

SPIDER-MSCONTROL: A TOOL FOR SUPPORT TO THE MEASUREMENT PROCESS USING GQIM APPROACH

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ABSTRACT

This paper presents a software tool called Spider-MsControl, a desktop solution that operates in a client-server system and aims to help the measurement process, with respect to the measures definition, collection, analysis and monitoring activities, following practices defined in GQIM approach. The software follows all practices, expected results and activities set for the Measurement process of CMMI-DEV and MR-MPS-SW models and the ISO/IEC 12207 norm, and other good practices guides in this discipline.

KEY WORDS

Measurement and Analysis; Process; Quality Models and Norms; Free Software Tools.

1. Introduction

The success of an enterprise is mainly determined by the presented product or service. Then, the quality is a variation degree that can be observed during the development and production process. In IT (Information Technology) enterprises it is necessary to use data to determine good practices, improve process models, analyze trends and improve estimates, establishing a knowledge

about enterprise and thus improving the service or product quality supplied [2].

Achieving a determined quality level to compete in the market is a difficult task and it is necessary to keep control, so the measurement is important in this context, because according to Tom Demarco “You can not control what you can not measure” [4]. And keeping control what it is doing, as well as predict the future behavior of software products and processes, it is necessary to use a measurement process [15], because “You can not predict what you can not measure” [6].

In this context, the enterprises are driven by goals, which are established and taken as targets to be achieved. For this, decisions must be made; however sometimes there are several options and should know which of these ones are the best. The measurement process helps achieving the enterprises’ goals producing necessary information to support decision-making [11].

However, a major problem that directly affects the time and consequently the financial cost is about how to perform the measurement process because many enterprises need to verify and create a set of documents and spreadsheets, which will be used to store the measures and control the measurement process, which sometimes makes it difficult to follow the same ones [15]. However, taking a systematic tool these obstacles become less aggravating, since the whole process will be centralized and more organized. Thus, the search for information may be

processed and found more easily, graphics and data will be generated automatically, while the measures are inserted in the tool, among other advantages. It is important to mention that there are few available and effective software to support the measurement process and these ones supports are not enough in practice, as can be seen in Section 6 of this work.

In parallel, many models and guides about good practices for software processes such as MR-MPS-SW – Brazilian MPS Reference Model for Software [14], the ISO/IEC 12207 [1] and CMMI-DEV - Capability Maturity Model Integration for Development [13], have reference to the implementation of the measurement area, emphasizing the importance of this process. Each model has a set of goals to be achieved in this process and suggestions how to implement it. However, often the micro and small enterprises have not sufficient resources to implement a process and evaluate it [14].

This study aims to present a software tool capable assisting these enterprises to implement the measurement process, because of its relevance to achieving the organizational strategic goals. The software tool proposed in this work is based on the practices included in GQIM approach (Goal-Question-Indicator-Metric) and quality models and norms such as CMMI-DEV, MR-MPS-SW and ISO/IEC 12207.

The paper is organized as follows: Section 2 presents the software architecture; Section 3 presents the main features of this tool; Section 4 presents some implementation aspects about the software; Section 5 reports an evaluation case study of this tool; Section 6 presents some related works; and, finally, Section 7 presents the conclusions and future works.

2. The Software Architecture

The tool was developed to adopt a client-server system to be used in a desktop platform. The choice of this approach due to meet the needs and realities of software development enterprises, providing that the same ones could share the data and information in real time.

The software architecture, called Spider-MsControl (Spider - Measurement Control), was specified on a combination of the three-tier architecture and MVC model. Thus, the events that occur are managed by controllers, which are intermediate between the user interface and database entities. This way, the main gain with this approach is the ease of maintenance and adding new features that may arise, such as changing user interfaces or database.

To keep the code more readable as possible, standardize the understanding of the development team and reduce future maintenance costs, it has also adopted the Facade and DAO design patterns [7], isolating the business layer of visualization and persistence layers, as can be seen in Figure 1.

