Scrum Maturity Model

Validation for IT organizations' roadmap to develop software centered on the client role

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Abstract—**Within the agile development methodologies context, the topic of client relationship management is strongly focused, mainly due to the importance of collaboration between the development team and its clients. Most clients avoid or are unable to develop a close cooperation with vendor organizations, since it requires a motivation and close participation among key stakeholders in the development processes within and correct usage of the adopted software development methodology. Hence, software development projects fail and become unsuccessful because of this lack of communication. In order to increase the rate of successful projects, this paper will present the journey of the validation process for this roadmap to lead and aid software vendor organizations improve their development processes, concentrating mainly on the client's role throughout the process. This concept is called Scrum Maturity Model; therefore, our main goal is to validate this concept with organizations that use Scrum agile methodology as their main development process, which turns out to be an viable approach to reduce the rate failed development projects.**

Keywords-development methodologies; agile methodologies; scrum development methodology; maturity model; action research

I. INTRODUCTION

According to a CHAOS Report [1], about 70% of IT development projects fail to deliver functional software, mostly due to a poor communication between stakeholders, who play key roles in the development process. This problem of human factors in software development collaboration is also highlighted in these three following papers [2][3][4][5].

The fact that most clients spend an extremely small amount of time and effort working closely with the software vendor organization, that develops the solution, goes against the Agile Manifesto values [6], which are the foundations for a successful agile oriented development.

The failure of Information Technology (IT) projects caused by mediocre software requirements engineering and other human/client factors is a highly researched theme among professionals and scholars. Therefore, this paper intends to provide a different insight about the current issues concerning this topic [7] [8][9][10].

The main concern that induced this research was precisely the dilemma mentioned above: lack of cooperation among stakeholders involved in an IT development project, focusing on the type of communication between the development team and the client. This problem in communication can result from: (1) Human factors and resistance to changes; (2) Distance that separates both vendors and clients or; (3) Inexistence of a commitment that follows the definition of a contract of collaboration.

Generally, both clients and software development organization teams may fear and avoid the adoption of new methods of collaboration with a new team [10]. This harms the partnership between the two, thus resulting in inadequate requirements engineering emphasized by agile methodologies, which will, eventually, lead to an unsuccessful project.

Concerning human behavior, the distance that separates the vendor organization and the client challenges the accomplishment of a fluent and successful cooperation [11]. Apart from this exact physical distance, that hardens the communication and occasionally blocks the possibility of face-to-face meetings, a cultural distance must also be considered, since this aspect may bring a negative impact, such as cultural clashes, to the performance of the collaboration and influence the project as a whole [10].

Another cause of this problem is the inexistence of highlighted goals, such as market competition, which will motivate all stakeholders to improve their processes and maximize the outputs. According to a survey made by Gartner [13], agile methodologies could use a maturity model as a roadmap and market differential, so software development organizations might explore their processes and reach higher levels of maturity. Moreover, a paper from Software Engineering Institute (SEI) [14] reveals that Capability Maturity Model Integration (CMMI) can coexist with agile methodologies and enhance these software development organizations [15].

This paper will focus on the changes from the previous proposal [16] and recent evaluation processes of the solution for this lack of collaboration, usually, between vendor organizations and clients. Moreover, it will conceive a roadmap for improvement in order to create successful IT development projects. Since Scrum development methodology emphasizes such collaboration, the solution shall be molded as a roadmap in the form of a maturity model so as to achieve the goal of this paper.

Note that this topic of maturity models and other IT governance frameworks on agile methodologies a highly polemic among the agile community. Nevertheless, IT governance mechanisms are necessary and welcomed in organizations which are underproductive, and, thus, hold the major slice of failed projects [14].

The chosen research method was Action Research (AR) due to its success in various academic investigations in the Information Systems area and for allowing the researcher to interfere and observe introduced modifications on the studied environment. AR is comprised by a five stages cycle [17]: (1) Diagnosis – problem identification; (2) Action Planning – planning and research phase to prepare the experiment and alternative actions; (3) Action – implementation of planned actions, introduction of changes and analysis of the outputs on the environment; (4) Evaluation – it is determined if the outcomes are expected or against odds and assures that introduced actions are the only reason for the obtained success; (5) Specifying Learning – Identify general findings.

Note that AR is carried out by individuals who are interested parties in the research. This fact has led to criticisms of the validity of the research process, with accusations of inevitable researcher bias in data gathering and analysis. The justification for AR counters this criticism by suggesting that it is impossible to access practice without involving the practitioner. Practice is action informed by values and aims which are not fully accessible from the outside. The practitioner may not even be wholly aware of the meaning of his or her values until he or she tries to embody them in her action.

Nevertheless, there are some limitations with this research methodology, namely: the unfamiliarity with research methods and the representations of the process of action research may confuse, rather than enlighten.

As stated, this paper continues our previous research, hence, the first two cycles of action research were already previously applied. This paper will mainly focus on the changes to the proposal, based on past learning, and iterate more cycles of action research in order to achieve stronger validation of the proposal.

