

Usage of Agile Methodologies in Implementing Software Projects in IT Companies in the Republic of Macedonia

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Abstract - In this paper we analyze the contribution of using agile methodologies and their principles in conducting software development projects. The research is focused on Macedonian IT companies for software development and the goal is to get an insight of the way these companies organize their work and involve agile principles in their way of delivering value to the stakeholders. The research was conducted on 15 different companies involved in software development operating in Macedonia, where 60 team members were surveyed. From the collected responses, we have concluded that the software industry in Macedonia is still pretty young and immature industry sector showing lower levels of agility in the development process in comparison to the best practices measured on a global scale. The results showed that the key agile principles for software development in the Macedonian IT companies are satisfied on an average 25% lower level than globally.

Keywords— agile methodologies, software development, project implementation, value delivered, quality

I. INTRODUCTION

Agile methodologies, essentially relate to management of changes that follow each project in its realization. Each time a change occurs, these methodologies provide a way through which these changes will be included during the project implementation [1]. This would increase benefits for the party concerned for the change, while also reflecting with insignificant level of risk for the implementation of that change. For this matter, the sooner the change will be included and implemented in the system, the simpler, the cheaper and with low level of risk, with no major implications for the system, this change will be staged in the implementation of the system [2]. This is basically the essential part of the agile way of development. Agile methodologies are answer to the traditional methodologies for software development, driven by the need of an alternative between extensive documentation and adaptation to the changing environment [3].

Motivated by the increasing acceptance of the agile methodologies among mainstream software developers in the past 20 years, our main intention was to get some insight about the level of acceptance and the spread of the agile methodologies among the IT companies in the Republic of

Macedonia. In our research we questioned 60 team members from 15 Macedonian companies for software development. Looking at the everyday habits and practices of the team member, we gained knowledge of the level of acceptance of agile principles and artifacts. We conducted a web-based survey among the developers, testers and managers who are directly involved in software development. Our questions were targeted toward understanding the applied agile practices, and the perception of what is most applicable on their project implementation. Our findings indicate that about half of the respondents are not familiar with the agile methodologies. Among the rest of the respondents, Scrum was shown to be the most popular agile development methodology. The survey also showed that practicing agile methodologies is relatively new phenomenon to most of the teams. Most of the companies that decided to implement agile approach, turned to agility being unsatisfied with some of the limitations of the traditional prescriptive, plan driven methodologies.

The rest of the paper is organized as follows. Section II discusses the main advantages of the agile methodologies. Section III presents some results from similar researches from other authors. The research conducted in Republic of Macedonia is described in Section IV and the results are discussed in Section V. The conclusion is given in Section VII.

II. PRINCIPLES AND EFFECTS OF AGILE PROJECT MANAGEMENT

The overall objective of the creators of the agile methodologies for software development boils down to the ultimate value delivered to the customer, achieved through certain model of software development, including traditional [4]. Conditions affecting the project and the needs driven by these conditions, define means that moves the organization and the team toward the project implementation [5]. Projects that include activities in predictable and sustainable environment with low level of changing requirements, are better suited towards traditional way of developing projects, while in turn, dynamic surroundings where requirements change very often, achieve better results in environment where agile approach is practiced [6]. The basic benefits that can be identified for all

agile methodologies are: reduced risk, increased control over the project and improved communication at all levels [7].

Having in mind that every day we are facing changing circumstances of the working environment, and by the project conclusion, the product may become obsolete for that newly created environment [8]. Agile methodologies, providing a structured approach to organizing the work in an environment where requirement can change constantly have shown value for the developers and the customers.

Our main intention was to investigate the level at which agile methodologies are practiced among the IT companies in Macedonia.

