

Software Process Improvement in Brazil: Evolving the MPS Model and Consolidating the MPS.BR Program

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Abstract. The main objective of the MPS.BR program is to develop and disseminate a software process model aiming to improve the software processes of Brazilian organizations in a fair period within reasonable costs. This paper focuses on the MPS model evolution and on the actions to consolidate the MPS.BR program achievements. We also present the most relevant results of this period along with the assets produced and data about performance results.

Keywords: Software Process Improvement, Software Reference Model, Process Assessment Model, Software Quality.

1 Introduction

The main goal of the MPS.BR program (from the acronym in Portuguese “Melhoria de Processo do Software Brasileiro”) is to develop and disseminate a software process model (the MPS model) aiming to establish an economically viable pathway for Brazilian organizations, including Small and Medium Enterprises (SME), to achieve the benefits of software process improvement and the utilization of good software engineering practices in a fair period within reasonable costs all over the country. Although the focus of the initiative is the SMEs, the model is also adequate to support process improvement in large enterprises. In the long-term planning, the MPS.BR program is aligned to the Association for Promoting the Brazilian Software Excellence (SOFTEX) objective of development of the Brazilian software market and the sustainable increase of the Brazilian Software and Services Industry competitiveness.

In the Implantation Phase of the MPS.BR program (2004-2007), three challenges were coped with: technical-scientific, of market and managerial. Due to the technical-scientific challenge, we identified that, in order to guarantee its relevance and sustainability for the effective improvement of software processes in Brazil, it would

be necessary to incorporate both internationally recognized practices for the implementation and assessment of software engineering processes, and the necessities of the business of the Brazilian software industry. The Reference Model MR-MPS [1] and the Assessment Method MA-MPS [2] were, then, defined based on the international standards ISO/IEC 12207 and its amendments [3-5] and ISO/IEC 15504 [6] and, due to the importance to Brazilian organizations that operate in international markets, compatible with the CMMI maturity model [7]. In 2009, necessary adjustments were done to conform the model to the ISO/IEC 12207:2008 [8]. In order to meet the market challenge, the Business Model MN-MPS was created and improved aiming to disseminate the MPS model in Brazil, at reasonable costs to SMEs. Concerning the managerial challenge, the MPS.BR program was nationally structured under the coordination of SOFTEX, which is responsible to administrate the program and control the execution of the activities.

In its present phase the MPS.BR program, named Consolidation Phase (2008-2011), maintains the same major original challenges: consolidation of the structure of the MPS.BR program and improvement of the MPS model; and dissemination of the MPS model in Brazil. This paper presents the results already achieved of the current MPS.BR program phase related to its three challenges (technical-scientific, of market and managerial) along with the evolution of the MPS model that cope with these challenges. We also present the MPS.BR program accomplished results. Section 2 describes the evolutions of the MPS model and its components. The results already accomplished by the program Consolidation Phase are presented in Section 3. Finally, section 4 contains our final considerations.

2 MPS Model

The MPS model is constituted of three main components: the MPS Reference Model (MR-MPS, from the acronym in Portuguese “Modelo de Referência para Melhoria de Processo de Software”); the MPS Assessment Method (MA-MPS, from the acronym in Portuguese “Método de Avaliação para Melhoria de Processo de Software”); and the MPS Business Model (MN-MPS, from the acronym in Portuguese “Modelo de Negócio para Melhoria de Processo de Software”). These components were established during the program Implantation Phase and are continually evolving due to the experiences gained through the years. The evolution of each component is described in the following subsections.

2.1 Evolving the MPS Reference Model (MR-MPS)

The MPS Reference Model (MR-MPS) is documented in the form of three guides (available at www.softex.br/mpsbr): the MPS General Guide, the MPS Acquisition Guide, and the MPS Implementation Guide. The MPS General Guide provides a general definition of the MPS model and common definitions to all other guides. The MPS Acquisition Guide describes an acquisition process for software and related services. The MPS Implementation Guide provides technical guidance for

implementing the MR-MPS and describes theoretic concepts that fundaments the processes defined in the MR-MPS maturity levels. Moreover, it contains detailed information on implementing MR-MPS process outcomes. This guide establishes the means to uniform Software Engineering knowledge among Software Process Improvement (SPI) practitioners and to reduce the risk of misunderstanding implementation issues essential for successfully satisfying MR-MPS processes outcomes. ISO/IEC 12207 [8] and ISO/IEC 15504 [6] were used as the technical base for defining the MPS model components. Considering the importance of CMMI [7] for Brazilian organizations that operate in international markets, it was also considered as a complementary technical base element for the MPS model processes definition. The MPS General Guide also provides a definition of scope and composition of MR-MPS process profiles for a declared level of organizational maturity level. The MR-MPS maturity levels are defined in two dimensions: process capabilities dimension and process dimension (as shown in Table 1).