Before the presentation of the improved proposition, a brief introduction and review of the related work in this area of research shall be developed in Sections II and III. After, the changes in the proposition are detailed in Section VI; in the next section (Section V) the results of newer and various practical experimentations of the proposition will be presented. Afterwards, in Section VI, the main lessons learned shall be analyzed. Finally, Section VII will conclude with the summary of this investigation, relating all mentioned topics as a whole. In this section, some future works and approaches are given to continue the research.

II. RELATED WORK

This section intends to make a brief review of the related work in the field of agile development study.

A. Agile Methodologies

The origins of Agile methodologies are deeply connected with the concepts of iterative and incremental development. There were several ideas concerning the agile concept, hence an Agile Manifesto [6] was established.

The set of values and inherent principles listed on this Manifesto stress the importance of the clients' presence in order to obtain a better collaboration outcome, working software as the main goal and agility when facing a sudden change in requirements [18][19].

Since this approach requires a high cooperation level between the client and the development team, mainly through face-to-face meetings, it has the drawback of being partially obsolete in the current market, in which an ascending number of projects are developed at a distance [20][21][22].

B. Scrum

Scrum is an agile methodology to manage development projects through an iterative and incremental method [23][24][25]. It is divided into three main key roles: (1) Scrum Master – individual who is responsible for the Scrum process and its correct usage maximizing its benefits; also known as the facilitator of Scrum team; (2) Product Owner – individual who is accountable for the alignment of the development and business goals definition, and; (3) Team – team that is in charge of delivering the product. A team comprises 5 to 9 members with cross-functional skills, who are self-organized and self-led.

This methodology identifies four objects that are operated by the Scrum team throughout the development cycle: (1) Product Backlog – a prioritized list of everything necessary to conclude the product; (2) Sprint Backlog – a list of tasks to perform during a sprint, i.e., an up to four weeks development iteration to introduce parts of the Product Backlog into working software; (3) Release Burndown Charts – charts that show the progress of the project over time, and; (4) Sprint Burndown Charts – charts that show the progress of the sprint over time.

The interaction of the roles maneuvering these objects is set for the following meeting: (1) Release Planning Meeting – Scrum team gathers and fills in the Product Backlog; (2) Sprint Planning Meeting – development team and client closely discuss matters and define the goals for the next sprint; (3) Daily Scrum – a brief meeting for developers to identify personal issues and possible improvements in methodology usage; (4) Sprint Review – demonstration of the working software to the client and stakeholders; (5) Sprint Retrospective – team performs a self-examination regarding the last sprint in order to seek improvements on their use of Scrum Methodology and collaboration in general.

Scrum methodology is an iterative and incremental development methodology. The phase for planning and system architecture takes place in Release Planning Meeting, while the sprints are comprised by Sprint Planning Meetings, Daily Scrum, Sprint Review and Sprint Retrospective.

Although Scrum has a wide definition of concepts, that, when applied, may allow agile software development, it cannot guarantee the success of IT projects. This methodology

emphasizes close collaboration between development teams and their clients; still, most of the time this does not happen and, thus, a supplementary solution to complement this imperfection is needed.

C.   Modified Agile

Modified Agile is an agile development methodology that results from the analysis of the flaws in the Agile Manifesto [6] opposing to distant outsourcing environment [11].

The main problems identified concerning this matter were the poor communication among participants of the IT projects and the exhaustive documentation needed for contract negotiation. All other values and principles mentioned in Agile Manifesto remain feasible in a distant outsourcing context.
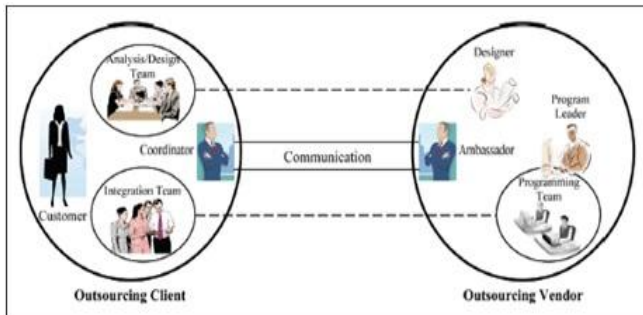

Figure 1.   Modified Agile communcation model proposal [11].

The solution recommended by the author of this paper is an authentic communication model and team composition structure, which will enhance the communication between clients and developers and reduce the negative effects derived from the distance factor that leads to a loss of knowledge.

In Figure 1, the introduction of two specific roles is emphasized: (1) Coordination – an individual from the client-side, who ensures the maximization of development outputs by assigning the most important business goals to be developed as a priority; (2) Ambassador – individual from the development team-side who makes sure that the product developed is aligned according to the customer's needs and wills. These two roles must work closely as a formal communication channel, while team members from both development and the client-side might communicate among themselves through an informal channel

Although this distributed agile concept is broadly used with several case studies proving its success, there are also many failed IT projects due to human factors and inadequate collaboration between clients and vendor organizations [26][27].

