Scrum Maturity Model

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Abstract: It is possible to notice that in the current conjuncture, in the information technology sector there is a growing interest in the adoption of agile methodologies in the management of software development projects.
It is possible to identify several structures, of agile methodologies, that make possible a change in the work habits throughout the life cycle of a project. Scrum is one of those agile frameworks that is iterative, increment, process-based and empirical. For this, Scrum adds value to the project even through focus, activity creation through transparency, and transparency in all processes and projects of a project. Despite all these benefits, a corporate culture that is very available for changing processes and introducing the Scrum framework is necessary.
Based on a Multivocal Literature Review (MLR), we will identify the benefits, such as inhibitions and what kind of facilitators we cannot find in the possession of adopting the Scrum framework in software development projects. After finalizing our SLR and MLR, we developed a maturity model for Scrum and presented it through semi-structured interviews.

Keywords: Scrum, Agile Methodologies, Project Management, Maturity Models.

1 Introduction

Agile methodologies are transforming the information technology sector with its changing paradigm. Many organizations in the sector are forcing their teams to follow and adopt agile methodologies throughout the project cycle. The use of agile methods plays a fundamental role in software development and in the delivery of products with added value to the customer.

In the process of implementing agile methodologies, we can find several frameworks, such as eXtreme Programming (XP), Dynamic Systems Development Method (DSDM), and Kanban but our focus will be on the Scrum framework. [1.2]

The Scrum Framework is based on iteration, increment, and process and is empirical, it also manages to add value, generate focus, and create clarity and transparency in all moments and activities of a project. We also know that this type of change in organizations, even because it is an easy-to-understand framework that generates value, is not easy to adopt and sometimes produces problems in its implementation. The success in the adoption, through facilitators, of this framework and in its use translates into the delivery of added value, such as lower production costs and a substantial emotional improvement in the project teams. It was in this sense that we carried out a Systematic Literature Review and then a Systematic Multivocal Review to identify

the benefits, challenges, inhibitions, and what kind of facilitators we can find in the process of adopting the Scrum framework in software development projects.

2 Research Background

2.1 Scrum Framework

Scrum is one of the first and most used frameworks in agile software development processes that emerged at the beginning of the software engineering approach during the period of 1995-2001. [3] Scrum is a framework that manages to deal with complex and adaptive problems it has a very effective capacity for change and provides products with high value and a high degree of quality. Scrum can manage and solving problems in very complex products. A variety of processes and techniques can be used by the technical teams that will serve to increase the value of that product. Scrum is iterative and incremental in its approach to software development, inspecting and adapting development as needed. [4]

There are two main artifacts, the Product Backlog, and the Sprint Backlog. The product backlog generates an ordered list of activities, development requirements, and bug fixes in products. The product backlog is ordered based on factors such as its value, the risk to the project, the priority of the business, and its need. [5]

There are 3 types of roles in the Scrum framework, Product Owner, Scrum Master, and the development team. The Product Owner is the person responsible for the product, and who represents the customer. The Scrum Master is responsible for managing and facilitating the life of development teams, ensuring that the environment is suitable for the successful completion of the product. [6] The development team is responsible for product development.

In Scrum, there are deliveries of incremental activities to the product that are known as sprint backlogs, usually carried out between two to four weeks. Each sprint starts with an activity plan, a set of items taken from the product backlog, and then ends with a general review of that activity. The sprint planning process is managed by the Scrum team and has a time limit that cannot exceed 4 hours. [two]During a sprint, daily meetings of a maximum of fifteen minutes are held so that the development team, together with the scrum master, can get a sense of the state of the sprint and optimize the team's performance. The success of these meetings depends on not exceeding the time limit of fifteen minutes. At the end of each sprint, there is a moment which is the sprint review, at this stage the entire sprint and its deliverables are evaluated, identifying if there is a need for any changes that will be increased in the next sprint. This session includes the development team, the Scrum master, the product owner, and the stakeholders.

The Sprint Retrospective is an essential part of the Scrum team, in general, it is at this stage that the team evaluates its performance during the sprint, where it reflects on all the activities that did well, those that went less well, and what can do to improve them. The result of this retrospective results in an increase in productivity in the next sprint. [7]

2.2 Maturity Model

The maturity model involves the concern to finding the existence of a reference that addresses the best practices to be followed in the software development process, in the implementation of methodologies. Currently, maturity models can improve specific processes and assess organizational maturity levels, thus being able to improve their productivity levels, their levels regarding product quality, and the predictability of reaching 'levels' of ability to integrate maturity models. [9]

Maturity models play an essential role and offer improvement in software development processes to software engineering companies, which intend to optimize their development processes. These tools provide an evolutionary path that determines, maintains, and optimizes the continuity of software development processes, with the best practices adopted and validated by the market. [10]

Watts Humphrey was a very influential expert in this area of the approach. During his tenure at the Software Engineering Institute (SEI), he established a software process program, eventually led the development of the Capability Maturity Model Integration (CMMI) and introduced assessment methods into software development processes. [10]

2.3 Capability Maturity Model Integration CMMI

Capability Maturity Model Integration is a procedural framework intended to be used in many software development best practices and can improve the implementation process. The CMMI is known to represent a chain of 5 process maturity levels. Organizations in software development aim to reach the maximum level of maturity, but to achieve these objectives, it is necessary to satisfy all the lower levels.