Table 1. MR-MPS maturity levels (ML), processes and process attributes (PA)

ML	Processes	PA
A	<i>(no new processes are added)</i>	1.1, 2.1, 2.2, 3.1, 3.2, 4.1*, 4.2*, 5.1*, 5.2*
B	Project Management <i>(new outcomes)</i>	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 <i>(new outcomes)</i> , 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 PAs are applicable only to selected processes. The others PAs must be applied to all processes.*

The MR-MPS process capabilities dimension is constituted of a measurement framework for the assessment of process capability based on the processes defined in the MR-MPS processes dimension. The measure of capability is based upon a set of process attributes (PA). Each attribute defines a particular aspect of process capability. The MR-MPS process attributes are based on the ISO/IEC 15504-2 process attributes used to define capability levels. The MR-MPS defines nine PA: PA 1.1 (process performance attribute); PA 2.1 (performance management attribute); PA 2.2 (work product management attribute); PA 3.1 (process definition attribute); PA 3.2 (process deployment attribute); PA 4.1 (process measurement attribute); PA 4.2 (process control attribute); PA 5.1 (process innovation attribute); and PA 5.2 (process optimization attribute). Each PA comprises a set of Process Attribute achievement Result (PAR) used to evaluate a specific PA implementation.

The MR-MPS process dimension is constituted of the processes to be assessed. The MR-MPS process dimension describes seven sequential and accumulative groups of processes that correspond to the MR-MPS maturity levels. The level G is the most immature level and level A is the most mature one. The MR-MPS maturity levels (ML) process profiles were defined accordingly to specific business needs of Brazilian software industry. The most relevant need was to make the benefits of SPI initiatives visible in a short time frame at reasonable training, implementation and assessment costs.

A new version of the MR-MPS was defined in 2009 based on the improvements identified in the last two year. The most relevant improvements are:

- Revision of PAs to improve the adherence to ISO/IEC 15504-2 [6];
- Change of the name of the process Decision Analysis and Resolution process to Decision Management, as defined in ISO/IEC 12207 [8];
- Transformation of all Causal Analysis and Resolution process outcomes into a set of Process Attribute achievement Result (PAR) related to PA 5.1 in order to increase the compatibility to ISO/IEC 15504-2 [6] because there is no such process in ISO/IEC 12207 [8];
- Definition of a new Project Portfolio Management process in the MR-MPS Level F to guarantee that companies analyze their project portfolios to initiate and sustain necessary, sufficient, and suitable projects in order to meet the strategic objectives of the organization;
- MPS Implementation Guide review to improve the understanding of the outcomes described in the MPS General Guide and to clarify what is a suggestion and what is mandatory in MA-MPS assessments;
- Review of MPS Implementation and Acquisition Guides due to comments and experiences collected from MPS assessors and MPS model implementation consultants during the last two years in order to facilitate the MPS model interpretation and, last but not least, to make the model more suitable to the organization reality.

2.2 Evolving the MPS Assessment Model (MA-MPS)

The purpose of process assessment is to determine the extent to which the software processes contribute to the achievement of organizational business goals and to help it focus on the need for continuous software process improvement. According to ISO/IEC 15504-2, an assessment should be carried out against a defined assessment input using conformant Process Assessment Model(s) related to one or more conformant or compliant Process Reference Model(s). In order to satisfy ISO/IEC 15504-2 requirements for a Process Assessment Model, the MPS Technical Model Team (ETM, from the acronym in Portuguese “Equipe Técnica do Modelo MPS”) defined the MPS Assessment Method (MA-MPS) which is documented in the MPS Assessment Guide (available at www.softex.br/mpsbr). This guide also describes the assessment process defined to support the application of the MA-MPS and the requirements for accreditation of: Organizations to provide MPS assessments services (MPS Assessment Institutions a.k.a. IA from the acronym in Portuguese “Instituições