III.   MATURITY MODELS

The maturity models from software development processes enable the classification of the performance of the actual ones and guide organizations to encourage process improvement through a staged method, also known as maturity. These maturity models are an interesting approach to solving the problem described in Section I, since the presence of a

maturity classification can allow the comparison between competitor organizations.

A.   Capability Maturity Model Integration

Capability Maturity Model Integration (CMMI) was introduced in 2002 and ever since, it has focused on process improvement approaches, which assist organizations in adopting the best type of practices from each process area and make the processes performance evolve [28][29].

In the staged representation, CMMI presents different levels that vary from one to five. One level of maturity is characterized by a set of predefined process areas, evaluated by the accomplishment of specific and generic goals applicable to the various areas. Each of these is attached to a set of practices, which reflect specific and generic goals [30]. This type of approach is highly successful worldwide amongst enterprises that wish to surpass competitors by providing improved and better products and services.

Given its broad scope coverage, CMMI does not solve the issue due to its non-focus on agile software development processes, which are the area of the current study.

B.   Agile Maturity Model

Agile Maturity Model (AMM) was introduced by two researchers in an IT University in Leeds, and it was conceived in order to provide future researchers a more in-depth agile maturity model as a basis for their investigations [31].
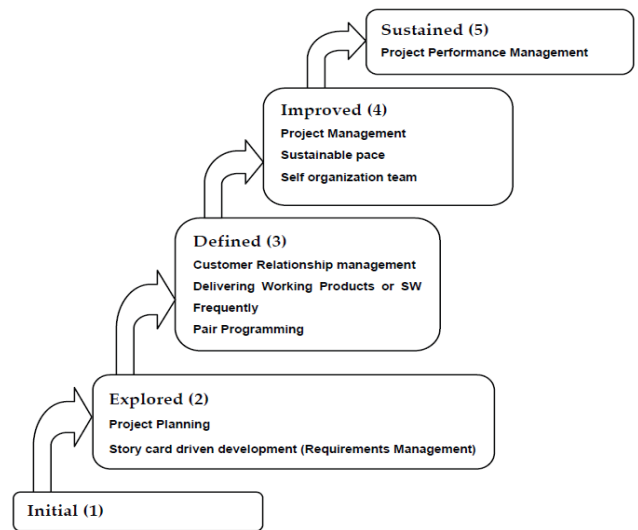

Figure 2.   Agile Maturity Model staged representation [31].

This model is shown in Figure 2. and it is somehow inspired by CMMI, since it also has 5 levels, each with a set of goals for their practices: (1) Level 1: Initial – organizations belonging to this level of agile maturity do not have a clearly defined process for agile development and eminent success depends solely on the competence of individuals; (2) Level 2: Explored – it gives particular focus to project planning and requirements engineering for organizations; (3) Level 3: Defined – it stresses the importance of frequent deliveries, pair programming and customer relationship enhancement; (4)

Level 4: Improved – it focus on project management, sustainable velocity of development and self-organizing teams; (5) Level 5: Sustained – underlines the need for the management of projects' performance, thus continuously improving processes.

The AMM provides a first approach to classifying the maturity of agile development processes, which comprises practices from various agile methodologies. Therefore, it leads us to a continuous research, since this model's set of practices crosses too many agile methodologies that most organizations do not apply, causing increased levels of entropy.

C. Agile Maturity

Agile Maturity paper appeared as a study case from the British Telecom while developing an IT project [32]. Since it was said that big organizations had increased the barrier for a successful agile adoption, an agile maturity roadmap was presented.

The agile maturity evaluates the agile performance in seven dimensions within five levels of maturity: (1) Level 1 – represents the appearance of software engineering best-practices; (2) Level 2 – best-practices are continuous and improve within small development teams; (3) Level 3 – there is continuous integration within local component teams; (4) Level 4 – there is an incessant integration within global journey teams, i.e., distributed teams, and; (5) Level 5 – on-demand development maturity.

For each of these levels there shall be an evaluation of each the seven existing dimension: (1) Automation of regression tests; (2) Code quality metrics; (3) Automation of deployment; (4) Automation of configurations and best-practices management; (5) Interface integration tests; (6) Test driven development, and; (7) Performance scalability tests.

The combination of these five maturity levels and the seven dimensions allowed British Telecom to incrementally perform a better agile development process. However, this approach is generic and non-focused on the description of these levels and their practices, which leads to one's need to seek another solution for the major problem stated in Section I.

IV. PROPOSAL

Following the problem focused throughout the last investigation and its various related work, the proposal of a potential solution was introduced in the previous work. Therefore, this section will present the improvements made, the results from the previous proposal through the last two cycles of action research, and propose an optimized roadmap for IT organizations, with renewed validation, so as to develop software with better quality, i.e., more focused on the client role and motivated to self-improvement and market competition.

