Evaluating Quality in Agile Developments. A first validation experience with NEA Software SMEs.

Noelia Pinto; César Acuña; Nicolás Tortosa; Blas Cabas Geat

Research Group in Software Engineering and Quality (GICS).
National Technological University, Regional Faculty
{ns.pinto; csr.acn;blasc147;nicotortosa}@gmail.com

Abstract. To obtain products of high quality software it is necessary to carry out good processes management in which measurement is a key factor. Therefore, companies should focus on continuous improvement cycles that integrate both the development process and the product obtained, to increase quality in both aspects. This cycle of improvement involves the adoption of a quality model appropriate to the characteristics of the company and a methodology that guides the software development cycle. In this sense, the agile philosophy proves to be the most suitable approach for the current development environments, and they are positioned as an alternative to the development processes with high cost in documentation and excessively long processes. This paper presents the results obtained by automation of QuAM Model [1] for the quality evaluation of agile projects on actual production environments and the subsequent analysis based on these projects.

Keywords: Software Engineering; Quality Software; Agile Projects

1 Introduction

In Argentina, the Software Industry is mainly made up of SMEs (Small and Medium Enterprises) where the quality of the work done, the low costs and the timely deliveries are essential elements for the increase of internal sales and projection at the international level [2].

There are numerous methodological proposals that guide the software development cycle and that impact in different dimensions in the process. Among the most used proposals we can mention the traditional methodologies, which are especially focused on a rigorous definition of roles, activities that are involved, artifacts that must be produced, tools and notations that will be used [3]. However, these approaches do not prove to be the most appropriate for many of today's projects, where the system environment is very changeable, and where it is required to reduce drastically development times, but maintaining a high quality both at the process level and the product.

In contrast to these approaches, agile methodologies emerge which pursue principles such as the incremental delivery of new functionality to the customer, which is prioritized per business value it adds (in this way the software product evolves in the different deliveries), continuous improvement and focused on close collaboration between the team of programmers and business experts [4].

To develop their products, the agile methodologies offer these SMEs the possibility of having lightweight and simple processes, which can be adapted to their structure. Quality (both in software developed and in its corporate image) and reputation begin to be competitive and differentiation's factors in this segment. Since the quality of the software product developed is closely related to the quality of the process used, SMEs need to implement strategies to improve their processes that allow them to increase the quality of their products.

In this way, there is a need to provide a framework that allows evaluating the quality when they choose to work with agile methodologies, which arises from the analysis of the situation of the Software Industry in the NEA region (North-East Region of Argentina) regarding the adoption of the life cycle that guides processes of software development [5].

In previous works [1][6][7], QuAM Model (Quality Agile Model) has been presented, which is a first approximation to the definition of a model that allows the evaluation of the quality of projects in agile environments. Also, the results obtained have been exposed, after analyzing the validation experience of this proposal with some of the SMEs software development companies in NEA region.

However, to evaluate the quality of agile projects, it is not enough to define a model, for that reason the development of QuAGI has been approached: A web application to provide support the management of the QuAM model, integrating the follow-up agile projects and quality evaluation throughout the process [8].

The present article that continues with this line of research Aims to expose the results obtained when evaluating the quality of agile projects in real production environments using QuAGI together with the analysis of the validation experience. The article is structured as follows: Section 2 presents a brief review respect to the models and tools that could be used for quality evaluation in agile environments. In Section 3, it is briefly described the architecture of QuAGI and it includes the study case that allows defining the QuAGI implementation platform. Then, in Section 4, the results of the experience of linking between the technical team and some companies dedicated to software development in the region are presented. Finally, Section 5 presents conclusions and future works.

2 Related Works

In the literature related to the research topic that we address in this work we have found studies that are focused on the relationship between agile processes and quality assessment from various perspectives. We present below, the topics that we consider most relevant, grouping them in studies where models for the quality evaluation and studies that allow to realize the management and monitoring of the projects are presented.

One of these cases is presented in [9], where the authors present AGIS, a tool capable of measuring the degree of agility of a process per the values of the agile manifesto, based on the principles of improvement and audit of ISO 9001: 2008 [10]. The purpose of this is to obtain an objective measure of the productive process that avoids false positives on both sides. AGIS aims to satisfy two needs: on the one hand,

it is focused on the companies, since this model allows achieving a differentiation with respect to other companies that have only certified quality through ISO 9001: 2008. On the other hand, AGIS to offers a report of improvement suggestions based on the assessment of the dimensions it proposes to evaluate. The model also offers an objective definition of the degree of agility of a project, which can be used to compare differents projects.