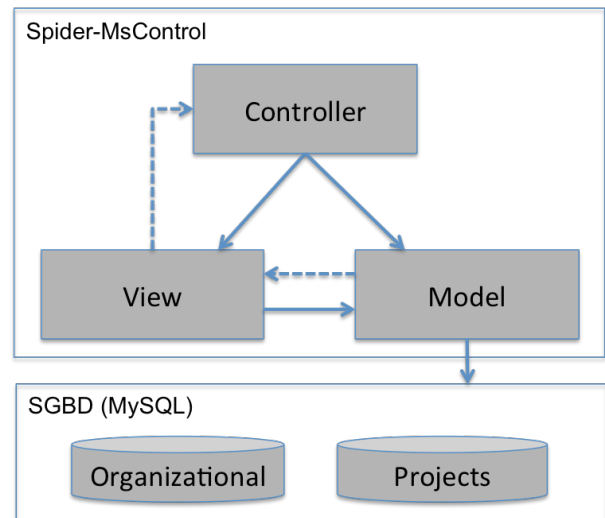


Figure 1. Overview of Spider-MsControl Architecture

3. The Main Features

The Spider-MsControl tool uses the concept of actor to specify who performs the activities in the measurement process. There are four kinds of actors: the **Measurement Analyst**, which holds most of the process activities as setting GQMI approach, defining the collection and analysis procedures, collect, analyze, develop/publish/review reports; the **Senior Management**, responsible for defining the activities of measurement goals and, together the Project Manager, validate metrics, appreciate reports, analyze results and can establish decision-making; the **Measurement User**, responsible to provide a database for the collection of metrics; and the **Measurement Librarian**, responsible for any data handled by the tool. It is important to point out that one user of this tool can represent more than one actor, depending on the involvement degree with the measurement process.

This section presents the main features of Spider-MsControl tool that make it an advantage in relation to other available tools, described in Section 6. A video for a better understanding of these features can be accessed at <https://youtu.be/0JCu0qKH15I>.

3.1 Using the GQIM Approach

During the measurement process it is important to use a measurement approach to help in the organization and the practice of how to make the software measurement. Among the most used approaches is the GQM (Goal-Question-Metric) [16]. In this approach the organizational and project goals are defined, questions are specified for with their answers can achieve the goals and answer how these measures are defined, collected and analyzed.

The GQIM approach is a variation of the GQM. This approach is based the understanding that identify questions and measures without displaying an indicator often is not enough [10]. The GQIM is more effective and efficient

because it builds on the enterprise's business goals, which are more comprehensive and more generally known. The GQIM starts with the question "What do you want to learn?". Furthermore, in GQIM the indicators are introduced, forming an intermediate level between the questions and metrics to help identify the most appropriate metrics. The GQIM approach, because of its efficiency and effectiveness, if applied correctly, is becoming more popular for use in measurement processes and so we opted for the same one to be used in the tool design and development. To better understand the application of GQIM approach we look at the example defined in Figure 2.