The Scrum Maturity Model's main purpose is to aid and guide IT software development organizations and encourage self-improvement, giving special attention to the client's role, which is mandatory on this fast moving, global and competitive worldwide market. Furthermore, this proposal intends to help organizations that are not familiar with Scrum and wish to implement and adopt it on a staged and incremental approach.

This proposition introduces five levels for Scrum development methodology with its respective goals, objectives, specific and suggested practices. The number of levels is a standard of maturity models; thus making it easier to be measured up with other maturity models for comparison and evaluation purposes.

Next, the main improvements made from the original proposal will be presented. Note that the full details of the proposition contain the complete goals, objectives, practices and suggested metrics for each level of Scrum maturity.

A. Level 1 – Initial

This first and lowest level of maturity, which can be assigned to an organization that uses Scrum, represents the absence of goals for process improvement. The explicit definition of agile development with Scrum methodology does not exist within organizations classified as belonging to this level.

The main issues of the organizations in this level are the frequent over-time and over-budget projects, poor communication among stakeholders and unsatisfactory quality of the final product. These organizations operate on their own and unique way depending on their particular situation which makes their success highly reliant on competent and skilled individuals rather than on standardized and capable teams. In fact, organizations that do not comply with the goal defined for level 2 of Scrum maturity are downgraded to level 1 until further improvements are performed in order to achieve the next level.

B. Level 2 – Managed

In level 2, software development practices appear more structured and complete than in level 1, due to the fulfillment of the two main goals set for this level also shown in Figure 3:

Goals	Objectives	Practices	Suggested Metrics
Basic Scrum Management	Scrum roles exist Scrum artifacts exist	(…)	(…)
	Scrum meetings occur and are participated	(…)	(…)
	Scrum process flow is respected	(…)	(…)
Software Requirements Engineering	Clear definition of Product Owner	(…)	(…)
	Product Backlog Management	(…)	(…)
	Successful Sprint Planning Meetings	(…)	(…)

Figure 3.   Goals and objectives for level 2 of Scrum Maturity.

- Basic Scrum Management – this goal dictates practices that organizations in this level must accomplish, which will ensure the minimum acceptable usage of the Scrum methodology and structure. Note that, although all Scrum roles, objects and meetings must exist in these organizations, those Scrum objects might not be correctly or effectively used, resulting on the need to have further process improvement;

- Software Requirement Engineering – this goal comprises a set of practices that the organizations must comply with in order to achieve satisfaction from the final product's quality created by the vendor organization. Organizations in level 2 usually face fewer problems in the development process than the ones in level 1. However, they still have difficulty in communicating with the client-side representatives and delivering their projects as planned, concerning schedule and budget.

According to the last evaluation of the proposal, this level showed solid goals, objectives, practices and suggested metrics. For this reason, level 2 presented minor changes in the text of the practices, remaining the majority of this level intact.

C. Level 3 – Defined

Level 3 of this maturity model has its major focus on the relationship with clients and on time deliveries. Hence, this level also has two major goals, shown in Figure 4, to guide organizations and improve their processes:

Goals	Objectives	Practices	Suggested Metrics
Customer Relationship Management	Definition of "Done" exists	(...)	(...)
	Product Owner available Successful	(...)	(...)
	Sprint Review Meetings	(...)	(...)
Iteration Management	Sprint Backlog Management	(...)	(...)
	Planned iterations	(...)	(...)
	Measured Velocity	(...)	(...)

Figure 4.   Goals and objectives for level 3 of Scrum Maturity.

- Customer Relationship Management – this goal emphasizes the importance of the client and the efforts required to maximize the collaboration with the customer side, even considering the three main difficulties mentioned in Section I. A set of practices are defined and must be satisfied in order to solve the core problem of this investigation.

- Iteration Management – this goal is indirectly linked to the previous one, since both contribute to raise customer satisfaction levels. In order to achieve this goal, a set of practices must be fulfilled and implemented so that the organizations always deliver their projects and sprints on time, following their budgets.

With the implementation of level 3 of maturity, an organization can be successful on several projects. However, this success is only partial due to the lack of standardized management, which would guarantee the same quality and performance in all development processes.

Again, the previous work evaluated this level as fairly solid, and only minor changes within the description of the practices were introduced.

D. Level 4 – Quantitativelty Managed

In level 4 of Scrum maturity, an organization can boost their achievements by offering standardized and regular software development process aided by the management of the process performance through measurement and analysis practices. In this level of maturity, there are two main fields:

- Standardized Project Management – this goal shall lead organizations to use the same development process for all projects and deliver significantly high quality and performance levels. In order to achieve this goal, an organization must complete the standardization of the performed processes;

- Process Performance Management – this goal demands the monitoring of all suggested practices up to level 4 of Scrum maturity. These metrics aim to provide enough feedback about actual processes and manage their performance.

Although this level seems very simple in Figure 5, it is actually extremely hard to implement the management and monitor all projects within an organization so as to fulfill all specific practices and maintain the process' consistency. Note that suggested metrics may be used and organizations are encouraged to customize them to be more appropriate for each enterprise's culture and best practices.

