. The highest median was in the level F organizations. The characterization allowed to observe that organizations that adopted the MPS have higher customer satisfaction, handle larger projects, are more accurate in their schedule estimates, and are more productive, when compared to organizations that are starting the MPS Model implementation. As in the previous performance variation analysis, the calculation of the indicators used the concept of correlation and the data was treated without comparing different organizations. Thus, to observe the evolution of the indicators in relation to the different moments related to the MPS deployment (starting the implementation, assessment and periodic follow-up), the correlation between the questionnaire submission date and each of the indicators (e.g., number of employees, number of customers, among others) was used. Note that the questionnaires are submitted to organizations in 3 different moments. Therefore, the analysis considered the increase (positive correlation), stabilization (zero correlation) or decrease (negative correlation) of each organization's indicators with the evolution of these moments. That way, we identified the percentage of organizations whose indicators showed increase, stabilization or reduction trends (Figure 2).



Indicator	A	B	C	D	E	F	G	H	I	J
Valid Answers	39	40	39	22	38	26	23	12	21	17
Confidence Level (%)	95.7	96.6	95.7	85.3	95.0	87.9	86.0	75.6	84.6	81.3

Figure 2. iMPS 2010 Results: Performance Variation of 42 Organizations with the Evolution of their MPS Deployment Initiatives

It is important to note that the measured effects are related with each SPI initiative carried through each organization but not necessarily caused solely by it since confounding factors may exist. Those confounding factors like the influence of the adoption of other maturity models and process reference model or the accuracy of software development project duration estimative are discussed in details in Travassos & Kalinowski (2010) (the same applies to other iMPS surveys).

The performance variation analysis allowed to identify that organizations tend to obtain the expected benefits of applying software engineering principles to their development efforts, regarding cost, schedule, quality and productivity. Table 2 presents the observed behaviors, marking in gray the indicators that showed similar behaviors to the observation hypotheses.

In 2011, 133 questionnaires were analyzed (8 starting the MPS implementation, 32 in assessment process, 49 assessed MPS level G, 28 assessed MPS level F, and 16 assessed MPS levels E-A). Regarding software development project size, 46 organizations reported the use of functions points (FP) metric. For those organizations in assessment process, project size median was 225 FP, while the median for organizations in levels E-A was 268.5 FP.

Indicator	Expected Behavior	Observed Behavior
Variation in Net Sales	↑	↑
Number of Customers in Brazil	↑	↑
Number of Employees	↑	↑
Average Project Cost	↓	↓
Average Project Duration	↓	↑
Average Project Size	↔	↓
Productivity	↑	↓
Quality	↑	↑

Table 2. iMPS 2010 Results: Expected and Observed Behavior of 42 Organizations with the Evolution of their MPS Deployment Initiatives

Once more, there was a positive correlation between the project size median and the MPS level increasing. Productivity was higher for organizations that adopted the MPS Model. The highest median was again in the level F organizations. The characterization has observed positive correlations between the maturity of organizations in the MPS Model and the number of projects (both in Brazil and abroad). In fact, higher maturity organizations deal with larger software development projects. Such organizations also showed higher estimation accuracy and higher productivity. Regarding the performance variation analysis, we were able to observe that organizations that continuously use the software engineering best practices depicted in the MPS maturity levels have more customers, have more software development projects, have a greater number of employees, deal with larger projects and also show higher estimation accuracy (despite a slight increase of projects' average duration). Figure 3 presents the performance variation of the 53 organizations that adopted the MPS and provided periodic information in 2010 and 2011.

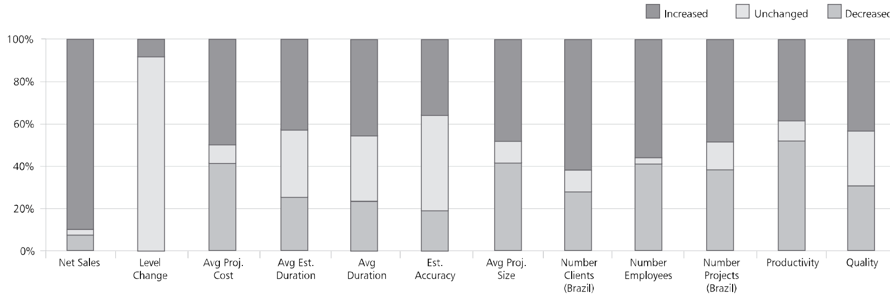


Figure 2. iMPS 2011 Results: Performance Variation of 42 Organizations with the Evolution of their MPS Deployment Initiatives

Organizations reported to have an increase on net sales, number of customers in Brazil, number of software development projects in Brazil, and number of employees. In addition, the indicators such as average project cost, average duration, and average size, indicate a slightly positive disassociation between cost, time and size when observed together. In other words, bigger projects do not necessarily lead to higher project duration or cost, what is consistent with the benefits of controlling and organizing the software process. Overall, after four iMPS project trials, we were able to observe that despite the variation and limitations of the type iMPS research, collected data support an indication of a positive trend towards the MPS model benefits and acceptance as a way to improve software development within companies.

