Analysis of tools for MoProSoft documental management

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Abstract

The Mexican standard NMX-059/02-NYCE-2016 MoProSoft, aims to raise the capacity of organizations dedicated to software development / maintenance, to offer quality services and reach international levels of competitiveness. It emerges as a regional need to achieve process maturity, because international models for Software Process Improvement have focused on large companies, while in Mexico 85.29% of software development organizations classified as medium and small companies. This country advocates the implementation of MoProSoft; however, the adoption of this standard has not been as expected. Although most organizations are working under the NMX-II-059-NYCE-2016 standard, they only reach maturity level 1, while the rest of the companies have an average level 3 maturity. The implementation of the Software Process Improvement requires cultural and organizational changes for success, which are usually complex to address and demand a large investment of resources and time. In this sense, it is essential to establish a guide for the implementation of the improvement. This paper analyzes MoProSoft standard document management in software development organizations. From this analysis, the tools that support the implementation of the standard are characterized, identifying positive aspects and limitations to be considered for its use.

Resumen

La norma mexicana NMX-059/02-NYCE-2016 MoProSoft, tiene como objetivo elevar la capacidad de las organizaciones dedicadas al desarrollo/mantenimiento de software, para ofrecer servicios con calidad y alcanzar niveles internacionales de competitividad [1]. Surge como necesidad regional para alcanzar la madurez de los procesos, debido a que los modelos internacionales para Mejora de Procesos de Software se han enfocado en empresas de gran tamaño, mientras que en México el 85,29% de las organizaciones desarrolladoras de software clasifican como mediana y pequeña empresa. En este país se aboga por la implementación de MoProSoft, sin embargo, la adopción de esta norma no ha sido la esperada. Pese a que la mayoría de las organizaciones están trabajando bajo el estándar NMX-II-059-NYCE-2016 sólo alcanzan el nivel de madurez 1, mientras que el resto de las empresas tienen en promedio nivel 3 de madurez. La implementación de la Mejora de Procesos de Software requiere cambios culturales y organizativos para el éxito, los cuales por lo general son complejos de abordar y demandan una gran inversión de recursos y tiempo. Es por ello por lo que resulta esencial establecer una guía para la implantación de la mejora. El presente trabajo realiza un análisis de la gestión documental de la norma MoProSoft en organizaciones de desarrollo de software. A partir de este análisis se caracterizan las herramientas que apoyan la implementación de la norma, identificándose aspectos positivos y limitaciones para tener en cuenta para su uso.

Palabras claves: gestión documental, Mejora de Procesos de Software, MoProSoft, norma NMX-059/02-NYCE-2016, herramientas.
Key words: document management, MoProSoft, NMX-059/02-NYCE-2016 standard, Software Process Improvement, tools.

1. INTRODUCTION

Software Process Improvement (SPI) focuses on improving processes to improve product quality and reduce the number of defects in products [1-3]. It is a systemic process regardless of the approach adopted, which requires time, resources, measures, and iterations for its effective and successful implementation. It aims to improve the performance of the software development process, based on the development of actions that manifest themselves as modifications [4].

[1] www.nyce.org.mx›certificacion-nmx-i-059-moprosoft

Organizations, scientific communities and governments have invested in the SPI through the definition of models, norms, guides and reference standards that lead the execution of improvement projects, being the most recognized in the literature: CMMI and ISO 15504/IEC:2004 or SPICE. In addition, regional initiatives have been developed that adapted previous proposals to their environments, as is the case of the Brazilian model MPS.Br [5] and the Mexican standard MoProSoft [6].

MoProSoft is a Mexican standard that aims to increase the capacity of organizations dedicated to software development/maintenance, to offer quality services and achieve international levels of competitiveness [6]. It is a Processes Reference Model made up of a set of good practices and software engineering and management methods, which contribute to organizations improving their way of managing projects [7].

MoProSoft emerges as a regional need to achieve the maturity of software development processes, since international models such as CMMI are focused on large companies, while in Mexico 85.29% of software development organizations are classified as medium and small enterprises [8]. The implementation of MoProSoft is advocated in this country; however, the adoption of this standard has not been the expected one. According to statistics on the certification of this model in Mexican organizations between 2006 and 2019, most of the certifications (472) correspond to maturity levels 1 and 2, with only 15 level 3 and 2 certifications reflected in level 5 [7]. Some authors had conducted studies where they refer to the implementation of the MPS, under any reference model, as requiring cultural and organizational changes, which are usually complex to address and demand a great investment of resources and time [9, 10]. MoProSoft is not exempt from this situation, so it is essential to establish a guide for the implementation of the improvement, with the aim of leading organizations in the implementation of the standard to obtain successful results. This paper focuses on an analysis of the document management implicit in the implementation of the MoproSoft model and the tools developed to establish a guide in its successful application.

