Intersection of MPS.BR-E and SPICE Models Focused on Projects for the Automotive Industry

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***Abstract*—The quality of software is an area of software engineering, which aims to ensure a satisfactory performance in the development of the final product through processes. With the need for better structured processes, models were instituted to steer organizations in their processes, however the adopted models may differ from company to company, in some cases companies become partners, or are suppliers of other, or no merger of companies, so it is important to understand the relationship between the models. This paper presents the intersection of MPS.BR (*Melhoria de Processo do Software Brasileiro*- Brazilian Software Process Improvement) and Automotive SPICE (Software Process Improvement and Capability dEtermination), in addition it relates the processes of a company that adheres to the Brazilian quality model, with automotive reference model. This paper provides a solution for two companies, with different reference models, to work together.**

Keywords- ***Automotive SPICE; MPS.BR; Software Quality.***

I. INTRODUCTION

With the software market on the rise, it was necessary that fashion models processes were established to provide products with higher quality. Today there are various types of process models and a company must analyze and choose a model that will help it increase the quality of its products through changes in their processes.

Process models are not just about the certifications. Their benefits go far beyond that, the institution of international production standards allows higher visibility and gains improving productivity of the company, as it reduces the time and investment used in the projects. However it is important to take note that these results come only upon the maturity of the new companies with the established processes.

Many Original Equipment Manufacturers (OEMs) in the automotive sector has factories in several countries in the world, and many of them have adopted the Automotive SPICE for the development of their products. These industries can hire local suppliers to help them, but need to keep the same instituted quality standards.

In Brazil there is a reference model called MPS.BR. The MPS.BR has seven maturity levels [1]. This model is adopted mainly by small and medium enterprises, and these are even beginning to institutionalize quality processes, and usually are lower maturity levels G, F and E. The company's case study was implementing the level and therefore this work was compared to the level E.

This work will address two types of process quality models, namely the MPS.BR and Automotive SPICE, which is a branch of ISO / IEC 15504 (SPICE). The MPS.BR is a Brazilian model which has as its main objective, the process improvement, being aimed primarily at small and medium-sized businesses. SPICE is an international model itself and its main differential is the focus on improving the design process, not the company as a whole. Many automotive companies use SPICE and a specific aspect of this model was created for these companies, called SPICE Automotive [2].

Given this scenario, the objective is to carry out a study of the compatibility between models of software processes MPS.BR level E and Automotive SPICE acting as a facilitator for companies to see the potential in the Brazilian quality model, and to also show the potential of the Brazilian company to provide services to the automotive industry.

In Section 2 Theoretical Foundations will introduce all the theoretical basis for understanding the work that will be presented. Section 3 the intersection of Automotive SPICE models with MPS.BR and the company will be addressed. Results of analysis are exposed in Section 4. In Section 5 will focus on the approached conclusion of all work.

II. THEORETICAL FOUNDATIONS

Software quality is fundamental for both customers and suppliers, and process models, such as the MPS.BR and SPICE act as guides that assist in improving the software production processes, and thus a means of increasing the quality of the final product.

With the increasing need for more elaborate software, quality becomes an essential item. Pressman defines software quality as conformance to functional requirements and performance that have been explicitly declared, the development patterns clearly documented, and the implicit features that are expected of all software developed by professionals [1]. According to Fuggetta, to guarantee the quality of a software standardization of procedures should be proposed, namely to establish processes that can be defined as a coherent set of policies, organizational structures, technologies, procedures and artifacts needed to devise, develop, deploy and maintain a software product [3].

Due to the increasing demand for software with higher quality, there is a need for more efficient processes. Pressman defines processes as being the Foundation of software engineering allowing the rational and timely software development. He also claims that the software processes are the

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basis for the managerial control of software projects and establishes the content in which the technical methods are applied, the work products (documents, data models, reports, forms, etc.) are produced, the milestones are established, the quality is ensured and the modifications are properly managed [1]. Another definition of process is given by Wilson de Paula Filho, that describes a process as something that can be defined with more or less detail and that its stages may have a partial ordering, thus allowing the parallelism between them [4]. As an organization matures, its software processes become more defined and consistent across the organization as a whole [5]. The quality of software is related only to a quality of the product, not making connections the way it was produced, or if there is a process that assisted in the manufacture of the same. On the other hand, when one looks at the quality of a software process, we seek to identify the ability of a software process to produce a quality product [6].