The expected capacity of an organization that intends to act in a mature way depends a lot on its direct ability to achieve the objectives, control, and improve its performance in the areas of implementation based on the practices of the model. [11]

2.4 Scrum Maturity Model

The main objective of the preparation model for development, adopting a methodology for development, also adopting a methodology for improvement, adopting a methodology for improvement, adopting a methodology also for improvement, and adopting a methodology for customer development. [12] This type of maturity model helps organizations less familiar with a Scrum framework through an incremental approach.

The Scrum Maturity Model is built on the Capability Maturity Model Integration) and Maturity Models (CMMI) that focuses on the Scrum framework. We can say that Scrum's maturity levels are like those of CMMI and AMM. [13]

In the Scrum maturity model, there are 5 levels that determine the maturity level of applicability of the structure in organizations. Level 1 (initial), level 2 (managed), level 3 (defined as Level 4 (quantitatively level), and level 5 (optimization) We can say that an organization is fulfilling the level with the objectives and practices to follow.

3 Research Methodology

In this section we will describe the method (DSR) is used for the development of future works and with the structure of the entire dissertation. The method used to carry out the investigation is the MRL, this method will answer our research questions.

3.1 Systematic Literature Review

The Design Science Research (DSR) methodology is a design method with the focus on solving a problem, in the end, the objective is to generate new knowledge, and other ways to solve a problem and create reality through the presentation. of a solution, which is completely different from the current reality.
DSR is based on the development of artifacts, that is, on the creation of models, on the creation of methods that influence the context and the people who share that same problem. During the process of applicability of the DSR methodology, we must include 6 steps for which rigor in its usability is necessary. [14.15]

The first stage of the process involves identifying our problem well and understanding its dimension. The second step in the process is to find a good definition of the objectives to be achieved in the search for the solution. Not least, we have the third stage which focuses on designing and developing artifacts for our solution. The fourth stage is the moment when we present our solution, we demonstrate its effectiveness as a solution to the problem. The fifth step of the process is to evaluate its usability and see if it corresponds to the defined objectives and if the resolution of the problem is identified.

Finally, the sixth step is to develop a solution communication plan.

It should be noted that there is no rigidity in the order of use of the process steps, which means that it is possible to reuse steps throughout the research process cycle.

3.2 Multivocal Literature Review

A Multivocal Literature Review is very similar to a Systematic Literature review, but its main differences are the introduction of gray literature, such as blogs, books, forums, websites, and white papers. This gray literature is often produced by qualified professionals in the field of information systems that are made available outside of academic forums and publications. The use of an MLR becomes important because it is possible to expand the scope of the research to be included. In the following image, it is possible to observe this same extension. [16.17]

An MLR is very useful for researchers as well as professionals in the field of study, as it is based on the use of summaries of the state of the art and best practices in a specific area. The MLR starts and the more in accordance with its quality systems throughout the world, the more studies are of quality through a set of studies and rules

that guarantee a set of procedures and their results, the more easily they are scientific information.

As an MLR's search sources are different from an SLR, it goes directly through search engines by introducing what it wants to accomplish. The purpose of this objective is to complete and expand our research questions, adding to the need to obtain results through an SLR through the MLR. [18]

4 Data Analysis

4.1 Evaluation of interactions with the model

During our interviews with the various participants, we selected 4 participants from 4 different organizations to make a more assertive contribution and adapt our model to what is done daily. We withheld the names of the companies for privacy reasons, but we managed to say that 3 are national companies, which are operating only in the national market and the other company is a multinational, in the automotive sector, with great expressiveness in the national market. and international.

The choice fell to these 4 companies because they had very different results from each other and because most of the interviewees are part of them. We can say that only one of them managed to reach maturity level 5, corresponding to the maximum level of our model. Of the remaining 3 companies of national origin, 2 of them did not pass level 3 of maturity, having a classification of partially achieved, and 1, did not go beyond level 2 with a classification of largely achieved. To reach the next levels, they will have to correct and adapt several points in their use of the framework to obtain a rating above 86% corresponding to the range shown in table 10.

We can analyse in these data that only the international company had a positive result, comparing the remaining 3. We are talking about companies that are highly developed and evolved in the areas of information technologies, giving a great advantage in the implementation of new ideas, with a very strong organizational structure and with a well-defined business structure. In almost all analysed levels, it obtained values above 90% of the classification, demonstrating its ability to use the framework. The national market compared to the international market, in this case, the German market still has a long way to go to achieve the desired results.

Another conclusion that we can draw from this small analysis is the entrepreneurial culture that exists between national and international companies. We were able to perceive that companies of national origin have much more difficulty in implementing the framework than companies of international origin, probably due to the strong friction that exists in our culture of change, lack of knowledge of implementation procedures, or even lack of knowledge. rules to be used throughout the software development process.