Another similar model is AGIT (AGIle software developmenT) [11] which suggests that the best performance is achieved when the goals of all stakeholders are met. This requires an approach that considers the views of different stakeholders, for which the appropriate indicators are defined for each one. AGIT considers four different points of view for stakeholders: the IT Administrator is the actor concerned with the traditional aspects regarding the performance of SW development considering time, cost and quality; the second actor is represented with team members whose goal is "job satisfaction"; The Scrum Master whose main goal is the "efficient resolution of impediments". Finally, the fourth stakeholder is customer satisfaction. This model suggests evaluating the quality of the development processes considering the points of view of the different stakeholders involved, describing the indicators that are appropriate to each of these profiles. Considering both AGIS and AGIT models, it is observed that there is no proposal that allows the quality evaluation of the agile processes themselves.

Regarding software tools, there are several alternatives that allow the monitoring and knowledge management of software projects based on agile methodologies. One of these applications is Trello [12], the web project management tool based on the agile Kanban method [13], with cards (representation of an activity described in a sentence) that cross different lists considering their status (pending, in process, finished). The lists are inside boards, and within the lists are the cards. The cards support any kind of documentation, images, videos, lists, comments, etc. So, they also serve as an instrument of communication in working groups, about a certain topic.

Another application used for knowledge management in software projects for agile methodologies is Jira [14]. This tool allows the handling of version control, notifications to the team members of new tasks to carry out or modifications to existing ones. Like other similar tools, it records operations to maintain traceability between artifacts. Each of them supports a life cycle in which you can add, remove or change transitions if required.

A third application studied is Taiga.io [15], open source web platform for the control and planning of projects using SCRUM. It is offered as software to be downloaded and installed on your own infrastructure or you can also use a SaaS version. Within the latter alternative, whenever public software projects are created, the tool will be free.

In this way, it is observed that there is no alternative to integrate both monitoring of agile projects and qulity evaluation, based in a model defined for this purpose. Therefore, from this line of research arises the proposal of a framework, AQF (Agile Quality Framework), which consists of a new quality model, QuAM, and for the moment, an only web application, QuAGI, which manages the components of that model.

3 Case Study: Real implementation of QuAGI

3.1 QuAM: Model for assessing the quality of agile projects.

In [6] we present QuAM, a model that, in its first approximation, aims to provide a method that allows to evaluate the quality of both software development processes based on agile practices and final products. QuAM, as indicated in Table 1, defines a scheme of components, including metrics and atributes, to configure a quality evaluation model that provides an objective measurement of the quality of the process implemented in each project.

Table 1. Tree of Metrics defined in QuAM

Metrics 1: Life Cycle Selection	
Positive Atributes	Negative Atributes
A1.1 Give value to Iterative and Incremental Cycle.	A1.2 Give value the Waterfall Cycle.
Metrics 2: Evaluation of the Work Team.	
Positive Atributes	Negative Atributes
A2.1 Give value to team meetings.	A2.2 Give value to schedule compliance.
A2.3 Give value to the roles definition	A2.4 Give more value to the process than to the team
Metric 3: Production capacity of deliverables.	
Positive Atributes	Negative Atributes
A3.1 Give value to use of change management tools.	A3.2 Give value to management of requirements.
A3.3 Give value to functional product.	A3.4 Give value to documentation.
Metric 4: Communication with Product Owner	
A4.1 Give value to collaboration with the product owner.	A4.2 – Give value to contractual negotiation

3.2 QuAGI: Web application for the monitoring and evaluation of agile projects.

It is not enough to have a quality model that allows to measure the level of quality of an agile process if a tool is not available that makes it possible to manage the elements of the model and to analyze the results obtained from various evaluated cases. Therefore, to give support QuAM, has been developed QuAGI [8]. This is a web application that allows the monitoring of projects based on agile practices together with the possibility of conducting continuous evaluations regarding the level of quality that is being achieved in the process.

First, QuAGI allows the administration of the projects through the visualization of the plan, provides reports regarding the states of the plan, provides comprehensive

information of the activities, serves as an internal communication tool, among others functions. Secondly, it supports the decision-making processes by assisting those responsible through reports about the quality evaluation of the project in question and recommendations for continuous improvement, all through the incorporation of algorithms of Artificial Intelligence integrated with QuAGI.