III. USAGE OF AGILE METHODOLOGIES

Numerous studies about the implementation of the agile methodologies in industrial context and their effects were carried out by different researchers in the past years. One exploratory study conducted in Microsoft in October 2006 about the "Usage and Perceptions of Agile Software Development in an Industrial Context" [9], where answers of 492 respondents were analyzed, concludes that around one third of the respondents are using agile methodologies in some form. The research has shown that Scrum methodology was by far the most popular, with 65% of respondents using it on their software teams. The two least used practices were test-driven development and pair programming. Most of the respondents viewed agile software development favorably, due to improved communication between team members, quick releases and the flexibility of designs in the agile process. On the other hand, the practitioners of the agile development, developers were mostly worried about scaling agile to larger projects (greater than 20-30 members), attending too many meetings contributing to excessive overhead, and experiencing difficulty with the upper-level management ignorance toward agile methodologies.

Another similar research was conducted by Scott Ambler [10] in December 2012 and January 2013. In this research, in order to get an insight of the level of representation of agile methodologies and to what level teams comply with the agile principles, the author examines the following five agile principles: business value, validation, stakeholder collaboration, self-organization and process improvement. The structure of the respondent in this research was as follows:

- 174 respondents: 47% North American, 32% European, 12% Asia Pacific, 9% Other
- 19% programmers or agile team members, 16% managers, 25% "Scrum Masters",
- 14% worked in organizations of 500+ IT people.

The results from this survey showed that 91% of the respondents produce a working solution that provides quantifiable value to stakeholders on a regular basis, or that they have met the "Business value" principle. The results also suggest that 88% of the respondents do continuous regression testing, and better yet take a Test-Driven Development (TDD) approach, or that they have met the "Validation" principle. Almost all (99%) of the respondents claimed that they worked

closely with their stakeholders, or a stakeholder proxy, ideally on a daily basis, or that they have met the "Stakeholder Collaboration" principle. 72% of the respondents are self-organized and work within an appropriate governance framework, or they are meeting the "Self - organization" principle. And finally, 92% of the respondents regularly reflect on, and measure, how they work together and then act to improve on their findings in a timely manner, or they are meeting the "Improvement" principle. These results are showing high level of agility among the respondents, which are following the agile principles in delivering value to their customers.

IV. CURRENT STATE OF THE USAGE OF AGILE METHODOLOGIES IN MACEDONIAN IT COMPANIES

In the last decade the ICT sector in the Republic of Macedonia, has recorded growth rates in revenues and the value added of over 9%, and increase in the number of employees by almost 5%. Thus, this sector significantly influences the development of the overall economy of the country [11]. This economic and at the same time technological growth, implies internal progress in the internal processes inside the IT companies, operating in software development industry. On the other hand, the request for IT services on the Macedonian IT market is stagnating, drawing most of the companies to foreign clients and outsourcing. Cooperation with (usually much bigger) foreign clients and companies is influencing the way the local companies are organizing their operations. The purpose of this research is to investigate how well the IT companies in Macedonia, accommodate their practices to the fast growing global environment.

The research was intended to answer several questions like the size of the companies working in the IT sector in Macedonia, to investigate their familiarity and usage of agile methodologies among the IT companies in Macedonia, the maturity of the agile approaches they are practicing, and the system used to measure the quality of the product they deliver. As a byproduct, we were particularly interested in the software development methodologies used by each of the companies in respect to their sizes.

A. Hypotheses

Five hypotheses considering our research were set:

- H1: Macedonian companies for software development are not sufficiently familiar with the methods of agile software development.
- H2: Most of the companies that chose to implement a project using given methodology follow the principles of the given methodology.
- H3: The majority of Macedonian companies for software development do not have a system to measure the quality of the product.
- H4: Most of the companies that have used traditional waterfall methodology in the past, have turned to using agile methodology in the implementation of their current projects.

H5: Most of the micro, small and medium sized companies rely their project implementation on agile methodologies.

B. Users

The survey was conducted through an online questionnaire on the suited sample of 60 respondents from 15 companies operating on Macedonian territory. According to the working position, majority of the respondents in this survey are developers - 51%, the testers are represented by 15% while the project managers and business analysts with 3% each, of the respondents. The rest of the respondents in this research are as follows: Agile Team Members - 8%, Scrum Master - 5%, Architecture Owner - 2%, Business Stakeholder - 2%, IT Manager - 2%, Product Owner - 2% and other - 7%.