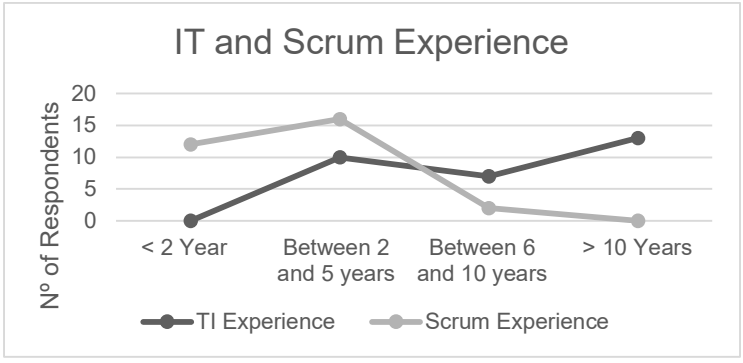
Below, in table 14, it is possible to observe the results of both companies that provided the answers to the model, we can observe that only one of the 4 companies reached level 5, the maximum level of our Scrum maturity model.

LEVEL	Company A	Company B	Company C	Company D
Level 1	97,22%	89,59%	95,14%	93,75%
Level 2	88,89%	90,97%	88,89%	81,25%
Level 3	38,20%	95,14%	68,75%	61,11%
Level 4	45,83%	89,58%	62,50%	75,00%
Level 5	47,22%	91,67%	44,45%	47,22%

4.2 Evaluation of the interview results

We start by evaluating professional experience, we can see in graph 6 that all our respondents have more than 2 hours of professional experience in information technologies. 10 interviewees have between 2 and 5 years of experience, 7 interviewees between 6 and 10 years of experience, and finally, 13 of the interviewees have more than 10 years of experience. This level of maturity in terms of experience was very relevant for the rest of the interview. I demonstrate a very high degree of knowledge and competence, in this evaluation phase, it was very important to have the inputs given by everyone.

As far as experience in the Scrum framework is concerned, the results have already been a little different. Of the 30 respondents, 12 had less than two years of contact with the framework, between 2 and 5 years we have 16 respondents, then between 6 and 10 years of experience we have 2 respondents and finally, we have no one with more than 10 years of experience. These results were very useful, in the end, to determine that the level of knowledge in the framework is not yet fully understood and that it has a strong impact on its implementation in organizations. If we look at the levels of maturity obtained, we can verify that only one company was able to reach the maximum level of maturity of the 4 analysed, in the same way, we can verify that of the 30 interviewees, only about 10% have more than 6 to 10 years of experience. To conclude this first evaluation phase, it is possible to verify that there is still a long way to go to reach sufficient maturity for the correct use of the framework.



The question asked for this phase was, “How often is the Scrum framework used in project development in your organization?”. Once again, we obtained very positive results, with only one of the cases of development being easier than the organization where you are employed. Software. 8 of the others seems that Scrum says that in your organization it is used a lot and used8 efficiency. In graph 7 it is possible to identify the results during this question.

We can use Scrum's highest utilization framework is quite high. With this result, it is possible to expect a good evaluation of our model and its use to assess the maturity of Scrum in organizations.

To continue our study, it was defined that we would have to understand how they would evaluate the use of Scrum, the question asked was the following, “How do you evaluate the use of the Scrum framework?”. In this question, the classification was assigned as follows: Difficult to use, with some difficulty, Fair, Easy to use, very easy to use. From the results obtained, which in turn can be consulted in Annex 7, we can infer that none of the interviewees thinks that the framework is difficult to use, any professional in information technologies can use and implement the Scrum framework. Only 6.7%, which is equivalent to 2 respondents, thought the framework was very easy to use, if we re-validate chart 6 we can determine that these assessments are related to professional experience in using Scrum. Already 13.3% of respondents, which corresponded to 4 people, said they had some difficulty using Scrum, through cultural resistance according to the inhibitors presented in research question PI3. In response to the following classification, we found 13 respondents who say that its use is reasonable and, finally, 36.7% say that it is easy to use the framework throughout the life cycle of a project.

We can conclude that most of our interviewees say that the use of Scrum does not correspond to any challenge and that in terms of inhibition, most of the 30 elements do not have a great impact.

4.3 Artifact approval

In this phase, we will analyse in a global way what is best achieved in our model, what we have to improve, and what we really have to abandon or remove. For this phase of the dissertation, we rely on the inputs left in the last question of our interview “What aspects did you change or improve in the model presented?”. Based on this question, we collected feedback in every way, I mean that we obtained feedback in which they mention the quality of the model, and the way in which the different levels of evaluation are structured. They approach the way of calculating the same and its representation regarding the various degrees of evaluation. However, we have also received some constructive criticism of our model, what we should improve, and how. They make a lot of references to forgetting to address the Scrum values and the main responsibilities of the elements that constitute Scrum.

With this model it is taken from here that our good is ideal, with optimal bases to be a Delivery to use, with the needs of fulfilment very easy and with the evaluation made to the references, we must not be careful enough to work, which it adds value to Scrum customers, which it adds value to customers. type of approach we should have in our

daily lives, what are the real responsibilities of each element within Scrum and not least, look at Scrum as an agile framework that makes a difference in the success of value delivery.

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