However, it is important to notice that the mere existence of a software process does not guarantee that a quality product will be created. For the results to be achieved in a satisfactory manner, it is necessary that the processes are well defined and understood. The process adopted must be used in all projects of the Organization, being appropriate to the particular characteristics of each project [7].

The software process model is an abstract representation of the architecture, design or definition of the software processes [8]. This work focuses on two models of software processes, the MPS.BR and Automotive SPICE. These models provide a set of core activities to obtain a software within what was proposed, however they do not specify a possible life cycle or how to put into practice such activities, so it is up to the Organization to model the processes within your reality[7][9].

Software process models are usually divided into maturity levels, which can be defined as specific or generic practices related to a pre-defined set of processes that improve the overall performance of an organization [10].

From these definitions, it is possible to conclude that the software processes are fundamental in an organization and the implementation of the same provides benefits in various sectors, mainly in the quality of the developed software. However, the implementation of processes without well-defined methods is usually a chore, this leads to process models, which provide a set of policies, organizational structures, procedures, among other elements that assist in this task.

A. MPS.BR

The Brazilian Software Process Improvement also called MPS.BR, is an evaluation model of software development companies developed by SOFTEX in 2003 [11], in partnership with the Brazilian federal government and the academic community. The Brazilian model is independent, but compatible with standards ISO 12207 and 15504, CMMI (North American model of process improvement) [12].

The MPS.BR is of great importance for the Brazilian scenario, since 94% of Brazilian companies are considered small and medium businesses [13]. Therefore, for these organizations a certification of an international model becomes costly and often impractical. The Brazilian quality model provides an effective way to process definition and certification costs affordable to the local reality. The MPS.BR is divided into seven levels of maturity. The maturity levels are: A, B, C, D, E, F, G. Level A is the highest level of the reference model. Each level of maturity has processes or activities that must be performed. The processes contained until the level E are reported in the Table I. With each new level of maturity, process or improvement processes that have already been established in previous levels are added. One advantage of the Brazilian model being divided into several levels is the deployment of more gradual fashion model, favoring its adoption by small and medium-sized enterprises [14].

TABLE I. PROCESSES OF THE MPS.BR-E

Level	Name	Processes
G	Partially Managed	Requirements management – GRE Project management –GPR
F	Managed	Measurement - MED Quality assurance –GQA Configuration management - GCO Acquisition -AQU Project Portfolio Management - GPP
E	Partially Defined	Evaluation and Improvement of the Organizational Process - AMP Organizational process definition - DFP Human resources management - GRH Reuse management – GRU

B. SPICE

The SPICE or ISO/IEC 15504 was originally created as a supplement to the ISO/IEC 12207, and it aims to guide the assessment and self-evaluation of the ability of companies in the processes and from this evaluation the improvement of its processes is enabled [15]. This model of software quality establishes a framework which is used for both the creation of evaluation processes and the improvement of software processes [16].

The ISO/IEC 15504 is structured in two dimensions. The first is the dimension of processes in which the processes are evaluated. The second is the capacity dimension that determines the ability of the company to evaluate in each of these processes [15].

The company does not need to execute all processes; the organization can opt for a subset of processes that match their needs. Thus, in an assessment, the processes can have different levels [17].

The five major categories within the dimension of SPICE processes are [15]:

- CUS: Customer/vendor relationship
- ENG: Engineering processes
- SUP: Support processes
- MAN: Management processes
- ORG: Organization processes

The SPICE capacity dimension possesses 6 levels [16]:

- 0- Incomplete
- 1- Process performed
- 2- Managed process
- 3- Process established

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- 4- Predictable Process
- 5- Optimized Process

C. Automotive SPICE

Currently it is estimated that about 85% of the functionality of an automobile are controlled by software. Auto companies need these softwares more reliable thus avoiding future problems like Recalls. For this reason, from a consensus among the major automakers, the Automotive SPICE was created, aiming to assist in the production of automotive software and based on the ISO/IEC 15504 (SPICE) [18]. In addition to the procedures defined by ISO/IEC 15504, the Automotive SPICE defines alterations in the ISO processes and inserts other suitable processes and a focus on the needs of the automotive industry [19].