Goals	Objectives	Practices	Suggested Metrics
Standardized Project Management	Quantitative Project Management	(...)	(...)
Process Performance Management	Measurement and Analysis	(...)	(...)

Figure 5.   Goals and objectives for level 4 of Scrum Maturity.

Organizations in this level adopt appealing Scrum development processes and the majority of their projects are successful. The only and last improvement left is optimization of the current processes.

With the previous evaluation process for this proposal it was possible to identify the ambiguity within level 4 for many organizations. In order to clarify it, the demand for "Standardized Projects Management" is now only applied to all agile Scrum projects within the organization, and not to all projects, since in one organization both waterfall development methodologies and agile, in different projects and clients, can coexist.

E. Level 5 – Optimizing

Organizations in level 5 of the Scrum Maturity Model are top class software developers using Scrum methodology. They focus on continuous self-improvement to excel competition and bring higher levels of satisfaction from client, development team and all stakeholders. The only goal for this level is:

- Performance Management – this goal allows organizations to measure and analyze their own actions and processes to self-improve.

Organizations in this level have achieved a maximum level and must not discard previous accomplishments and goals by negligence which will block continuous process improvement.

In Figure 6, the four objectives for the main goal of this Scrum maturity are illustrated, being "Causal Analysis Resolution" a newly added objective to this level of Scrum maturity.

Goals	Objectives	Practices	Suggested Metrics
Performance Management	Successful Daily Scrum	(...)	(...)
	Successful Sprint Retrospective	(...)	(...)
	Causal Analysis and Resolution	(...)	(...)
	Positive Indicators	(...)	(...)

Figure 6.   Goals and objectives for level 5 of Scrum Maturity.

The main result from the previous work for the definition and first approach experimentation was that the top levels of this Scrum Maturity Model were slightly incomplete and ambiguous. Therefore, the objective "Causal Analysis and Resolution" was included to be used with Daily Scrum and Scrum Retrospective Meeting as to analyze the occurred impediments, differentiate them from incidents and problems, make causal analysis retrospective and then take corrective actions against them.

Note that the whole Scrum maturity model was constantly aligned with similar and renowned best-practices such as CMMI. This decision was based on the purpose of future comparisons with CMMI assessments versus assessments using the proposed model, in order to provided another form of the validation.

Before the results from the practical experimentation of this preposition, note that this Scrum Maturity Model is comprised by its goals, objectives, specific practices and suggested practices for each level. However, due to its size, the complete list of specific practices was not presented. Therefore, only instances from the set were given.

V.   RESULTS

In order to evaluate and validate the usefulness and effectiveness of this improved proposal, a third cycle of action research was planned, which included two interviews with Scrum, agile and CMMI experts to validate the concept and details of the proposal as well as six appraisals and audits of Scrum maturity in three different enterprises so as to evaluate its usefulness, efficiency and impact made.

A.   Interviews

In order to attain validation of this concept: maturity model for agile Scrum development methodology, a few experts were interviewed.

1)   Expert A

Expert A, an international CMMI, Agile and Scrum expert and also partner of an Agile coaching company, granted us two interviews to present our previous proposal and discuss it regarding its viability, usefulness and value created from it.

According to Expert A, the first three levels of Scrum maturity have sufficient detail and acceptable approach. However, although level 4 and 5 have proper goals and objectives, they required some more detail, more specifically, practices to enhance the quality of Scrum Retrospective Meeting are lacking. For instance, practices such as "Question five W's", "Identify problems and incidents" and "Build cause-effect diagram to identify problems" would enhance the quality of the inner inspection from retrospective meeting to seek continuous improvement.

Nevertheless, in her feedback, Expert A also stated that the suggested metrics from level 4 of Scrum maturity presents an excellent feature, since not even CMMI presents suggested metrics that exists in COBIT. These suggested metrics allow the monitoring of the current state of the process and discover where to put efforts for improvement, apart from analyzing quantitative statistics from the development process.

About the concept as a whole, Expert A accepts that scattered Scrum loses integrity, however she also agrees that Scrum Maturity Model is not intended to split Scrum into five levels and areas, but rather to provide more emphasis on different areas in each level. Furthermore, it was assured that if this proposal does not become a standard worldwide, it will at least be an extraordinary tool to be used in Scrum Retrospective Meetings as self appraisal and assessment of own maturity.

2)   Expert B

Expert B, also an international Agile and Scrum expert as well as a Scrum coach, works for a top five world largest IT company, and conceded us an interview to present to him the actual proposal and discuss about its viability, usefulness and created value . He was pleased with the concept which involves the evaluation of the maturity of the Scrum process, and provided precious feedback for the definition of the practices of each level and within each goal.

Most of the original proposal remains, while merely the definition of the required practices changed, remaining the goals and objectives intact.