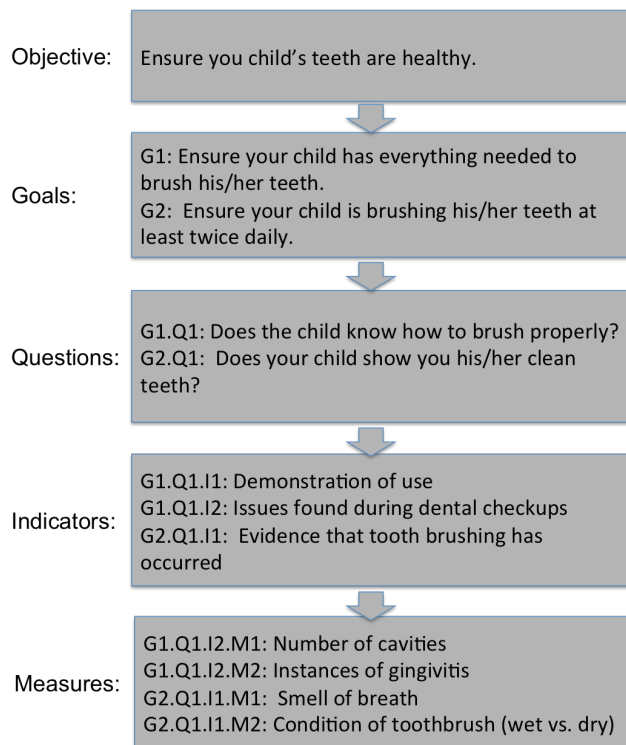


Figure 2. Application Example of GQIM Approach

Thus, to maintain adherence to GQIM approach, the following features have been defined for the tool: management of the measurement goals; management of the information needs associated with the goals; definition and approval of indicators to meet the information needs; characterization of measures for the indicators. Each of these features will be presented in Section 3.4.

3.2 Login and Access Levels

The tool supports so that each user has a login and thus identifying the user, it can limit the access to the same level according to its profile. The tool provides that the Administrator profile can select what each profile can perform while running the tool, which turned out to be a very attractive option, since it can be manipulated to suit the reality of the many enterprises and projects.

3.3 Simultaneous Management of Several Projects

The tool was developed to be used managing multiple projects easily, visualizing information of each one in detail. It is also allowed to view the measurement process of finished projects and analyze the indicators of these projects. Evaluations are important inputs for the registration of an organizational historical bases and guidance for future projects.

3.4 Setting of Goals, Information Needs, Indicators and Measures

For this work some concepts must be understood [2]: information need is the information required for the management of goals, risks and problems; goal is the purpose for which measurement and strategic actions are planned/carried out; indicator is a representation of a measure of simple or intuitive way to facilitate its interpretation compared to a reference or target; measure is a measurement instrument that is used to assign a value to a measurable element or may be the quantification of data in an acceptable standard and quality (accuracy, completeness, consistency, temporality).

For the management of measurement goals, the tool allows to define "what is important (necessary)" for the enterprise to know with the measurement process in order to meet organizational goals. Subsequently, the management of information needs associated with goals is performed from an interview sheet with the enterprise's Senior Management for the purpose of extracting and structuring information (such as quality factors, variation factors) relevant to the measurement process. Another purpose is to raise issues, which are questions and inquiries facilitating the achievement of measurement goals defined.

After that, in the tool happens the definition and adoption of indicators to meet the information needs. These indicators represent information from which it can evaluate a situation and its historical evolution. Finally, there is the characterization of the measures for the indicators, which defines metrics that will be used in this measurement process and should be reviewed to ensure they are in accordance with the measurement goals.

The definition or registration of new goals, information needs, indicators and measures is carried out in detail, where the registration fields are defined according to the models studied and store the necessary information in order to have a good measurement process.

Indicators, when registered, must indicate which information needs are related and each information need, when set, should indicate for what goal is related. The measures are specified and collected, can be used to address the scope of the proposed limits to the many indicators. In turn, these indicators answer to the information need, providing data to make decision more assertive and so reach the stated goal.

3.5 Setting of Collection and Analysis Procedures

This feature details how the data collection from metrics provided will be held. The procedure helps ensure that the correct data is being collected and to clarify the information needs and measurement goals are being met.

The collection procedure is set to a specific measure, which stores information about how the measures collection will happen: how and when the collection will be held; who will hold the same one; how the frequency a specific collection will be held; what the calculations made for a measure to be generated from this collection; among other information.

While the analysis process is set to an indicator, storing information about how the analysis of an indicator will be held: how and when the analysis will be performed; what kind of chart generated that fits for a clearer analysis of it; who will analyze; what targets for each indicator status (ok, alert and critical); how the analysis should be done; what actions should be taken, knowing what state lies; among other fields.