2. MATERIALS AND METHODS OR COMPUTATIONAL METHODOLOGY

Among the scientific methods used for the development of this work, the following stand out:

Theoretical methods:

- The historical-logical and dialectical method for the critical analysis of works associated with the use of the MoProSoft standard, with the aim of establishing a reference point and analysis of the results.
- The analytical-synthetic method to decompose the problem in elements that contribute to its deepening to be synthesized in future research lines.

Empirical methods:

- Documentation analysis for literature review with the aim of extracting the necessary information about the implementation of the MoProSoft standard, the tools used for its document management and its main limitations in this aspect.

ISSN: 2007-4786

3. THEORETICAL ANALYSIS

Software Process Improvement

According to ISO 9001:2000 [11], continuous improvement means the constant effectiveness of the quality management system using quality policies, audit results, data analysis, corrective and preventive actions and management review. This definition makes no distinction between the industry upon which it applies continuous improvement, however Mathiassen and Pourkomeylian [12] contextualize continuous improvement to software development as a structured approach that enables a software organization to continually improve its capabilities to provide quality services competitively. Although the authors conceive the improvement from a software quality approach, they do not consider the process as a focus, which is considered by Ashrafi [13], who states that the SPI focuses on improving the performance, usefulness and effectiveness of processes in a disciplined way.

SPI focuses on process improvement to improve product quality and reduce the number of deliverable defects. In addition to the above definitions, Sommerville [14] incorporates increasing product quality, reducing costs and development time by understanding and modifying existing processes according to needs.

Chrissis [15] identifies three dimensions on which an organization can focus to improve its activity: people, methods and procedures, and tools and equipment. Another substantial element is offered by Maturro [16] in stating that improvement is not a one-step event, but one that develops gradually through transitions from one level of maturity to another. While Pressman [17] visualizes Maturro's transitions through a cyclical perspective to reach maturity states, from three main actions:

- Process measurement: to improve the measurements according to the objectives of the organization involved in the SPI.
- Process analysis: to identify the weaknesses and risks of the process. The models that describe the process are usually developed during this state.
- Process change: the changes identified during the analysis are introduced.

Trujillo [4] defines SPI as *"Systemic process, regardless of the approach adopted, requires a certain amount of time, resources, measures and iterations for its effective and successful implementation. Its objective is to improve the performance of the software development process by developing actions that manifest themselves in modifications to the software development process".* In the context of the research, this definition is considered more complete, as it also addresses the SPI as a project with implications of time, resources and the consideration of iterations that guarantee the cycle of continuous improvement.

From the elements addressed, the SPI is conceived as a systemic and iterative process that generates significant advantages regarding the performance, utility, and effectiveness of the processes. It requires time and resources for its effective application with the aim of providing quality products and services, although its results are not observed in the short term. To undertake the SPI, some countries and institutions have opted for the development of models and guides with the objective of conducting the improvement and raising the quality of the processes and products of the software development.

ISSN: 2007-4786

Models and guides for the SPI

Among the models and guidelines for SPI conceived to help organizations to conduct improvement, the most referenced in the literature are: Shewhart's [18] Plan-Do-Check-Act (PDCA) model, McFeeley's [19] IDEAL model, Arthur's [20, 21] Focus-Improve-Maintain-Honor (FISH) method and Arthur's Lean Simplified [22] method. In addition, regional proposals have been developed that make adaptations of the previous models to their specific environments, such as the Brazilian proposal MPS.Br [23] and the Mexican standard MoProSoft [5, 24]. Table 1 shows the phases and contextualization of the models and guides for the SPI.

Table 1. Models and guides for the SPI.

Models and guides	Phases or stages	Context
PDCA	Plan, Do, Check, Act	Generic
IDEAL	Start, Diagnosis, Establishment, Action, Use	Generic
FISH	Focus, Improve, Sustain, Honor	Generic
Lean Simplified	Sorting, Straightening, Polishing, Standardizing, Maintaining	Generic
MPS. Br	Conception, Diagnosis, Development, Transition	Specific (Brazilian industry)
MoProSoft	Identification of change factors, Diagnosis, Implementation, Evaluation	Specific (Mexican industry)

From the analysis of the previous proposals, the authors consider that, among their main contributions, the conception of continuous improvement as a set of activities developed in a systematic way through the conception, diagnosis, application and evaluation of the processes stands out.