Avaliadoras”); MPS Competent Assessors; and MPS Provisional Assessors (assessors that support competent assessors during assessments). The objective of the assessment method MA-MPS described in the MPS Assessment Guide is to verify the maturity of an organization unit in the execution of its software processes. All MA-MPS assessments are audited to increase their credibility and are valid for only three years. There are three levels of MA-MPS assessors: initial, intermediate or experienced competent assessor. The initial assessor can only lead Level G or F assessments, intermediate assessors can lead assessment through Level C, and only experienced competent assessors are allowed to conduct high maturity assessments (i.e., Level B or A assessments).

A new version of the MA-MPS was defined in 2009 based on the improvements identified in the last two year. The most relevant improvements are:

- Review of MPS Assessment Guide due to comments and experiences collected from MPS assessors and MPS model implementation consultants during the last two years in order to facilitate the MPS model interpretation and, last but not least, to make the model more suitable to the organization reality;
- MA-MPS rules to characterize the MR-MPS Maturity Level G were reviewed to reflect ISO/IEC 15504-2 [6] requirements that says that PA 1.1 must be considered Totally Implemented.

2.3 Evolving the MPS Business Model (MN-MPS)

In order to guarantee the success of the MPS model, it is essential that the organizations can effectively adopt it and obtain benefits of implementing software process improvement. In this way, the component denominated MN-MPS, as shown in Fig. 1, was developed to support MPS model adoption and dissemination.

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.

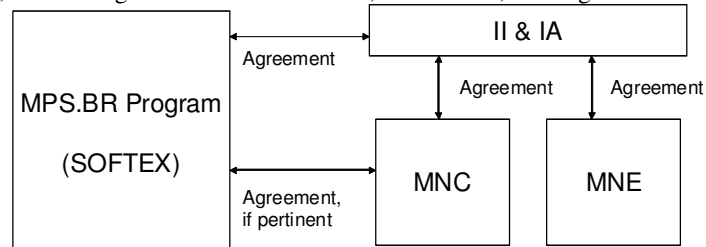


Fig. 1. Business Model for Software Process Improvement (MN-MPS)

Three domains can be observed: the domain of the MPS.BR program, coordinated by the SOFTEX; the domain of the MPS Implementation Institutions (II from the acronym in Portuguese “Instituições Implementadoras”) and MPS Assessment Institutions (IA); and the domain of the enterprises that adopted the MPS model and the Organizing Institution of Groups of Enterprises (IOGE from the acronym in Portuguese “Instituições Organizadoras de Grupos de Empresas”).

The MN-MPS had just minor adjustments, which indicates its feasibility and soundness. Moreover, the MPS.BR Program Team works hard to improve the commitment of all MN-MPS participants to foster continually the success of the program. Thus, a parallel can be done between the business model MN-MPS and the triangle of services [9], that highlights the relation among the Enterprise, the Client and the Colaborators of the Front Line, as it can be seen in the Fig. 2. The Enterprise is represented by the MPS.BR program itself. In the front line, i.e., in direct contact with the clients, are the IIs, IAs, IOGEs and Instructors of the official courses. These entities and persons are responsible for great part of the image that the clients have about the MPS model and they share the same responsibilities for the success of the project. Generally, in the relation described in the business model MN-MPS we can highlight the search for balance and synergy among the involved parties. It is also the objective to guarantee that the relationship cycle be fed constantly in the search for a win-win relation, aiming the continuity and improvement of the MPS model.

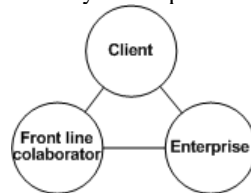


Fig. 2. Triangle of Services [9]

3 MPS.BR Program

In order to manage the MPS.BR program, an organizational structure was defined. The MPS.BR program structure units are: (i) MPS.BR Program Team: responsible to manage the program activities; (ii) MPS Technical Model Team: responsible to develop and maintain the MPS model, and to prepare and execute MPS model trainings; and (iii) MPS Accreditation Forum: responsible to accredit organizations to provide MPS model-based implementation and assessments 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.