An intrinsic feature of these procedures regards definition of measures storage, which specifies where (repository) the metrics are stored. Setting a repository on the measurement context helps ensure that data is available and accessible for future use. The repository must be defined in terms of location, insertion procedures and access to data, including permissions and responsibilities. Thus, it is clear that the own tool has systematized this feature.

3.6 Measures Collection and Indicators Analysis

This feature is responsible for grouping and organization of the data provided by users, which will be used in the measurements, and the analysis of data collected for possible making-decision can be established. Charts that facilitate the interpretation of a data collection accompany data analysis.

Important to emphasize that Spider-MsControl tool is integrated to another process modeling tool, called Spider-PM (Spider - Process Modeling) [3], which provides a tool to support the definition of activities that will be measured.

Thus, the measures collection and indicators analysis are conducted from the process defined in Spider-PM tool. Because this process is not patterned into the Spider-MsControl tool, this feature allows for flexibility to the enterprise in the generation of results a measurement process.

3.7 Results

This feature is to generate reports from the analysis carried out about the metrics in order to show the results of the measurement process. Once generated, the measurement reports shall be disclosed (communicated) for Project Managers and/or Senior Management, enabling the evaluation of this report, from criticism and suggestions.

In the result phase, the tool provides a field in which the responsible will analyze the generated charts to interpret them and thus define a decision-making based on the data presented. Thus, it reaches the goal of a measurement process, which is to get enough information to make the assertion possible decision.

3.8 Measurement Plan and Reports

The tool generates two artifacts or documents well defined in the .pdf extension: these ones are the Measurement Plan and Report. The Measurement Plan contains basically the collection and analysis procedures, i.e. how the project was planned to perform the measurement process. The report contains the quantitative data itself, along with the charts generated in each analysis and the interpretation thereof, as well as the decisions made. The Spider-MsControl tool has the capability to allow the indicators analysis generated from the data collection as well as the record of actions taken as decisions, when a possible realization of a Critical Analysis Meeting with the Senior Management.

It is important mentioning that the tool allows that artifacts with partial contents can be generated, i.e. documents can be generated even if not all fields that determine it have been filled.

Finally, all records must be stored, consisting of keeping them in the measurement repository in order to organize the work product produced by measurement process.

4. The Software Technologies

The Spider-MsControl tool was developed using the Java programming language, under the GPL - General Public License, related specifically to the Software Measurement process, adhering to the good practices recommended by MR-MPS-SW, CMMI-DEV and ISO/IEC 12207 standards, and the GQIM approach. It is a desktop environment that uses client-server system and its development has been guided in the use of open source tools such as: Ubuntu 10.14 OS, NetBeans IDE 8.0.2, MySQL 5.6.24 database for both data persistence and for communication between the local server and the tool.

5. The Usage Scenario and Evaluation

To evaluate the systematization of a software measurement process, the tool was used in the development environment of a software enterprise in Brazil, which certified its projects in the CMMI-DEV Level 2, whose its projects address products evolution. The pilot project team was composed of 1 (one) Project Manager/Scrum Master, 1 (one) Product Owner, a Technical Team of 5 (five) members, 1 (one) Quality Manager and 1 (one) Configuration Manager. The Project Manager/Scrum Master has experience with more than

seven years in this profile, and PMBoK and Scrum certifications, participating in implementation of CMMI actively. The Spider-MsControl tool was used to support the systematization of a measurement process included in this quality model.

Initially, the tool Administrator (Project Manager/Scrum Master) inserted information about the enterprise project and the users, who would use the tool in the current project. After that, the access levels for each profile specified by tool were set (as seen in Section 3), i.e. what tool's features would be permitted to specific profiles were set. Some of these profiles are required, such as the Measurement Analyst, but the enterprise has the flexibility to readjust in the tool the access to the features for the same ones. Figure 3 shows the screen that the features are listed, allowing restricting the access of each profile. It is also possible understand in Figure 3 how the software is structured, considering that the administrative section of the tool is concentrated in the top menu bar and the features about measurement process, which can be performed in a specific project, can be found on the side menu (left), from a tree structure. The screens are changed dynamically, according the feature selects, on a fixed section of the tool.

