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Study of the use of agile methodologies in the development of software construction projects in Colombia

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Abstract. The Software Engineering Research Group of the University Francisco de Paula Santander has been implementing projects based on the development of methodologies for the creation of software; thus, as part of these projects a study of the use and knowledge of Agile Methodologies was conducted. The study was based on the application of a survey to determine the preference of IT professionals in identifying the most agile methodologies used in development groups in Colombia and to determine the selection criteria. The survey was applied to a sample of one hundred and four (104) professionals from a population of one thousand two hundred and thirty-four (1234) Systems Engineers; graduates from the Systems Engineering program who work as developers throughout the country. From the study, it can be concluded that Colombia is keeping up with global trends in the use of Agile methodologies; as a result, 73% of the professionals surveyed applied an agile methodology for the development of software products and of the percentage obtained, 43.42% used the Scrum methodology and 19.7% applied the Scrum/XP hybrid.

1. Introduction

Good engineering practices are fundamental in software development; in addition to having a good development team, it is essential to have knowledge of a developmental methodology that allows us to plan a course of action to achieve the objective initially proposed, such as obtaining products that meet all the requirements and needs of customers and users of the system and that these products have a high degree of quality. Based on the above, the Software Engineering Research Group of the Universidad Francisco de Paula Santander has been advancing research projects in this area, allowing for investigation into what agile methodologies are used within the software development groups in Colombia.

An Agile methodology within the development of software products considers a development environment used by a work team, organized in small groups of programmers which generate functional products [1-3].

Studies carried on an international level were consulted for this research of which statistics on the most applied Agile Methodologies were provided, such as the case of VersionOne Inc. developed in 2011 [4], an organization dedicated to conducting studies on trends in software development. Likewise, a survey was conducted at the national level for professionals in the area of Information Technology (IT).

The previous study allows for the knowledge of the tendencies or preferences that Colombian professionals have when selecting an agile methodology that favors the development of software



projects; using the most frequent problems and the most relevant characteristics that a methodology has as a selection criterion.

2. Generalities

The Agile Method in software development is an approach initially proposed by Martin [1-3], who defined it as Rapid Application Development, RAD, which consisted of a development environment, in which small groups of programmers participated using tools that automatically generated codes using high-level and highly productive syntax entries. Subsequently, methodologies such as XP - *eXtreme Programming* developed by Kent Beck were developed, beginning the era of agile methodologies, which were initially known as lightweight methodologies, but were not yet approved by the community of developers because they were considered to be intuitive methodologies.

Agile methodologies are adaptive rather than predictive and are more people-centered than process-centered [5]. This type of methodology focuses mainly on the relationships that people have in the development team rather than on the processes and tools used to build the product. Based on these characteristics at the beginning of the year 2001, a group of experts from the software developers' industry established the term agile applied to software development and created the "Agile Manifesto" which has the principles and values that the development groups must apply to create software and respond quickly to changes that may arise throughout the project, all of the above while maintaining the quality of the product that is generated [6].

Currently, methodologies such as: Scrum, eXtreme Programming -XP, Cristal Methodos - CM, Adaptive Software Development - ASD, Agile Modeling - AM, Agile RUP - dX, Dynamic Solutions Delivery Model - DSDM, Evolutionary Project Management - EVO, Feature-Driven Development - FDD, Feature-Driven Development - LD, among others are known.

The Software Engineering Research and Development Group of the Francisco de Paula Santander University is currently developing the following projects: agile methodology applied to the projects of the Systems Engineering Program of the University Francisco de Paula Santander involving the development of Mobile Applications [7], Agile development model for the implementation of an Enterprise Resource Management (ERP) system in the cloud and a model for its administration [8] and Project Management at the level of the Systems Engineering program and the Academic Department of Systems and Informatics of the UFPS [9]; These projects were investigated by incorporating the agile methodologies mentioned above.

This article analyses the preference of IT professionals in choosing an agile methodology. A population of one thousand two hundred and thirty-four (1234) professionals working in software development under agile methodologies in Colombia were consulted.

Likewise, the results obtained for this article are based on the study conducted in the year 2011 by VersionOne Inc. where a population of six thousand and forty-two (6042) respondents from companies that develop technology projects around the world were asked about the trends in the use of agile methodologies for the development of technology projects, in which more than 65% of the organizations that apply agile practices use Scrum, normally accompanied by others such as eXtreme Programming and Kambas [2, 12].

3. Data

The data for the study were taken from the Database of graduates of the Systems Engineering Program of the Francisco de Paula Santander University, Cúcuta, Norte de Santander, who work in software development. The population corresponds to one thousand two hundred and thirty-four (1234) System Engineering professionals graduated in the year 2017, who are distributed throughout the national territory.