The MPS.BR program objective is to improve the software processes of the Brazilian companies. Therefore, two long-term goals were defined:

- The technical goal aims to create and improve the MPS model by providing: (i) the MPS Guides; (ii) courses, exams and workshops; (iii) Implementation Institutions (II) accredited to support the implementation of the MR-MPS; (iv)

Assessment Institutions (IA) accredited to assess organizations using the MA-MPS; and (v) MPS Acquisition Consultants (CA from the acronym in Portuguese “Consultores de Aquisição”) certified to support the acquisition of software and related services.

- The market goal aims to disseminate and promote the adoption of MPS model in a fair period within reasonable costs all over the country by: (i) creating and improving the MN-MPS; (ii) supporting the use of the MR-MPS by a large number of Brazilian practitioners and organizations; and (iii) promoting the MA-MPS assessment of a large number of Brazilian organizations.

3.1 Consolidation Phase of the MPS.BR Program

In its present phase, the program basically maintains the same major original challenges of the MPS.BR:

- Consolidation of the structure of the MPS.BR program and improvement of the MPS model, with four goals in the period 2008-2011: (i) consolidation of the MPS.BR program structure; (ii) MPS model improvement; (iii) accreditation of Implementation Institutions (II) and Assessment Institutions (IA); (iv) analysis of MPS.BR Lessons Learned [10] and Performance Results [11].
- Dissemination of the MPS model in Brazil, with four goals in the period 2008-2011: (i) training in the MPS model: courses, exams and workshops; (ii) support to groups of enterprises for MPS based implementation and assessment in the levels G and F (base of the pyramid), under agreement with the IOGEs; (iii) support to groups of enterprises for MPS based implementation and assessment in the levels E, D and C (middle of the pyramid), under agreement with the IOGEs; (iv) dissemination of the MPS software acquisition process.

In order to accomplish the goals it is important to manage efficiently all the actions needed. Due to that, was defined an approach based on the PDCA cycle (Plan-Do-Check-Act) [12]. In this quality improvement approach, from the planning of the goals and objectives to be accomplished in a specific period, predicted activities are executed followed by periodic monitoring activities aiming to assess the project performance and actions are elaborated in the sense of improving the execution of the activities. For the MPS.BR program there are two types of planning: a long-term and other short-term. The short-term comprehends the activities to be executed in a period of one year aiming to achieve two goals: (i) development and improvement of the MPS.BR program and the MPS model and (ii) implementation and assessment of the MPS model in the enterprises. Every year, at the end of the first semester the annual planning execution is verified and at the end of the second semester is done a critical analysis considering the achieved results and the planning for the next year is approved. This annual planning is in concordance with the long-term planning that comprehends a period of 4 years and defines the components/activities using the methodology of the Logical Framework Approach (LFA). In the long-term planning, the goals are defined aiming to be accomplished in the period, it is highlighted the alignment of the MPS.BR program with the SOFTEX objective of development of the

market and sustainable increase of the competitiveness of the Brazilian Software and Services Industry and, also, are described the actions that should be executed aiming to achieve the success of the program.

3.2 Results Accomplished of the MPS.BR Program

One criterion for evaluating the success of standards and models is to identify the degree of acceptance and usage by their target community [13]. In this context, a specific goal was established in the context of the MPS.BR program addressing MPS model adoption and dissemination across the country. This goal is two fold: (i) to train people and accredit institutions to provide MPS model-based implementation and assessment services in different cities of the country; and (ii) to support adoption of MPS model by a large number of organizations.

In order to train people and accredit institutions to provide MPS model-based services, a strategy, constituted of official courses and exams, was defined and is being executed to establish and maintain a community of MPS model practitioners. Until June 2009, 3,600 people attended MPS model courses in different cities of Brazil and 1,120 people were successfully approved in MPS model exams.

Another important aspect to guarantee the adoption of the MPS model is to accredit institutions in different parts of the country to provide MPS model-based services: 19 IIs are accredited to provide MPS model-based implementation services, and 11 IAs are accredited to provide MPS model-based assessment services. Moreover, 133 MPS model implementation consultants are associated to accredited II effectively working in MPS model-based initiatives and 58 competent and provisional assessors are associated to accredited IA with conditions to conduct MPS model-based assessments.