Institutions, scientific communities and governments, have invested in function of the MPS through the definition of models, norms, guides and reference standards that lead the execution of the improvement projects, being the most recognized in the literature: the Integrated Maturity Capacity Model (CMMI) and the ISO 15504/IEC: 2004 or SPICE standard. In addition, regional initiatives have been developed to adapt previous proposals to their environments, as is the case of the Brazilian model MPS.Br [5, 25, 26] and the Mexican standard MoProSoft [6, 27, 28]. These proposals lead the MPS in a gradual way by establishing an alignment of the organization with the reference quality model specifying what actions the organization should undertake, but they do not provide recommendations on how to implement the improvements. The organization should define its process improvement plan and adapt the proposed actions to its particularities.

Studies [3, 29-31] point out that the models in general are very restricted because they do not take into account the socio-cultural aspects of the organizations according to their context to implement the MPS. The need for cultural and organizational changes for the success of MPS projects is inferred, which are usually complex to address, lead to recommendations that are complicated and demand a great investment of resources and time [4, 32]. Therefore, guides are required indicating how to facilitate the implementation of these models in a specific environment. MoProSoft is not exempt from this situation; according to the Register of companies ruled in the MoProSoft standard, Figure 1 shows the decline in certifications in this model over the years from 2009; the analysis covers several countries, but with greater incidence in Mexico (only one certification does not correspond to Mexico and belongs to a Peruvian company). In addition, in a previous study carried out on the limiting factors in the implementation of MoProSoft [33], it is evident that there has been a decrease in the number of publications associated with the application of the model. In addition, there are limitations related to the process and technology: complexity of the processes, insufficiencies in knowledge management, poor technological management as a support for improvement, and limitations with respect to tools for

technological support of the execution and evaluation of the model. The present research focuses on the MoProSoft model, with special attention to its document management and the analysis of tools to support such management.

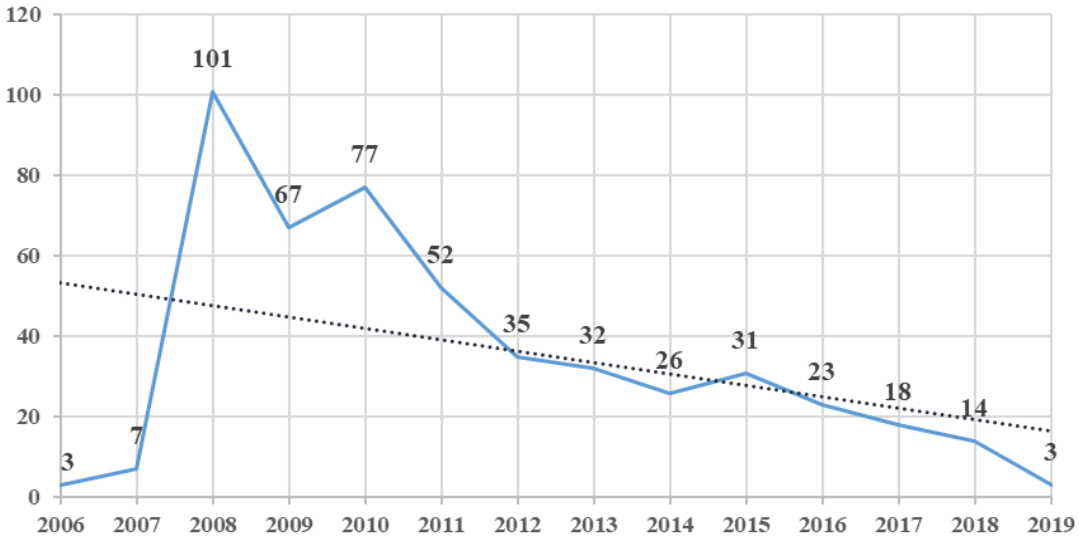

Figure 1. MoProSoft certifications per years.

4. RESULTS AND DISCUSSION

MoProSoft is focused on processes and considers the three basic levels of the structure of an organization which are: The Top Management, Management and Operation. The model aims to support organizations in the standardization of their practices, in the evaluation of their effectiveness and in the integration of continuous improvement.

Documental Management for MoProSoft

To document the processes that guide the model, process patterns must be considered, which are made up of General definition of the process, Practices and Guidelines for adjustment.