The simple probabilistic type sample was used in this investigation, where all the individuals have the same probability of being chosen to be part of the sample and, consequently, all the possible samples of size n have the same probability of being selected. This method of probabilistic sampling assures us the representativeness of the extracted sample [8].

4. Process

To obtain the value of the sample, the following Equation 1 was used [10-11]:

$$n = \frac{(N(Z)^2P(1-P))}{(N-1)e^2 + ((Z)^2P(1-P))} \tag{1}$$

Where is taken a population of 1243 graduates, with a confidence level of 1.96, a probability of success of 5% and a sampling error of 4% generating as a value of the sample 104 graduates. The choice of the sample of 104 engineers was made randomly over the population.

A test with seventeen questions was applied, four of which were selected for their relevance to this article. For the development of the following article, five (5) questions were analyzed, which are the basis of this article. These questions are intended to explore the knowledge, the types of agile methodologies that engineers used in software development, and the features they considered relevant.

The questionnaire was divided into two sections: a) General data: roles played as developers, experience in software development; b) Agile methodologies: usage, degree of complexity in use, causes of misuse of methodologies, agile methodologies used and their characteristics.

5. Results

The investigation yielded the following results: 73% of IT professionals indicated knowledge of and use of agile methodologies and some existing methodologies, such as Scrum with 43.42%, Scrum/XP hybrid with 19.70%, XP with 10.50%, Crystal with 9.2% and ASD with 5.3%, the most used. See Figure 1.

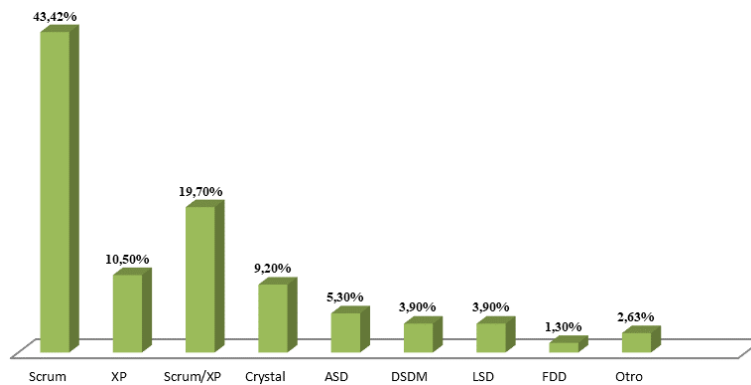


Figure 1. Most frequently used agile methodologies.

A comparison between the study conducted by VersionOne Inc in the year 2011 and the study object of this article can be seen in Figure 2, the results obtained show that the trend in Colombia is to use the methodologies used worldwide.

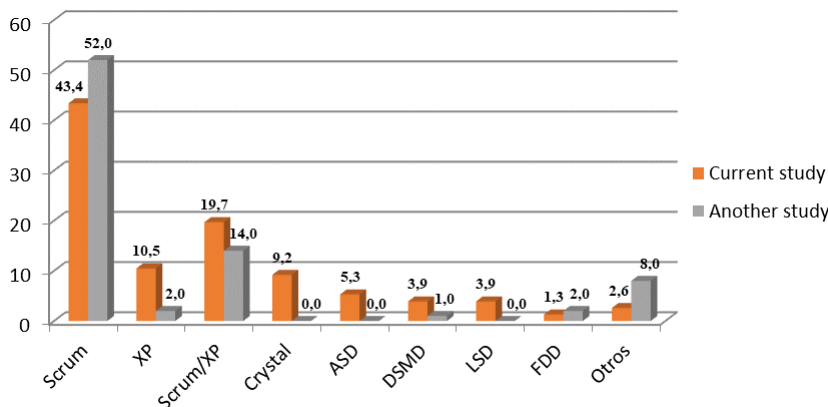


Figure 2. Comparison of agile methodologies used in Colombia and worldwide.

The level of knowledge of the methodologies used was evaluated and it was determined that the professionals surveyed who stated that they used an agile methodology were between a high level of 39% and medium of 53%, allowing for the appropriate application of the agile methodologies and expressing that the use of such has generated an improvement in the delivery times and overall quality of the products generated. See Figure 3.