The proposed architecture of QuAGI, as shown in Figure 1, consists of a platform based on reusable components, allowing the applications that are integrated to the platform make use of such components. In the presentation layer, the interface design and user interaction was done using the framework Materialize along with jQuery functions. As a development framework Django is used, based on an MVC (Model-View-Controller) pattern that separates business logic from presentation logic by using the template system. The choice of Django is fundamentally due to the philosophy of reuse and fast development of web applications. Related to this, the decision to use PostgreSQL is due to the robustness it provides by being integrated into this framework.

Fig. 1. Architecture

So far, QuAGI allows access to three types of users: Role of Project Manager (maximum responsible for the Project), Team Members (those who are assigned tasks for each project) and Product Owner (who defines the requirements of the project). For example in Figure 2 shows the interface that allow manage projects, track tasks, view reports, and so on, based on the permissions granted.

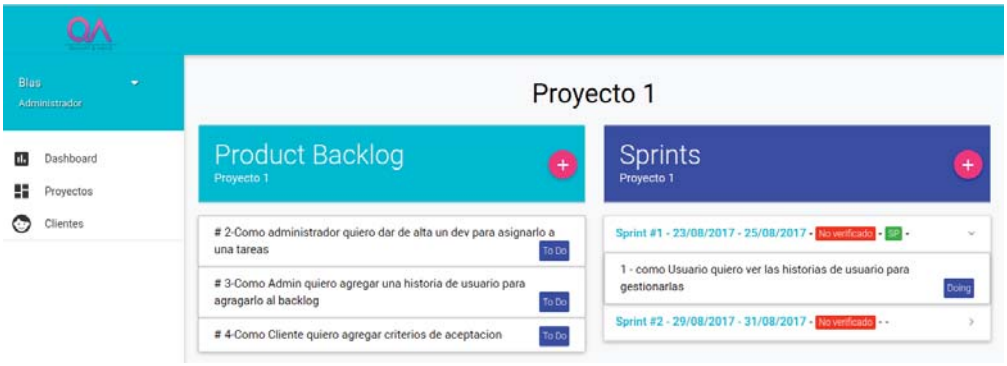

Fig. 2. UI "Details of each Project"

3.3 QuAGI Validation Process

In order to analyze the impact of AQF on SMEs, a stepwise validation process was implemented, as shown in figure 3, on real production environments based on the use of QuAGI as an agile project management tool.

Fig. 3. Validation Process

The stages of the Plan are described below:

- Selection of companies: From the population of SMEs dedicated to the development of software in Chaco and Corrientes, only a few companies were selected for the validation experience, considering those that had agile projects in production. The sample size is equal to 5 companies, which represents 25% of the SMEs population in total.
- Implementation and Monitoring: Because the tool is in the process of adjustment and considering the availability of the companies to collaborate with the implementation process, it was proposed to start with the evaluation of one of the QuAM metrics.

  The chosen metric was "Communication with the Product Owner" whose attributes and criteria are shown in table 2. This choice is based on the fact that the agile projects that participated in the experiment have not yet completed; so it is not feasible for QuAGI, in an early stage of the process, to obtain quality values for the rest of the metrics. This does not happen with metric 4, because information about client is requested at start and at the same time it is necessary to indicate how the project requirements will be managed.

Table 2. Metric 4 "Communication with Product Owner"

Positive Attributes	Negative Attributes
A4.1 - Assess the collaboration with the client. - Product Owner is part of the team, responds to queries, plans iterations, and collaborates in writing requirements (3) - Product Owner is part of the team, responds to queries and plans iterations	A4.2 - Assess the contract negotiation. - There is detailed contracting at the beginning and no changes are accepted (-3) - Recruitment requires contemplating changes during the project (-1) - The contract exists but does not

(1) - Product Owner cooperates with team demands (0)	affect the project at the level of the development process (0)

Each of the teams had to load information from their projects into the enabled dashboards in the tool per each account requested to obtain preliminary results. Then, QuAGI's technical team carried out the monitoring of the project management with the quality evaluation reports that were made at different times.

In case of metric 4, only the interaction of company's Product Owner with the project was analyzed. QuAGI considered the following factors in order to obtain the measured values:

- To give value to the positive attribute, an evaluation is performed when the customer is registered:
  - If your relation to the project was indicated as "Per contract only", the corresponding value is 0.
  - If it was included as a member of the project team, but it was detected that it does not write user stories and it only validated iterations, it corresponds to a value of 1.
  - If it collaborates as a member of the team, in the writing of user stories and validates the iterations corresponds to the maximum value of 3.
- To give value to the negative attribute, the contract is evaluated:
  - If the contract already includes the requirements without possibility of generating new user stories corresponds a value of -3.
  - If the project is associated with a contract, with immovable requirements but it is possible to incorporate new functionalities corresponds a value of -1.
  - If the contract exists but does not directly affect the development process (e.g. only defines economic factors), the value is 0.