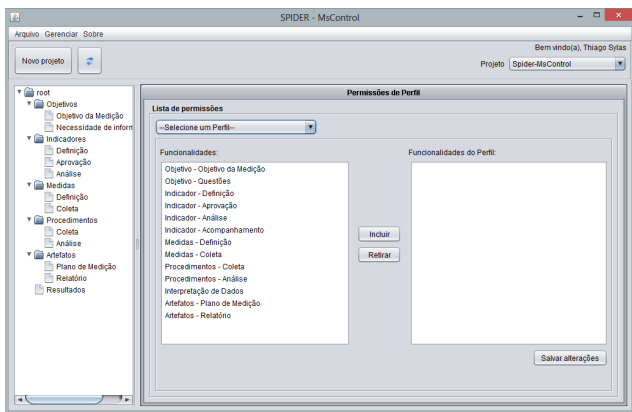


Figure 3. Permissions that can be assigned to each Profile in Spider-MsControl

The second step was the setting of goals, information needs, indicators and measures. The tool requires that all information about them is filled. This obligation, beyond represents important information for the measurement process, also implies to meet good practices recommended by quality models (MR-MPS-SW, CMMI-DEV, ISO/IEC 12207).

Then, the collection and analysis procedures have been established. The collection procedure, as mentioned above, relates to the measures, and the analysis procedure relates to the indicators. Fields about them are also required. In addition to the data already mentioned in the Subsection 3.5, it is also set intervals to collect and to analysis, i.e. it is defined the time that both ones happen. Figure 4 shows that a weekly interval was selected to perform the indicator analysis, having the option to schedule a day that it is desired the analysis is performed. There are other intervals available in the tool, such as daily, monthly, bimonthly, quarterly, semiannual and annual.

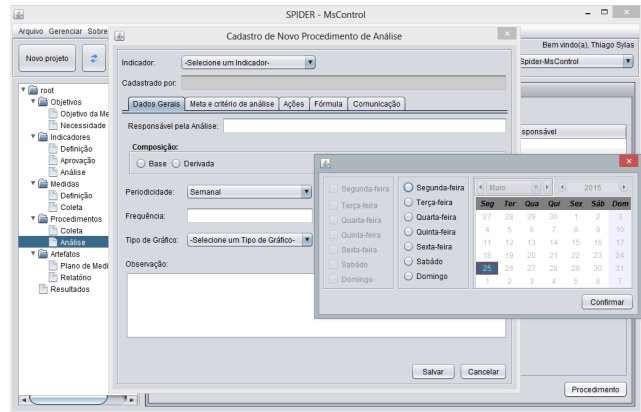


Figure 4. Setting the Analysis Procedure on Spider-MsControl Tool

With the collection and analysis procedures defined, the collections are started to determine the measures. Within the enterprise's software process, this collection followed the collection procedure set, respecting the specific periods and intervals, among other guidelines. In Spider-MsControl tool, data collection can be performed manually, i.e. inserting values from the keyboard or through a spreadsheet, imported from a file. Because it is quantitative data, the value of the indicators will be generated automatically, considering the formula that it has and the restrictions about periods and intervals. Then, it can generate a chart (for more accessible viewing) from the values of the stored indicators, analyze them and take conclusions about them. It is important to mention that the tool does not have pre-defined indicators and measures, it facilitates the definition of them from the application of GQIM approach, which its steps were implemented from features in the tool. Thus, the indicators and the measures are defined according to the enterprise's information needs, because it depends on the characteristics of each project and the enterprise culture.

For a chart is generated in Spider-MsControl and it is possible to analyze the data, choose a time interval simply. It will be created automatically in the pie, bar or line shape, according to the data was selected in the analysis procedure. Thus, interpretations and/or observations may be made from these charts. From these interpretations, it has inputs for decision-making, which is registered in the feature called Results. Additionally, in the tool all user activities are stored and maintain the history of all actions of these users. These records shall be accompanied, if necessary, and from them the artifacts discussed in Subsection 3.7 are created. It is important to remember that the Administrator defines who will have or not access to these artifacts.