The groups of processes that the Automotive SPICE treats and will be addressed in this paper are in Tables II-VIII. Each process contains process outcomes and base practices to assist in understanding and implementing processes.

TABLE II. ACQUISITION PROCESS GROUP (ACQ)

Acronym	Name
ACQ.3	Contract agreemen
ACQ.4	Supplier monitoring
ACQ.11	Technical requirements
ACQ.12	Legal and administrative requirements
ACQ.13	Project requirements
ACQ.14	Request for proposals
ACQ.15	Supplier qualification

TABLE III. SUPPLY PROCESS GROUP (SPL)

Acronym	Name
SPL.1	Supplier tendering
SPL.2	Product release

TABLE IV. ENGINEERING PROCESS GROUP (ENG)

	Nome
ENG.1	Requirement elicitation
ENG.2	System requirements analysis
ENG.3	System architectural design
ENG.4	Software requirements analysis
ENG.5	Software design
ENG.6	Software construction
ENG.7	Software integration test
ENG.8	Software testing
ENG.9	System integration test
ENG.10	System testing

TABLE V. SUPPORTING PROCESS GROUP (SUP)

Acronym	Name
SUP.1	Quality assurance
SUP.2	Verification
SUP.4	Joint review
SUP.7	Documentation management
SUP.8	Configuration management
SUP.9	Problem resolution management
SUP.10	Change request management

TABLE VI. MANAGEMENT PROCESS GROUP (MAN)

Acronym	Name
MAN.3	Project management
MAN.5	Risk management
MAN.6	Measurement

TABLE VII. PROCESS IMPROVEMENT PROCESS GROUP (PIM)

Acronym	Name
PIM.3	Process improvement

TABLE VIII. REUSE PROCESS GROUP (REU)

Acronym	Name
REU.2	Reuse program management

D. The company

The company which processes were studied is a small company located in the city of Londrina-PR, It works with firmware development, test and validation to automotive industry. With ten years of activity, this organization possesses certification MPS.BR-F and comes pleading the level E of the Brazilian model. In addition to these achievements, the company also has MoProSoft certification, a Mexican model of quality process [20].

III. LIST OF AUTOMOTIVE SPICE PROCESS WITH MPS.BR-E AND WITH PROCESS COMPANY

In this section the relationship between the processes of Automotive SPICE with the MPS.BR level E it will be addressed, as well as the comparison with the already established processes within the studied company. The correlation between the two models of references was developed considering each Automotive SPICE process and checking the corresponding in MPS.BR. The same analysis was performed with the company's processes, but only if the company complied fully, partially or did not fulfill the requirements presented in the templates.

This intersection was illustrated below through the Automotive SPICE's PIM.3 process and its compatibility with the MPS.BR's processes, and finally, the compatibility of the PIM.3 with the company's processes.

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PIM.3 - Process Improvement

Process Purpose [18]: "The purpose of the Process improvement process is to continually improve the organization's effectiveness and efficiency through the processes used and aligned with the business need."

Process Outcomes

As a result of successful implementation of this process:

1) commitment is established to provide resources to sustain improvement actions;

2) issues arising from the organization's internal/external environment are identified as improvement opportunities and justified as reasons for change;

3) analysis of the current status of the existing process is performed, focusing on those processes from which improvement stimuli arise;

4) improvement goals are identified and prioritized, and consequent changes to the process are defined, planned and implemented;

5) the effects of process implementation are monitored, measured and confirmed against the defined improvement goals;

6) knowledge gained from the improvement is communicated within the organization; and

7) the improvements made are evaluated and consideration given for using the solution elsewhere within the organisation.

The compatibility of MPS.BR with each item listed above is presented in the following:

1) It is not addressed in MPS.BR level E;

2) The identification of the organization's issues are treated in AMP1;

3) The analysis of the current state is covered in AMP3;

4) The identification of improvements and prioritization are treated in AMP5, already planning the implementation is contained in AMP6;

5) The effect of improvement implemented is specified AMP6;

6) It is treated with relevance in MPS.BR E;

7) Evaluations and considerations are discussed in AMP9.