- Validation: Based on the measurement process that QuAGI was carrying out, control points were established to validate partial results. Thus, working together with each company, the feedback was obtained taking into account the experience of an agile project.
- Proposals for Improvements: Finally, the responsible team established improvements to the platform that will be included in the next iteration together with the need to modify the model to fit the reality of agile projects.

4 Results Obtained

After completing the first implementation cycle, which lasted approximately 45 days, and considering the checkpoint agreed with the companies, the analysis of the

information generated by QuAGI was performed, obtaining the results that can be observed in figure 4.

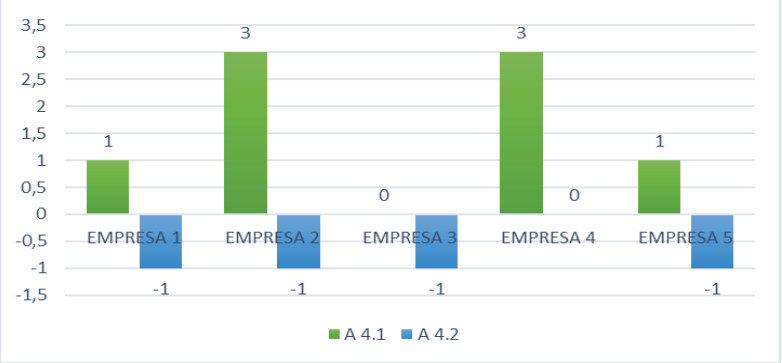

Fig. 4. Evaluation Results: Atribute 4 of Metric 4

In this graph, it can be observed that 40% of the companies studied achieve the maximum value for the positive attribute "Evaluate the collaboration with the product owner". However, it can be distinguished that 4 of the 5 companies obtain a value -1 for the negative attribute "Evaluate the contractual negotiation" which means that there is a contract with rigid requirements but with the possibility of incorporating new functionalities. All of this, is summarized in the quality values associated with metric 4 that are included in figure 5.

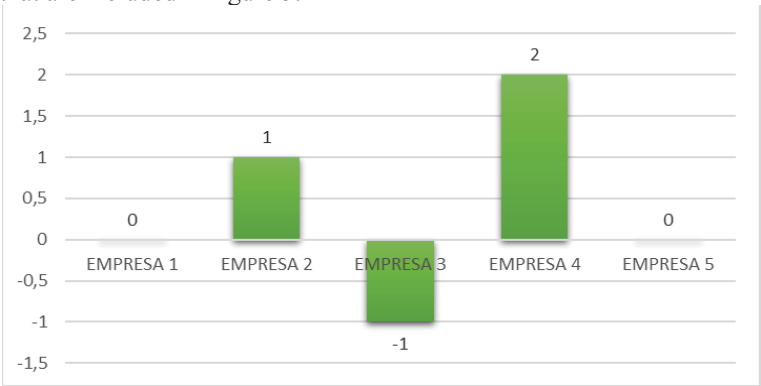

Fig. 5. Quality Values: Metric 4

Only 2 of the 5 companies that participated in the validation experience are close to the optimum value for the metric 4, taking into account that all companies worked with agile projects, using QuAGI as a tracking tool.

5 Conclusions

This work presented the results obtained from the quality evaluation of agile projects in real production environments in SMEs of Chaco and Corrientes, using

QuAGI, as a tool for monitoring agile processes and management of components defined based on a new model called QuAM.

Thus, on the one hand, model QuAM is proposed as an approximation to a new model that allows the initiation of quality evaluation in real software projects guided through agile practices. And, on the other hand, to offer a web platform called QuAGI that allows companies to optimize the quality in the process of their agile software projects, providing information not only referring to the monitoring itself, but also to the associated quality.

After this first stage of implementation, and through different cases that allowed the validation of the framework in real environments, it has been observed that companies easily incorporated QuAGI as a support tool for the development process. This is due, fundamentally, to a user-friendly interface and clearly defined workflows. Likewise, with respect to the results obtained through the quality evaluation of the only implemented metric, the SMEs remarked that they reflect what is expected per the characteristics of each one but that are not significant attributes to the quality of the project in question.