Process general definition

The following elements of the process can be identified:

- Process name: preceded by the acronym established in the definition of the elements of the process model structure.
- Category to which it belongs: name of the category to which the process belongs and its acronym.
- Purpose: General measurable objectives and expected results of the effective implementation of the process.
- Description: general description of the activities and products that make up the process workflow.
- Objectives: specific objectives whose purpose is to ensure that the purpose of the process is fulfilled.
- Indicators: definition of the indicators to evaluate the effectiveness of the fulfillment of the process

ISSN: 2007-4786

objectives. It also specifies one or more identifications of the objectives to which they respond.
- Quantitative targets: numerical value or range of satisfaction per indicator.
- Responsibility: main role responsible for the execution of the process.
- Authority: role responsible for validating the execution of the process and the fulfillment of its purpose.
- Subprocesses: list of processes of which the current process is composed.
- Related processes: names of the related processes.
- Entries: the product name and the reference to the product's origin are specified for each entry.
- Outputs: for each output, the name of the product or resource, description and characteristics, and the reference to the recipient of the output are specified.
- Internal products: for each internal product, the name of the product generated and used in the process itself is specified, as well as its description.
- Bibliographic references: standards, reference models, books and other sources that support the process.

Practices

The Practices identify the roles involved in the process and the training required; describe the activities in detail, associating them with the objectives of the process; present a workflow diagram, describe the verifications and validations required, list the products that are incorporated into the knowledge base. In addition, the Practices identify the infrastructure resources needed to support the activities, establish the measurements of the process, as well as the practices for training, handling exceptional situations and use of learned lessons.

Adjustment guidelines

The Adjustment Guidelines suggest modifications to the process that should not affect the process objectives.

Tools for MoProSoft management

To facilitate the implementation of the MoProSoft standard, several tools have been developed, some focused on guiding the management of the processes and documents generated and others on the evaluation of the compliance with the standard. Most of them have been developed between 2005 and 2010, and there are no more tools in the current literature.

Kuali:

Tool developed as part of the AceleraProsoft project in 2005. Its objective is to provide a mechanism for managing processes and controlling the documentation generated. Kuali describes MoProSoft's processes, which makes it easier for staff to consult the procedures to be carried out to solve specific problems. It emphasizes the documentation of processes and their correct execution [34].

Among its limitations was that it did not offer support for conducting evaluations or accelerating the adoption of the standard. Currently, the availability of the tool is limited, and it is only possible to consult published information about it [35, 36]. The tool does not fully cover the process pattern defined by MoProSof [34]. Furthermore, it does not consider all levels, processes, activities, products, and roles of the model. Nor does it allow the management of improvement plans, guide the user during the execution of the process, or integrate a version control tool for the products generated. It does not contemplate the generation of reports or show the status of the entity. It is a proprietary tool, which makes it difficult to access.

fTIMoN:

It focuses on applying a business process model. It restructures activity diagrams considering the maturity of

ISSN: 2007-4786

company processes, focusing on the process pattern and activity diagrams defined by MoProSoft. It allows to coordinate the flow of internal input and output tasks and products, as well as to make the activity states known among the roles [37, 38].

Among its limitations is that: it does not allow the evaluation of established processes, nor does it facilitate the integration of new processes [37]. In addition, it does not allow the management of improvement plans, does not guide the user during the execution of the process, and does not integrate a version control tool for the products generated. It does not contemplate the generation of reports or show the status of the entity. It is also a proprietary tool, which makes it difficult to access.

AsistenteHIM:
It is a guidance and supervision tool for the automated use of the MoProSoft process model. It allows providing users with information about their responsibilities and possibilities, tasks to be performed and those responsible for them, suggestions on how to carry them out, reminders of pending tasks and coordination of work with other users, all in accordance with the MoProSoft standard. It was developed using elements of Software Engineering together with Agent Theory and Case Based Reasoning, which allowed the use of knowledge from experiences to solve problems through agents [35, 39].

Its limitations are that: it focuses on the execution of processes and coordination of activities, but does not carry out process assessment; it does not cover all of the proposed objectives; and the agents and the case-based system remain unfinished [37, 38]. It does not contemplate the generation of reports or show the status of the entity. In addition, it does not allow for the management of improvement plans, does not guide the user during the execution of the process, nor does it integrate a tool to control the versions of the products that are generated. It is a proprietary tool, which makes it difficult to access.