C. Process

The survey was conducted in the period September/October 2014, and it included 9 questions. The questionnaire was distributed through personal contact on social networks Facebook and Linked in, where target respondents were selected and surveyed. The questionnaire was constructed to examine the use of the following methodologies: XP, Scrum, DSDM, FDD, ADS, Crystal, Lean SD, Kanban, and Waterfall. The questionnaire was created using Survey Monkey.

V. RESULTS

The received responses showed that most of the respondents (88%) were working in companies up to 100 employees and 33% were involved in the development of software for corporate performance, and according to the working position most of the respondents were developers (51%).

In order to investigate to what level agile methodologies are practiced in the IT companies in Macedonia, similar to the previous studies, the five basic principles of agility (business value, validation, stakeholder collaboration, self-organization and improvement) were evaluated according to the respondent's feedback on the questions of the survey.

The principles of agility were evaluated as follows:

- **Business value:** Calculated as percentage of respondents claiming that their team is delivering functional software in each iteration, including several possible iterations without functional software delivery at the beginning of the project. (68%)
- **Validation:** Percentage of respondents claiming to perform regression tests or following the principle of test driven development during the design and development of functional requirements. (73%)
- **Stakeholder collaboration:** Percentage of all teams claiming to have the product owner representing the stakeholders, or working with domain expert as needed or have access to stakeholders on a daily basis. (65%)
- **Self-organization:** Calculated as percentage of teams claiming to hold iteration planning meetings and/or daily meetings. (72%)

- **Improvement:** Calculated as percentage of teams that claim to hold retrospective meetings at the end of each iteration or on a temporarily basis throughout the project. (65%)

In comparison to the global trend, represented by the results of Scott Ambler research in 2013, we can notice a certain degree of disagreement between the global practices and what Macedonian IT companies for software development are practicing, shown in Table I.

TABLE I. COMPARISON OF AGILE TRENDS

Agile Principles	Comparison of Agile Trends	
	Globally (2013)	Macedonia (2014)
Business Value	91%	68%
Validation	88%	73%
Stakeholder Collaboration	99%	65%
Self-organization	72%	72%
Improvement	92%	65%



Fig 1. Comparison of the levels of satisfying basic agile principles

As shown on fig 1, although noticeably present, except for the self-organization principle that showed the same value in Macedonia as in the global research, all other principles are satisfied on the average by 25% less teams in Macedonia than globally.

Regarding the number of employees, most of the Macedonian IT companies act as micro, small and medium-sized companies of up to 100 employees. The results show that the vast majority of 88.14% of the respondents in our research fall into this group. Only 8.47% of the respondents declared that they worked in a company that has over 100 employees, while only 1.69% of the respondents worked in company with over 500 employees, and additional 1.69% in a company with more than 1000 employees. (Table II.)

TABLE II. COMPANY SIZE

Number of Employees	Company size by number of employees
	Responses
1-10	27.12%
11-50	33.90%
51-100	27.12%
101-500	8.47%
501-1000	1.69%
1000+	1.69%

If we analyze respondents' answers to the question “Where do you find yourself towards this methodologies?” we can conclude that agile methodologies in Macedonia are still not well known, as considerable number of the respondents claimed that they were not familiar with most of the listed methodologies or that they only heard about some of them but did not apply them to their operations. These results confirm the first hypothesis. According to the respondent’s answers, shown in figure 2, the most widely applied methodology in the software development companies in Macedonia is the Scrum methodology (34% of the respondents) in most cases replacing the Waterfall approach used in the past (31%). The second most frequently used methodology by the respondents showed to be FDD, where 20% of respondents said they were currently working according to this methodology.