Therefore, and as part of future work, the need to adjust the proposed model arises from the definition of new attributes in each metric according to real agile practices. In addition, it will be necessary adjust QuAGI and to carry out more case studies to achieve a more approached version to the reality of the SMEs and yours agile projects. Finally, continuing with the development of the platform will mean extending the functionality of the tool to the evaluation of the remaining metrics as defined in QuAM.

Acknowledgments. The work presented here is framed in the project "Evaluation of Quality in Agile Processes of Software Development", which is funded by the UTN and executed in GICS of UTN FRRe, with code IAI4445TC. Also, the article is part of the activities planned in the Technological and Social Development Project (PDTS) presented as "Contribution to the competitiveness of the software development companies of the NEA", IP253, evaluated and approved by the National Council of Scientific and Technical Research of Argentina (CONICET). And it is related to activities from Project "Tools and Methods to support Software Engineering: requirements, agile strategies and quality of processes and products", residing in the Regional Faculty of Santa Fe and approved as a Project of the Secretariat of Science, Technology and Postgraduate of the UTN, with code IPN4409. In addition, the results contribute to the activities of the project "Quality Assessment Model in Agile Processes of Software Development" funded by Gastón Dachary University under the code A07010. Finally is necessary to acknowledge to PhD Verónica Bollati for her contributions by your experience in agile environments and the translator Miryam González for her collaboration in the writing of this article in English language.

References

1. Noelia Pinto, Gabriela Tomaselli, Liliana Cuenca Pletsch, Nicolás Tortosa, César J. Acuña "Validación del diseño de componentes de QuAM: un Modelo de Calidad para procesos Ágiles". Publicado en Libro de Actas del IV Seminario Argentina-Brasil de Tecnologías de la Información y la Comunicación (SABTIC 2016).
2. "Reporte anual del sector de software y servicios informáticos de la República Argentina", Abril 2016, CESSI, Argentina, http://www.cessi.org.ar/descarga-institucionales-2007/documento2-130347cd83ae771a9f3db3da5407269a
3. Letelier, P., Penadés, P. "Metodologías ágiles para el desarrollo de software: eXtreme Programming (XP)" Técnica Administrativa, Buenos Aires. ISSN 1666-1680, 2006.
4. Rujana M., Romero Franco N., Tortosa N., Tomaselli G., Pinto N. (2016). Análisis sobre adopción de metodologías ágiles en los equipos de desarrollo en pymes del NEA. GICS, UTN, FRRe. XVIII Workshop de Investigadores en Ciencias de la Computación (WICC 2016, Entre Ríos, Argentina).
5. Acuña, C., Cuenca Pletsch, L., Tomaselli, G., Pinto, N., Tortosa, N. "Calidad de Software y Metodologías Ágiles en las PYMES de la Industria del Software". Publicado en Memorias de 3er Congreso Nacional de Ingeniería Informática / Sistemas de Información (CONAIISI 2015). Noviembre, 2015. ISBN 978-987-1896-47-9.
6. Pinto, N., Tomaselli, G. et al. "Hacia un modelo de evaluación de calidad de Procesos Ágiles". Publicado en Memorias del 4to Congreso Nacional de Ingeniería Informática / Sistemas de Información (CONAIISI 2016). Noviembre, 2016.
7. Pinto, N., Acuña, C., Cuenca Pletsch, L. "Quality Evaluation in Agile Process: A First Approach". XIII Workshop Ingeniería de Software (WIS). XXII Congreso Argentino de Ciencias de la Computación (CACIC 2016).
8. Pinto, N., Tomaselli, G., et al. "QuAGI: Una propuesta para el seguimiento y evaluación de proyectos de Software Ágiles". Publicado en los Anales del V SABTIC, VIII STIN y XVIII Foro, Trés de Maio, Brasil. DOI: 10.5281/zenodo.583174
9. Matalonga, S., & Rivedieu, G. AGIS: hacia una herramienta basada en ISO9001 para la me-dición de procesos ágiles. Computación y Sistemas, 19(1), 163-175, http://www.agilemanifesto.org/iso/es/
10. Beck, K., Beedle, M., Van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., Grenning, J., Highsmith, J., Hunt, A., Jeffries, R. and Kern, J., 2001. Manifesto for agile software development.
11. Cohen, D., Lindvall, M. and Costa, P., 2003. Agile software development. DACS SOAR Report, 11.
12. Trello, https://trello.com/
13. Garzás, J. "¿Qué es el método Kanban para la gestión de proyectos?", http://www.javiergarzas.com/2011/11/kanban.html (2011)
14. Jira, https://www.atlassian.com/software/jira
15. Taiga.io, https://taiga.io