The iMPS 2012 (Travassos & Kalinowski, 2013) and 2013 (Travassos & Kalinowski, 2014) surveys were answered by 132 and 148 companies, respectively, involved with the MPS model for Software (MR-MPS-SW). Satisfaction with the MPS model remains high (> 95%). The characterization showed similar behavior to previous results, reinforcing the indication that higher maturity levels tend to have better performance regarding productivity, quality and estimation accuracy. For example, organizations were asked to report the number of defects per unit of project size as a measure of quality. In 2012, again the most used unit was function points (25 organizations). Considering these definitions, the quality increase (fewer defects) was positively correlated with the MPS-SW maturity level increase (+0.87). Figure 4 shows the average number of defects per function point for each group in the study.

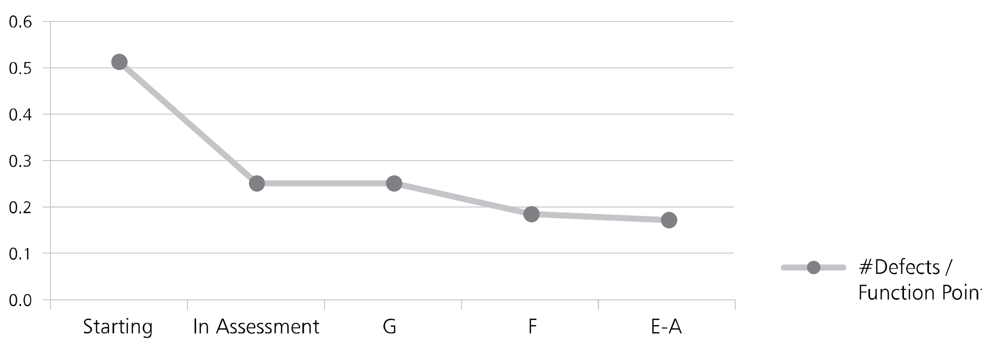


Figure 3. Median Number of Defects per Function Point (Travassos & Kalinowski, 2013)

Lessons Learned

During the last years we have collected best practices and lessons learned regarding key aspects of the MPS.BR Program and the interaction of University, Industry and Government in this context. The following subsections depict some of those lessons learned and best practices. Former publications, such as (Santos et al, 2012 & Rocha & Weber, 2008), also contain discussion on lessons learned and MPS.BR benefits due to the enduring University – Industry – Government alliance. In this paper we summarize the most important ones and also present more information acquired along the years and deeper discussion.

Adapting International Best Practices to Local Reality and Necessities

Along the years the MR-MPS-SW has been extended and improved aiming to address software engineering best practices we believe are appropriate to Brazilians SMEs. Due to that a set of actions undertaken to improve the Reference Model (MR-MPS-SW), which include: (i) maintain the consistency with the evolution of CMMI-DEV and new parts of ISO/IEC 15504; (ii) provide better process profile to support companies' software processes, including the definition of processes not present on CMMI-DEV but defined on ISO/IEC 12207 such as Reuse Management, Development for Reuse, Human Resources Management, and Project Portfolio Management; (iii) define different assessment profiles to address organizations only acquiring software development or coding software or working as testing factories.

As any process model, MR-MPS-SW does not prescribe any specific development methodology, framework or practice (such as Scrum, Lean, RUP, TDD, PMBOK, Six Sigma, kanban etc.). In fact it is quite common that organizations, especially small enterprises, utilize agile methods/practices such as Scrum, kanban or continuous integration tools, as a way of combining the rigorousness of a maturity model and their needs to provide better products in short time and consuming fewer resources. It is also worthy notice that Softex supports the adoption of multiple models along with MR-MPS-SW such as CMMI-DEV (see Rocha et al (2009)), ISO/IEC 29110 (ISO/IEC, 2011) or MoProSoft (Oktaba, 2006).