B.   Appraisals

Another way to validate this theoretical work is to apply it to organizations with strong contact with real business problems. To evaluate the proposal, the following process was adopted:

- Pre-appraisal questionnaire – First, a brief presentation of Scrum Maturity Model concept and its goals on each level will take place. Then, the organization will be asked to fill in the pre-appraisal evaluation form, which will unfold its beliefs about the level in which the organization should and will be classified;

- Appraisal – Later on, if it was never audited before, the appraisal for level 2 of Scrum maturity will begin. If they had obtained successful appraisals before, then the next level of Scrum maturity will be appraised. This process consists in auditing the organizations' practices against the checklist of the Scrum ones which must be

accomplished in order to obtain the intended level Scrum of maturity.

- Post-appraisal questionnaire – After the appraisal, the assessed organization receives a post-appraisal questionnaire to evaluate the proposal. This phase aims to extract all feedback, both positive and negative, about the proposal and the satisfaction level with appraisal results, comparing it to the initial expectations.

Next, we will present the action taken within three IT development and consulting organizations while auditing the maturity of their development process using Scrum. A number of organizations provided more than one project in progress for the audit process, therefore, in some, more than one project manager was interviewed.

1) Organization X

Organization X, which is focused on cutting waste in software delivery through the practice of lean and agile concepts that they have been implementing for a year now, allowed an audit of their software development process to assess their maturity of Scrum usage.

They are comprised by around seven developers abroad in Ukraine, who assume the Scrum role "Team", and three project managers in Portugal, that take on the role of "Scrum Master" involved in two or three projects at a time. This enterprise is the excellent example of distributed Scrum, which intends to manage the resources wisely without creating waste and still fulfills the needs of the client, considering the problems from cooperation and distance.

Within the pre-appraisal questionnaire, the organization predicted the possible outcome from the audit as level 2 or 3 of Scrum maturity, since they were aware of the lack of mechanisms to measure and monitor process metrics and formal processes for continuous improvement.

As the appraisal occurred, the organization was confronted with the checklist of the practices which had to be fulfilled in order to achieve the first level of Scrum maturity – level 2. According to the audit, they failed the "Basic Scrum Management" goal by missing the objective of "Scrum meetings occur and are participated". Actually, they ignored the need of a Scrum Retrospective Meeting and neglected the importance of a formal Daily Scrum Meeting and Scrum Review Meeting.

During the post-appraisal questionnaire, the organization did not show any sight of disappointment and, instead, appeared to be very excited with the results, displaying motivation and critic analysis toward the results and opportunities for future improvements for a better development process. First, they argued that it is very difficult to communicate with clients in this fast moving generation. It was hard to convince the collaboration and their presence at the end of each sprint, which caused them to fail practices such as "Sprint Review Meeting occurs exactly once per Sprint" and "Sprint Review Meeting is attended by Stakeholders, Scrum Master, Product Owner and Team". They also claimed against the failed "Daily Scrum occurs exactly once per workday"

practice, since the organization affirms there are casing meetings from lean development principles, for the nature of these meetings is different.

Nevertheless, at the end, the organization will rethink these failed practices, and the interviewed project manager planned to immediately launch the implementation of Scrum Retrospective Meeting, since it has great potential benefits that had not yet been considered.

When the interview ended, the interviewee gave the following feedback regarding the Scrum Maturity Model: "This proposal provides a good roadmap for IT organizations by offering goals and objectives per level to evolve and gradually improve, attacking one goal at a time."; "For higher levels of maturity, it is required much more stability to see the improvements and, although the existence of suggested metrics is brilliant, it lacks how to implement the monitoring mechanism.". As a final word, the Scrum Master from the organization stated: "Many organizations nowadays declare themselves as agile, but how agile they can be when there are no definitions or rules? The existence of this proposal can surely differentiate the successful agile practitioners from the others."

2) Organization Y

Organization Y, a fast growing IT consultant enterprise focused on satisfying the market needs through agile and flexible principles, also accepted to be a part of this investigation by providing three of their four project managers to be audited with Scrum Maturity Model.

They are around forty employees, with about thirty in headquarters and ten distributed in two other branches, being one of these branches located abroad, in Vienna. Currently, they employ four project managers and the CEO arranged three meetings with three of them in order to receive some academic research feedback within his company.

a) Project Manager Y1

Project Manager Y1 has been recently promoted to perform the more technical oriented role of project manager. He has a background in the business intelligence field, and now focuses more on the leadership and management of the team of developers for consulting projects.

During the pre-appraisal questionnaire phase, while analyzing the goals required for each level, he determined levels 1 or 2 as a possible result, for he was fully aware that the organization is on the early stage of agile implementation and several goals might not be fulfilled.

As the appraisal for level 2 of Scrum maturity occurred, soon the missing practices was identified. They missed the "Sprint Retrospective Meeting occurs exactly once per Sprint" practice. Unfortunately, this missing feature made this organization fail level 2, although many other practices were accomplished.