The tool was evaluated from the questionnaires for all directly and indirectly involved with measurement in the enterprise, described in the beginning of this section. The following questions for this evaluation were considered: agility, correctness, completeness, suitability and usability about the measurement process.

After the end of the project, the experts team who used the tool showed some strong findings, such as: clarity in the

necessary information for completing the collection and analysis procedures; a systematic flow for implementing a measurement process; a knowledge and historical base for all managers about the measures and indicators maintained by project; generating charts automatically to facilitate the indicators analysis; support for organizational improvement from the MR-MPS-SW, CMMI-DEV and ISO/IEC 12207.

These experts also requested adjustments to non-functional requirements such as usability, portability and maintainability, which will be implemented in the next Spider-MsControl release. During this case study other managers used the tool, but these professionals were in training, allowing provide mentoring about measurement from the use of the tool and found it a clear understanding of this process, which also concluded the importance this tool for learning.

6. Related Works

Among the tools found in the literature, which also offer support to the measurement process, are the REMEX software [8], the Spider-MPlan tool [5] and MedPlan application [12]. However, beyond all of them adopt the GQM approach (Goal-Question-Metric) to define how the measurement process will take place, i.e. not including indicators; the last application mentioned defines that only Project Manager can make the measurement analysis, limiting the causes analysis and decision-making.

Another tool that also uses GQIM approach is WebAPSEE [9], though this one differs from the proposed software in this work for modeling software processes and just allows measurements to be performed on activities included in these processes, which limits the definition of indicators for the projects. This tool also fixed that only Project Manager is responsible for performing the measures collections. In the tool proposal in this work it is allowed the Administrator controlling the access level for each profile, in order to suit for different organizational environments and projects.

Thus, Table 1 compares the features between REMEX, Spider-MPlan, MedPlan, WebAPSEE and Spider-MsControl tools, based on the features described in Section 3. Each tool gets the identification: "Y", if it has the feature; "P", if the feature performs partly, with restrictions; "N" if there is not the feature; and "I" if the reference discussed about the tool does not identify this information.

Table 1
Comparison of Spider-MsControl Features with Related Work.

Features	Remex	Spider-MPlan	MedPlan	WebAPSEE	Spider-MsControl
Using GQIM Approach	N	N	N	Y	Y

Features	Remex	Spider-MPlan	MedPlan	WebAPSEE	Spider-MsControl
Login and Access Levels	N	Y	N	Y	Y
Simultaneous Management of Several Projects	N	Y	Y	Y	Y
Setting of Goals, Information Needs, Indicators and Measures	P	P	P	P	Y
Setting of Collection and Analysis Procedures	P	P	P	Y	Y
Measures Collection and Indicators Analysis	P	P	P	P	Y
Results	I	Y	P	P	Y
Measurement Plan and Reports	I	P	P	P	Y

7. Conclusion

The focus of this work was to conduct a study on the software measurement process, to be developed a tool to systematize the good practices of the models studied. The tool was used in a case study project, identifying possible adjustments. The Spider-MsControl tool proposes to make the implementation and execution of a measurement process in software development enterprises more effective. In this way, the organization will benefit as a whole, having better control of tasks related to measurement. And, it is expected that there is a reduction of working with the adoption of this tool, since most of its data will be generated automatically, and have more information for decisions-making more assertive. In addition, managers with little experience in measurement can deploy this process in their projects more easily, aligned to the main software process quality models.

As future work, we intend to: (1) promote the use of the tool in other real software projects, contemplating different scenarios in software development, especially in organizations seeking the certification in quality models; (2) insert in the tool a list of information needs, indicators and measures most commonly used in the measurement process and can be reused or modified, if necessary, in accordance with reality; (3) integrate with supporting tools to implement other software processes such as project management, requirements management, among others.

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