MoProSoft Document Manager (MDM):
Tool developed in 2005 by Caballero de la Villa [40]. Its objective is to assist in the implementation of MoProSoft through the documentation of Business Management, Process Management and Specific Project Administration processes. In addition, it stores and manages the documents of the three processes mentioned above and allows the creation of templates and modification of documents about the processes of some specific projects of a stage of MoProSoft. Mexican companies, in a simple and easy to apply way [37], conceived this tool as an option to facilitate the adoption of Moprosoft.

Among its limitations is that it does not consider all levels or processes of the standard. In addition, it does not conceive of process evaluation and does not completely cover the process pattern defined by MoProSoft. It only incorporates three processes limiting the monitoring, interrelation, and implementation of the remaining processes [37, 41]. Furthermore, it does not consider all levels, processes, activities, products, and roles of the model. Nor does it allow the management of improvement plans, guide the user during the execution of the process, or integrate a version control tool for the products generated. It does not contemplate the generation of reports or show the status of the entity. It is a proprietary tool, which makes it difficult to access.

SelfVation:
It is a tool for the standard process's evaluation using an RIA (Rich Internet Application) approach. That allows the generation of plans to improve the evaluation results [42]. The approach used in the evaluations consists of the modeling of company processes and the application of evaluation questionnaires in the Senior Management categories for management information and in the Management and Operation categories for managing the practices carried out by the project leaders.

ISSN: 2007-4786

Among its limitations is that it does not consider all the processes and levels of the standard in the Management category. Nor does it allow the management of improvement plans, it does not guide the user during the execution of the process, nor does it integrate a tool for controlling the versions of products generated. It is proprietary, which makes it difficult to access.

KWE 2.0:

The tool works as a knowledge base adapted to the requirements of the standard NMX-I-059-NYCE-2011 and allows the management, control and supervision of the activities and work products, as well as the follow-ups stated in the standard. Among its potentialities, we can find [43]:

- It has three features: customization, integration, and collaboration between users.
- It allows a better monitoring of the activities, thanks to the management feature of an indefinite number of monitoring for each task.
- It allows the creation of repositories that can be customized with your own set of activities, which helps the tool to adapt naturally to the needs of the company.
- It allows the sending or assignment of a specific task to different users at the same time, thus gaining efficiency and practicality. It allows the attachment of multiple files per task or follow-up.
- Allows the sending of an email notification when an activity is assigned or delegated.
- Allows for the proper management of projects (planning, monitoring and control), regardless of the characteristics of it.

It has as limitations that: it is exclusive, it does not consider all the levels of the model; it does not manage improvement plans and it does not guide the user step by step.

Summary analysis of the tools:

The analysis of these tools shows that efforts have been focused mainly on facilitating the adoption of the standard, providing mechanisms to become familiar with the established processes and the documentation generated from each process. However, some focus only on process evaluation and others on document management. All of them are proprietary; they do not properly manage improvement plans. Furthermore, they do not integrate version control tools of the generated documentation and do not guide the user step by step, so the characteristics of the standard must necessarily be known to use it.

Nevertheless, among them KWE 2.0 stands out, which integrates all the elements of the standard and is the one proposed by NYCE for the management of MoProSoft. Next, a comparative table is shown that summarizes the differences between the analyzed tools.

Table 2. Comparative summary of tools that implement MoProSoft.

Criteria	Kuali	fTimon	AsistenteHIM	MDM	Self Vation	KWE 2.0
Considers all levels of the model	No	Yes	Yes	No	Yes	Yes
Considers the pattern in its entirety	No	Yes	Yes	No	Yes	Yes
Manages improvement plans	No	No	No	No	No	No
Shows company's status	No	No	No	No	Yes	Yes
It guides the user step by step without the need for in-depth knowledge of the standard	No	No	No	No	No	No
Is it privative?	Yes	Yes	Yes	Yes	Yes	Yes

CONCLUSIONS

It is essential to establish a guide for the implementation of the MPS, with the objective of leading the organizations in the implementation of good practices.

The present paper made an analysis with the objective of identifying the guidelines to guide the implementation process and the documentation generated by MoProSoft, which favours the understanding of the organizations to adopt the Process Improvement using this standard.

An analysis of tools that implement the MoProSoft standard was carried out, evidencing that most of them do not cover the process pattern and do not manage adequately the improvement plans. In addition, they do not establish a guide to the users for the execution of the processes and they are proprietary tools, which hinders their accessibility.

KWE 2.0 is the most current and contextualized tool to the modifications of the MoProSoft standard, being the recommendation of NYCE for the organizations that apply the standard.

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