Then, within the post-appraisal questionnaire, the project manager agreed with the results, although slightly disappointed with the obtained level. The grounds for this result, he said, was that many unimplemented practices were not given the importance they should have and, although it is possibly very

rewarding, they wanted to focus more on the current client needs without having to worry about overworking their employees. Another explanation is that, given the dimension of his team, so much formality in the development process was not really necessary, as long as the results show up and the clients are satisfied.

For evaluation purposes, it was allowed for the project manager to inspect the next level, which turned out to be another failed appraisal, but this time for level 3, the organization failed the "Sprint Backlog Items are split into tasks" practice when all other practices were accomplished. With this result, the project manager was relieved as he believed that they could achieve up to level 3 of Scrum maturity with a relative small amount of effort, even though it required immense work in employees' culture to implement them.

To conclude, he agreed that the concept itself has potential to grown into a certification, which will provide more market differentiation. Another interesting point is that it might not be very expensive to concentrate efforts and obtain an acceptable level 3 of Scrum maturity.

b) Project Manager Y2

Project Manager Y2 is in charge of four development projects, each of them with only one or two developers located in Vienna focusing on the improvement of applications for smart phones. The main challenges for him are how to coordinate and perform the role of middle man between the client's needs and developers' performance with Scrum methodology, since he has less than a year experience with this development methodology.

Within the pre-appraisal questionnaire, given Manager Y2 relative inexperience, the project manager did not have high expectations and pointed out level 2 as a possible outcome.

During the appraisal, they failed many practices such as: "Release Burndown Chart exists", "Sprint Burndown Chart exists" and "Sprint Retrospective Meeting occurs exactly once per Sprint".

In the post-appraisal questionnaire phase, the project manager explained that due to the unawareness of the technical capabilities from the project management tools, it was not possible to maintain updated and correct burndown charts. Concerning the missing retrospective meeting, he stated that it is very difficult to have a formal meetings with the distributed team located in Vienna, seriously affecting the performance of this communication.

Again, for evaluation purposes, it was allowed for the interviewee to inspect the fully detailed Scrum Maturity Model, and advanced to the next level's audit. They did not accomplish practices like: "Definition of 'Done' is achieved in each iteration" and "During Sprint Review Meeting Product Owner and other stakeholders provide feedback".

In the end, the project manager was satisfied to learn more about agile Scrum methodologies, and where he should improve in further projects. He stated that this maturity model might be an important tool to measure their current performance and guide them to continuous improvement.

c) Project Manager Y3

Project Manager Y3, a very experienced and enthusiastic Scrum and agile practitioner, is leading the company to implement the backbone for Scrum adoption. It has been almost a year since they started trying to reach this objective, and, at the moment, they are in the final stage. For him, continuous improvement is the core strategy to achieve a competitive advantage. In order to achieve this goal, he leads the implementation and integration of several support systems to aid the development process, since he believes that no agile is solid enough without the required backbone tools. Now, he is in charge of a development project with three developers and a three month length deadline.

The pre-appraisal questionnaire phase revealed that he had high expectations and confidence in their maturity, choosing the level 4 or 5 as the expected result from the appraisal.

When the appraisal began, they succeed to fulfill level 2 practices, and then level 3. No problems were encountered so far. Surprisingly, level 4 was also achieved, because all his previous projects were managed with a standard method and he had a data mining module that defined, monitored and measure their development process and metrics. At the last appraisal for level 5, unfortunately, they failed the practices: "Successful Retrospective Meetings result in concrete improvement proposals" and "Successful Retrospective Meetings' lessons learned are recorded to a knowledge base".

Within the post-appraisal questionnaire, the project manager was satisfied with the results, seeing his efforts recognized by external parties and not totally disappointed with the obtained level 4 of Scrum maturity, since they were working on the quality of retrospective meetings now.

His final feedback for this proposal is the following: "This proposal is an excellent tool for deeper insight, to rethink their agile path. Moreover, this preposition motivates the adoption of Scrum by separating several objectives via levels. Agile is easy to learn, however very hard to master. Thus, it is very important for prepositions like these to exist in order to aid organizations to correctly adopt Scrum."

3) Organization Z

Organization Z is a worldwide renowned company that provides technology solutions and services around the world. In their office located in Portugal, they employ around four hundred professionals, delivering both consulting service and software solutions. Their development projects are normally very big involving more than forty people and a twelve-month period per project.

a) Project Manager Z1

Project Manager Z1 is the senior software architect and performs team coaching regularly. He worked for a leading and pioneer company using agile methodologies, where he learned a lot about agile best practices from the elite from that generation. Currently, the project he is working with involves forty people, three scrum teams and a year of schedule, and it applies Scrum methodology with this particular client for the first time. They are on the production and deployment phase.

In the pre-appraisal questionnaire assessment, Manager Z1 suggested level 3 as the possible result, since he was aware that the company missed the goals "Measurement and Analysis Management" and "Performance Management".

During the appraisal for level 2 of Scrum maturity, Manager Z1's project succeeded to accomplish all practices for level 2, except "Sprint Burndown Chart exists" practice.