Compatibility with the Company:

1) It is not implemented by the company;
2) The company has a process called Definition and Process Improvement, in which executes this request.
3) The company has a process called Definition and Process Improvement, in which executes this request.
4) The company has a process called Definition and Process Improvement, in which executes this request.
5) The company has a process called Definition and Process Improvement, in which executes this request.
6) The company has a process called Definition and Process Improvement, in which executes this request.
7) It is not implemented by the company;

All processes of the Automotive SPICE were related in this same manner in Leite [21], as with MPS.BR as with the company.

These processes are summarized in the Tables IX-XV and were created comparing the definitions employed by standards of the Automotive SPICE [18] with the MPS.BR E defined by SOFTEX guides [11], and with the processes of the organization. The Tables relate the processes of Automotive SPICE, the processes of the MPS.BR-E and if there are processes in the company, being that this relationship can be addressed in three ways: completely, partially or there may not be processes in MPS.BR-E used by the company that meets what is determined Automotive SPICE

The following Tables with the intersection of processes.

TABLE IX. INTERSECTION OF MODELS AUTOMOTIVE SPICE , MPS.BR-E AND ORGANIZATION PROCESSES FOR ACQ.

Automotive SPICE Process	Approached by MPS.BR-E?	MPS.BR-E	Company
ACQ.3	Yes	AQU3, AQU4, AQU6	No
ACQ.4	Yes	AQU4, AQU6	No
ACQ.11	No		No
ACQ.12	Partially	AQU4	No
ACQ.13	No		No
ACQ.14	No		No
ACQ.15	No		No

TABLE X. INTERSECTION OF MODELS AUTOMOTIVE SPICE , MPS.BR-E AND ORGANIZATION PROCESSES FOR ENG.

Automotive SPICE Process	Approached by MPS.BR-E?	MPS.BR-E	Company
ENG.1	Partially	GRE1, GRE4, GRE5	Partially
ENG.2	Partially	GRE3, GER4, GRE5	Partially
ENG.3	No		Yes
ENG.4	No		No
ENG.5	No		Partially
ENG.6	No		No
ENG.7	No		No
ENG.8	No		No
ENG.9	No		No
ENG.10	No		No

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TABLE XI. INTERSECTION OF MODELS AUTOMOTIVE SPICE , MPS.BR-E AND ORGANIZATION PROCESSES FOR SUP.

Automotive SPICE Process	Approached by MPS.BR-E?	MPS.BR-E	Company
SUP.1	Partially	GQA1, GQA2, GQA3, GQA4	Yes
SUP.2	No		Yes
SUP.4	No		Yes
SUP.7	No		Partially
SUP.8	Yes	GCO1, GCO2, GCO3, GCO5, GCO6, GCO7	Yes
SUP.9	Partially	GPR18, GPR19	Yes
SUP.10	Partially	GCO5	Partially

TABLE XII. INTERSECTION OF MODELS AUTOMOTIVE SPICE , MPS.BR-E AND ORGANIZATION PROCESSES FOR SPL.

Automotive SPICE Process	Approached by MPS.BR-E?	MPS.BR-E	Company
SPL.1	Partially	GPR1, GPR2, GPR4, GPR5, GPR6, GPR7, GPR8, GPR9, GPR11, GPR12	Yes
SPL.2	Partially	GCO1, GCO2, GCO6, GCO7	Yes

TABLE XIII. NTERSECTION OF MODELS AUTOMOTIVE SPICE , MPS.BR-E AND ORGANIZATION PROCESSES FOR MAN.

Automotive SPICE Process	Approached by MPS.BR-E?	MPS.BR-E	Company
MAN.3	Partially	GPR1, GPR2, GPR4, GPR8, GPR13, GPR19	Yes
MAN.5	No		Partially
MAN.6	Yes	MED1, MED2, MED 5, MED6, MED7	Partially

TABLE XIV. INTERSECTION OF MODELS AUTOMOTIVE SPICE , MPS.BR-E AND ORGANIZATION PROCESSES FOR PIM.