So far, 158 organizations (106 MPS-G, 40 MPS-F, 5 MPS-E, 1 MPS-D, 1 MPS-C, 0 MPS-B, and 5 MPS-A) had gone through successful MPS model-based assessments all over the country. Most of those organizations are SMEs but there are also big companies and government organizations such as Brazilian Navy and Brazilian Air Force units, and Bank of Brazil. All the MPS assessment results are published on the SOFTEX Web site (www.softex.br/mpsbr). The MPS and CMMI assessments, in the correspondent maturity levels, both are recognized by Brazilian private and governmental organizations as a way of demonstrating organizations' process quality.

In order to support adoption of MPS model by a large number of organizations, the SOFTEX organizes groups of organizations, under agreement with the IOGEs, according to the MPS Cooperative Business Model (MNC-MPS) for SMEs interested in implementing and assessing the MPS model, and sharing MPS services and costs. Sponsors such as IDB (Inter-American Development Bank), MCT (Brazilian Ministry of Science and Technology) and SEBRAE (Brazilian Service to Support Micro and Small Enterprises) provided 40% to 50% of the overall MPS model based implementation and assessment costs of those groups. The implementation of MPS model according to the MNC-MPS has been recognized by SMEs as an important pathway to achieve process improvements benefits at reasonable costs.

3.3 Performance Results

In order to understand the performance variation of organizations due to the adoption of the MPS model the iMPS survey was created. The results of the first phase of the study concluded in August 2008 [11], based on 123 valid questionnaires, indicate that organizations that adopted the MPS model presented higher user satisfaction degree, higher productivity and capacity to develop large projects. Additionally, more than 80% of the organizations declared to be satisfied with the MPS model.

As noted in Fig. 3, organizations are more satisfied with the MPS model as they evolve their SPI initiatives. We believe that behavior is related to the MPS model viability and its capability to support the development of better software products in large scale. As shown in Fig. 4, an important issue to support the dissemination of the MPS model is related to the return on investment (ROI). 30 organizations have provided information about their ROI: 28 have already had a return on their investment due to the MPS implementation and assessment, 20 of those organizations reported more than 100% return over the original investment. We believe these results are possible due to the improvement of their productive capability and to new projects and partnerships accomplished due to the credibility of their assessments. Moreover, a new iMPS survey is being executed and its results will be presented in October 2009.

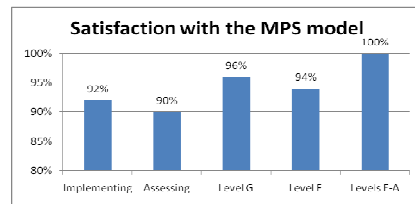


Fig. 3. Performance Results – Satisfaction with the MPS model

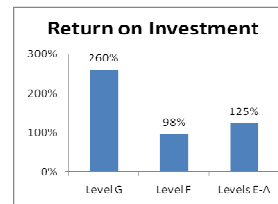


Fig. 4. Performance Results – Return on Investment (ROI)

4 Conclusion

Concerning the MPS.BR program, we come to the following conclusions: (i) until the present moment, the program sustainability was guaranteed and the achieved results were excellent, outperforming the expected results; (ii) it is a big business in the Brazilian software industry, with a strong interaction University-Enterprise-Government; (iii) the MPS.BR is a long-term program; (iv) the MPS.BR is a mobilizer program; (v) it is a great effort for nationally increasing the capacities (of persons, institutions and organizations interested in the MPS model) to continually improve the software processes in the enterprises and the capacity of innovation both in local and global markets. Moreover, due to the initial iMPS results, we can confirm the MPS.BR program importance to Brazilian software organizations.

Moreover, we had the following relevant results concerning the MPS model evolution: (i) the improvement of the MPS model is done in conformance to international standards, compatibility with the CMMI, based on the best software

engineering practices, and adequate to the reality of Brazilian enterprises; (ii) stimulus to the adoption of best software engineering practices by the enterprises of the industry not only in their development and maintenance processes, but also in the software and related services acquisition process, in conformance with the state of the art and applicable international quality standards. Moreover, three new MPS Implementation guides will be created in 2009 to describe how to implement the MPS model on organizations that acquire software, on Code Factory organizations and on Test Factory organizations.

In this way, the challenge of the next years is continue the consolidation of the MPS.BR program organizational structure aiming to maintain its institutional, operational and financial sustainability, and also the continuous increasing of the Brazilian software industry competitiveness both in local and global markets.

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