Furthermore, the answers to this question showed that 48% of respondents stated that they didn’t use any particular methodology in organization of the project implementation they were part of, in the past. Unfortunately the results are also showing that 42% of the respondents are currently working on the projects where they do not use any of the listed methodologies, including Waterfall as a traditional methodology. The results showed that the Crystal family of methodologies is the least known, where 78.58% of the respondents stated they were not familiar with it. (Figure 2)

According to the answers it can be noticed that 28.30% of the respondents are not familiar with XP (Extreme Programming) and 52.83% of them only heard of it but never practiced it. This goes on for the other methodologies:

- 20.69% are not familiar with Scrum and 17.24% only heard of it but never practice it.
- 54.72% are not familiar with DSDM and 33.96% only heard of it but never practice it.
- 37.74% are not familiar with FDD and 33.96% only heard of it but never practice it.
- 49.06% are not familiar with ASD and 37.74% only heard of it but never practice it.
- 78.85% are not familiar with Crystal Family and 19.23% only heard of it but never practice it.
- 30.19% are not familiar with RAD and 45.28% only heard of it but never practice it.

- 52.94% are not familiar with Lean and 31.37% only heard of it but never practice it.
- 59.62% are not familiar with Kanban and 23.08% only heard of it but never practice it.
- 25.93% are not familiar with Waterfall and 27.78% only heard of it but never practice it.

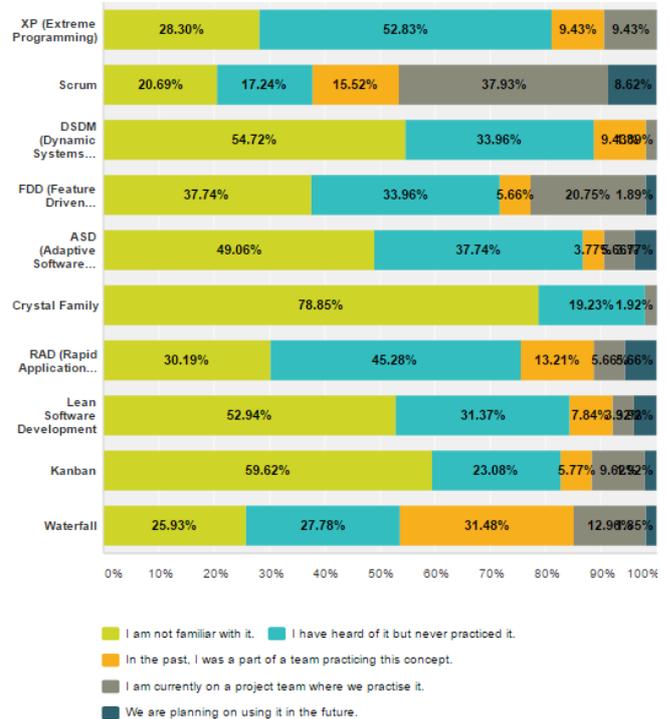


Fig 2. Where do you find yourself towards this methodologies?

Analyzing the answer of the respondents claiming to follow Scrum methodology in the Scott Ambler research from 2013, we can note that among the practitioners of the Scrum methodology the expected presence of the principles of agility is nearly 90%. Considering our research, the principles of agility with the Scrum practitioners group we can see that 86.36% of the respondents meet the Business Value principle, 81.82% meet the Validation principle, 68.18% meet the Stakeholder Collaboration principle, 81.82% meet the Self-organization principle, and 77.27% meet the Process Improvement principle. (Figure 3) This brings to the conclusion that Scrum practitioners in the software development companies in Macedonia are pretty close to fulfilling the basic agile principles, which partially confirms the second hypothesis.