Automotive SPICE Process	Approached by MPS.BR-E?	MPS.BR-E	Company
PIM.3	Partially	AMP1, AMP3, AMP5, AMP6, AMP9	Partially

TABLE XV. INTERSECTION OF MODELS AUTOMOTIVE SPICE , MPS.BR-E AND ORGANIZATION PROCESSES FOR REU.

Automotive SPICE Process	Approached by MPS.BR-E?	MPS.BR-E	Company
REU.2	Partially	GRU1	Partially

IV. ANALYSIS OF RESULTS

With the basis of the information presented in the Tables IX to XV, one can extract some considerations. In Figure 1, the result of the compatibility between the processes of the MPS.BR are exposed and adopted by the Organization in relation to the Automotive SPICE.

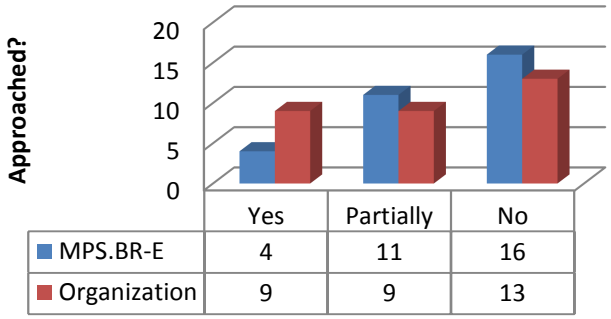

Figure 1. Processes Compability Results

These results show that the Brazilian quality model in the level E was not as compatible with the automotive model. However, it is noticed that the existing processes within the company have a more significant compatibility.

The above report exposes a remarkable fact, the organization, which should theoretically have a similar result with the quality of Brazilian model, because it has implemented the level E, got more processes completely addressed in relation to the Automotive SPICE, it shows that even with the certification of a quality model, the company has to fit and supply what is needed and what is not exposed in the implementation of a quality model guides

The factor that may have influenced the company to greater compatibility with the SPICE is in fact the organization provides services to the automotive industry for almost 10 years constantly, dealing with the high level of requirements of certain customers. In addition, the company also has another certification of quality model that is the MoProSoft.

Another analysis that can be extracted from this compatibility is that the level E from MPS.BR has 11 processes, of which 8 were used at the intersection with the Automotive SPICE. Based on this opinion, it can be concluded that the majority of Brazilian model processes have been addressed, so the level E from MPS.BR discussed in this work brings a few contributions when compared to automotive model.

V. CONCLUSION

This paper showed that quality is an important element when it comes to software and processes tend to bolster its development, granting in this way an accuracy and standardization by assigning a higher quality to the final product. Software process models provide guidance and precepts that assist in the preparation and even implementing processes.

With the analysis of the intersection between models and company, it can be concluded that among the Automotive SPICE and the MPS.BR-E the compatibility was little expressive, when looking at the number of processes that were addressed in the Brazilian model, it was concluded that the level covered in this work is insufficient on automotive model processes. Probably there will be greater compatibility when compared with the higher maturity levels the MPS.BR.

The organization compatibility was more significant. Domestic needs, customer requirements, certification of other

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quality model, providing services for the automotive area are some of the factors that influence the company's processes, it resulted in a more complete processes and therefore in greater compatibility.

Through the analysis a question arises. Should the company change its processes to meet the Automotive SPICE? As it was exposed, the necessary changes to an organization that adopts the MPS.BR-E would be rough, the company must analyze its services, if the majority of its projects do not have the focus to the automotive sector, the organization may choose to sell this differential when needed, not changing its processes.

The big companies, or international certifications, will not always be found in environments where industries are located, so how to seek suppliers? It is concluded that suppliers with certifications will be better able to provide services than those without, as well as to assimilate/attend processes arising from the contractor.

With the compatibility of quality models and the company made throughout this work, it obtained a document that could assist other organizations that might adopt the MPS.BR, and become a facilitator so that a company can see its potential in front of a model of international quality and provide services to the automotive sector. Another factor that it is necessary to emphasize, is that a company with this intersection relationship has the possibility to analyze the processes that are not addressed by the Brazilian model and adapt to the automotive model without necessarily aiming at a certification, and thus a differential in the market. Thus, it was concluded that the work reached the objectives proposed, since it was held the intersections of Automotive SPICE process with the MPS.BR-E and with the process of an organization.

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