In the post-appraisal questionnaire phase, Manager Z1 intensely argued about the need of a sprint burndown chart, which is only used to manage small two weeks sprints and creates waste by joining efforts to manually build such a chart. Note that the organization uses manual means to follow Scrum methodology.

By analyzing the next levels, Manager Z1 felt frustrated again, because he would fail level 3 due to the inexistence of the sprint burndown chart stressed in the goal "Iteration Management". However, to achieve levels 4 and 5, he agreed that more efforts were needed and that they intend to move further in their question of continuous improvement as a competitive advantage.

As final words, he said: "What I see here is a very interesting approach in agile methodologies study. The roadmap is very good for new enterprises to adopt Scrum and a nice differentiation model for companies in the development industry."

b) Project Manager Z2

Project Manager Z2 is also a well experienced Scrum practitioner within the organization, and is currently managing a project with four years already, which involves three Scrum teams. This project's particularity is that the client does not collaborate as closely as the company would wish, so Scrum was only applied as internal communication and work methodology.

In the pre-appraisal questionnaire, after the overview of the maturity mode, he selected level 2 as most likely result of the appraisal.

As the appraisal started, "Sprint Burndown Chart exists" practice was found to be missing just like in the last project manager. Moreover, they did not have "Sprint Review Meeting occurs exactly once per Sprint" practice formally implemented, only some demonstrations once or twice a year. Yet another missing practice was "Sprint Retrospective Meeting occurs exactly once per Sprint", as according to company's culture, it only happens right after the Scrum Review Meeting.

During the post-appraisal questionnaire, he commented as the following: "Agile methodologies stress communication a lot. Its qualities are not shown in tiny projects, but in large scale projects in which real problems occur. In these big projects, flexible and constant communication is needed to maximize and optimize the work performed. This proposal presents a staged maturity model to guide Scrum implementation and Scrum performance and usage to differentiate enterprises, which is a magnificent idea."

VI. EVALUATION

Given the results previously presented, in this section, a critic study for the Scrum Maturity Model will be analyzed and presented.

Regarding the interviews, it was possible for us to realize that the first three levels were well structured, while top levels needed some rework, which is already done. Moreover, it was stated by professionals that the preposition is a very good approach for Scrum adoption, self-inspection and continuous improvement.

This study considered the six performed appraisals in three sample organizations from Portugal, represented by a small, a medium and a large-sized company. Although the average level of maturity is not very high, many of the audited organizations were able to easily reach level 3 by focusing efforts to implement the missing goals, objectives and practices.

The most common missing practices for the first level of Scrum maturity, level 2, were "Sprint Review Meeting occurs exactly once per Sprint" and "Sprint Retrospective Meeting occurs exactly once per Sprint". In level 3, "Definition of 'Done' is achieved in each iteration" is the most commonly failed practice. Top levels were scarcely achievable due to their requirements for mechanisms and concepts for measurement; analysis of process metrics; causal analysis; resolution of problems; and, impediments identified, which were not popular among IT development organizations.

Although many organizations define themselves as agile and Scrum followers, another interesting finding is that many of the basics were not taken into account, and only main and popular values and principles were retained, resulting in these low levels of Scrum maturity.

Through this assessment, it was possible to conclude that the proposal provides a good roadmap for organizations that want to implement Scrum methodology from scratch, align their position for benchmarking purposes or for organizations that want to self-improve.

All feedback collected from both interviews with experts and professionals in the development industry gave us a great deal of confidence and insight to continue our research, refine it and possibly scale its usage and define it as a standard.

VII. CONCLUSION AND FUTURE WORK

In Section I, followed by some discussion and analysis, the main problem was a visible lack of collaboration, in most cases, between vendor organizations and clients as they tried to achieve the development of a successful IT project. This problem is a widely researched topic amongst IT experts, due to its vital importance on the success of software development projects [1][2][3][4][5][6][7][8].

Inspired by the related work and maturity models, the improved proposition, from previous research, with five levels of Scrum maturity presents a roadmap for organizations to implement Scrum methodology and compare the performance of software development process amongst competitors.

The main focus of this paper was the validation phase of the current proposal within cycles of AR, which are comprised

by two interviews with two agile and CMMI experts and six appraisals and post-appraisal assessment. The proposal was evaluated and validated by them, and it is our intention to share our findings with the scientific community. Since this proposition is continuously evolving, the current research shall be repeated until the community agrees on a final iteration and accept it as standard.

We are aware that the evaluation process has limitations, but despite credibility issues regarding this process, the experienced validation phase is worthy to be share with the scientific community, given the interest of the process and its results.

Along with the analysis of the motivation for this research, it was pointed out that further investigation on human factors and on the change of management areas might benefit and enhance the performance of this maturity model. Another interesting research topic would be the classification of the partnership and client maturity, since, as referred to in Section I, clients are usually the major impediment for successful IT projects.

In the end, and we once more stress, the proposition of maturity model is highly polemic within agile community. Nevertheless, the concept Scrum Maturity Model has proved successful as the roadmap for organizations that seek self-improvement and guidance.

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