The adaptation of ISO/IEC 15504 and ISO/IEC 12207 profiles and reference model is important to build a body of knowledge on how Brazilian companies deal with SPI initiatives. It allowed us to shape the MPS requirements both to their needs and software engineering best practices, also to somehow align the *state of practice* to the *state of art*. In the business perspective the MPS.BR Business Model (MN-MPS, described as follows) allows Softex to act proactively to promote MR-MPS-SW adoption, grant money to foster SPI adoption in SMEs, and create a community of SPI practitioners, assessors and consultants throughout the country. In a strategic perspective the set of undertaken actions to manage the MPS.BR program allowed to forge formal and informal alliances among the Government, Industry and University that are responsible to its success

The Business Model and the Success of MPS.BR Program

A Business Model, consistent with the necessities of a comprehensive program such as the MPS.BR, is necessary to guarantee its survival and long-term management (Rocha & Weber, 2008). Therefore, the business model has a very important role in the management of the MPS.BR program, describing all the business rules. It comprises two types of SPI business models according to organization specific needs and availability of resources: (i) a Specific Business Model (MNE, from the acronym in Portuguese "Modelo de Negócio Específico") suitable to large companies which do not want to share MPS model-based SPI services and costs with other companies; and (ii) a Cooperative Business Model (MNC, from the acronym in Portuguese "Modelo de Negócio Cooperado") for groups of SME interested in implementing and assessing the MPS model, and sharing MPS services and costs, for instance, training activities. The Cooperative Business Model is especially attractive to small and medium enterprises, because the implementation based on this model is feasible of obtaining external resources intermediated by Softex to support SPI implementation and assessment activities.

In the Specific Business Model for one enterprise (MNE), each interested enterprise in the implementation of the MPS model negotiates and signs a specific agreement with an accredited Implementation Institution (II). In order to be assessed on MPS model, an organization negotiates and signs a specific agreement with an accredited Assessment Institution (IA).

In the Cooperative Business Model in Group of Enterprises (MNC), the first step is the constitution of a group of organizations committed with the implementation and the assessment of the MPS Model, which can formed, for instance, due to a Softex Agent initiative. When appropriate, Softex signs an agreement with an Organizing Institution of Groups of Enterprises (IOGE) for each group of enterprises. From this constitution, the coordination of the group of enterprises will negotiate and sign a contract with an accredited Implementation Institution (II). In a posterior phase, after implementation, the IOGE negotiates and signs an agreement with one or more accredited IA – observing that the Assessment Institution (IA) can be neither the same institution that implemented the reference model MR-MPS-SW in the enterprises, nor the institution that organized the group of enterprises.

Sustainability of the MPS.BR Program

Besides providing results, a program such as MPS.BR has to be sustainable in different aspects. So, among the success factors in the management of the program, we can highlight its achieved results, the assets built and also the aggregated value by MPS.BR and its operational, financial and institutional sustainability. MPS.BR program sustainability is achieved through its coordination by Softex which comprises actions necessary to the planning, execution, verification and corrections of the program, including those related to political, institutional, operational, technical and financial aspects.

We can consider that one of the critical success factors of the MPS.BR until now has been the support given to Groups of Enterprises through accredited IOGE. In the MNC model, there is a division of implementation and assessment expenses between the financial agent (up to 40% of the reference cost for each enterprise) and the IOGE through the capture of resources (notice that at least 30% of the budget must come from each enterprise involved). At first, enterprises without official assessments interested in the Levels G and F had priority. Later, aiming to increase the dissemination of the model and also to guarantee that the assessed enterprises continue in the quest for quality, the financial support was expanded to also consider enterprises interested in Levels E, D and C implementation and assessment. Now this support is also expanded to consider organizations interested in Levels B and A.

The dissemination and deployment support of software engineering best practices adherent to international standards in the Brazilian software and services industry is carried through MPS model implementations and assessments in organizations, organizations' practitioners training in MPS model practices and software process improvement consultants training and accreditation of professionals. Therefore, the MPS.BR Program stimulates not only software engineering best practices adoption in the software development process but also in the acquisition processes for software and correlated services, always in conformance with the state of art and applicable international quality standards.

Conclusion

As many other countries (Hawk & McHenry, 2005. Chudnovsky & López, 2005; Ania & Mejía, 2007; Nicholson & Sahay, 2009), Brazil has established strategies to increase the competitiveness of its software industry for the domestic and international market. One of these strategies is a national-wide long-term software process improvement program called MPS. This paper presented main results achieved by MPS Program in the last 10 years. The development of the MPS reference model aligned to the Brazilian Government strategic goals and the participation of Universities has brought real benefits to the Brazilian software Industry. This fact is supported by the constant increase of organizations using the MPS model to guide their efforts to improve software processes. Quantitative data have shown that companies are improving their software development processes in terms of cost reduction, schedule and increase of quality. The next steps includes the development of new models, such as the reference model for services (MR-MPS-SV) and human resources management (MR-MPS-RH), focusing IT companies, and the expansion to other countries through the RELAIS (Latin America Software Industry Network) project (by now 6 organizations have been appraised in Colombia, Uruguay and Argentina).

The results and benefits presented in this paper can be useful to practitioners and decision makers in Government, University, and Industry interested in software process improvement and software industry competitiveness. In addition, the benefits reached by organizations after adopting the MPS model can motivate new organizations to adopt it and also can motivate the ones already engaged in software process improvement initiatives based on the MPS model to continue their efforts on improving their software projects quality.

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