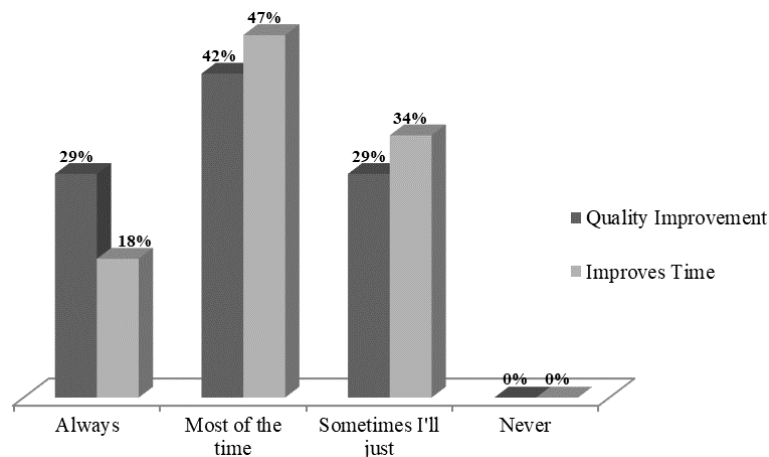


Figure 3. Improvements in quality and time with the use of agile methodologies.

According to the study, the difficulty in the use of agile methodologies is mainly due to the fact that there is no change in the organizational culture (28%), the lack of experience in the use of these methodologies (23%), the unwillingness of the development team to follow an agile methodology (19%), the little training and preparation given to the development team (14%). See Figure 4; and the degree of difficulty tends to be between medium (47%) and high (16%), although there is a significant percentage of professionals who state that it is low (32%).

Likewise, the respondents stated that the characteristics they consider most relevant in agile methodologies are those that allow for: constant communication with the client (100%), partial deliveries of the product (100%) and easy learning (100%), among others. See Table 1.

Table 1. Characteristics of agile methodologies.

Characteristics	Absolute frequency	Absolute frequency accumulated	Relative frequency	Cumulative relative frequency
	F_i	F_i	N_i	N_i
Communication with the customer	74	74	0.1	0.1
Partial deliveries	74	148	0.1	0.199
Easy Learning	74	222	0.1	0.299
Equipment size	71	293	0.096	0.394
Tolerance to variations	69	362	0.093	0.487
Time sensitivity	66	428	0.089	0.576
Project control (meetings)	66	494	0.089	0.665
Minimum defined artifacts	66	560	0.089	0.754
Communication between the team	65	625	0.087	0.841
Defined Roles	61	686	0.082	0.923
Planning	57	743	0.077	1

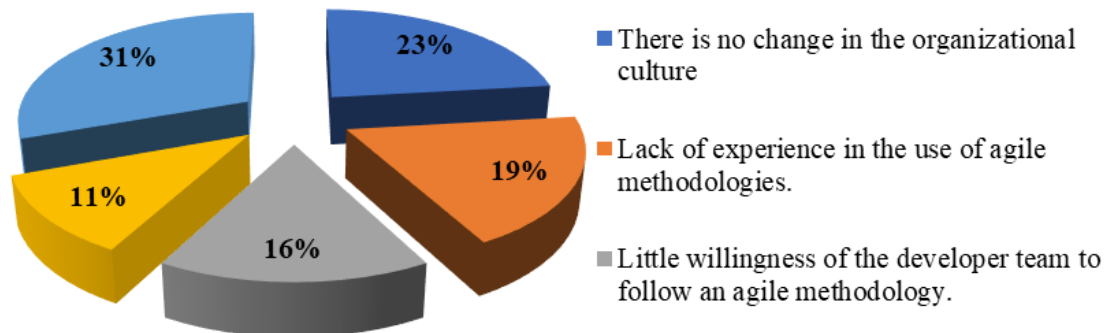


Figure 4. Main problems with the use of agile methodologies.

6. Conclusions

The development of Software projects in Colombia, is gradually increasing; Within Project Management, the selection of a methodology for the development of products is vital. Therefore, development teams are questioning what the best methodology for is obtaining a software product. Some simply adopt the best practices of an already recognized mythology in the environment and others already have a methodology adopted by the organization. It cannot be ignored, that software development is continually affected by the proliferation of methodologies that software development implies. One of the trends are agile methodologies, which allows software products to be delivered within shorter times and to the satisfaction of the client. The results of the article make it possible to determine that in Colombia the global trend in the choice of agile methodologies for the development of software products is constant. IT professionals are inclined to use agile methodologies such as Scrum, XP and their hybrid. It is important to indicate that the preference for these methodologies is given by the most relevant characteristics they possess, such as constant communication with the client, partial deliveries of the product and easy learning of the same. IT professionals explain the importance of applying an agile methodology within the development of software products, because it guarantees the improvement in delivery times and product quality thanks to the control and monitoring that is done in the development process.

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