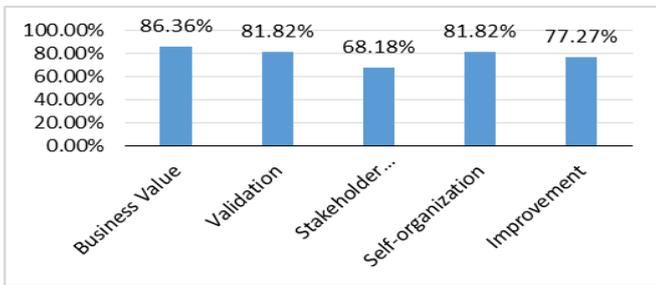


Fig 3. Basic principles valued from respondent who chose Scrum methodology

If we analyze the answers of the question “What strategies does your team follow to validate their work?”, most respondents stated that they validated their work using regression tests on a regular bases (58%) or practicing “final” testing by an independent test team before releasing the system (50%). This indicates that software testing during the development is less common. Analyzed from the standpoint of satisfying the “Validation” principle translated as performing regression tests or practicing test driven development, the survey results showed that 73% of the respondents were practicing one of these approaches for validation, which is 15% less than globally. On the other hand, the group of respondents claiming to be agile using the Scrum methodology, showed level of validation (68%) that is considerably lower than the global practice (88%). According to these results the third hypothesis can be confirmed, as most companies in Macedonia do not have established systems for continuous quality measurement and control. As for the assessment and approval of the developed software, at the end of each iteration, presenting a demo to the key stakeholders (40%) also showed to be quite popular (Figure 4).

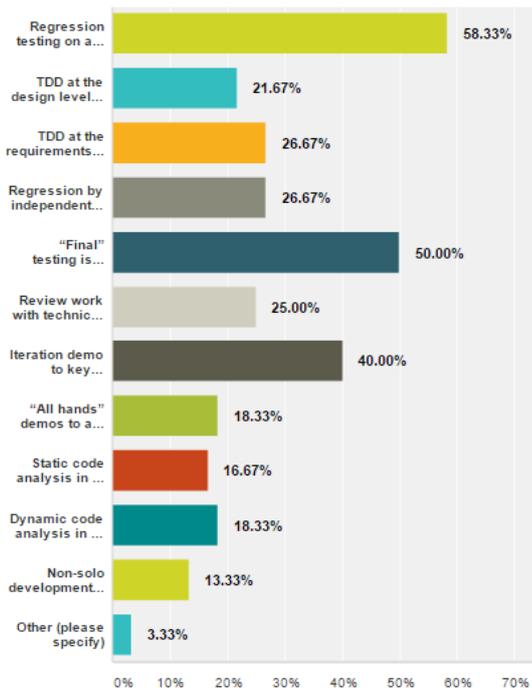


Fig 4. What strategies does your team follow to validate their work?

If we take into consideration particularly the respondents that stated that they did not use any specific methodology in the past and compare their answers to what methodology they were currently using, we come to the following conclusion: 66% of them still did not rely on any specific methodology, 28% transitioned to Scrum, 10% to XP and FDD, 7% of them have decided to use RAD, and 3% switched to DSDM, ASD, Crystal, Kanban and Waterfall (Figure 5).

Analyzing the responses of the practitioners that used to use Waterfall in the past, considering what were they currently using, the following conclusion can be derived: 63% of the respondents that used Waterfall in the past, were now using Scrum; 13% were using Kanban; 6% - XP; 6% - Lean, while 13% were not using any of the listed methodologies (Figure 6). This confirms the fourth hypothesis.

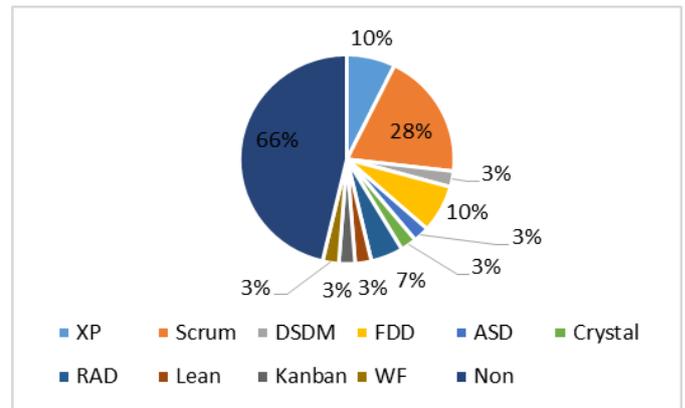


Fig 5. Methodology transition from no methodology in the past

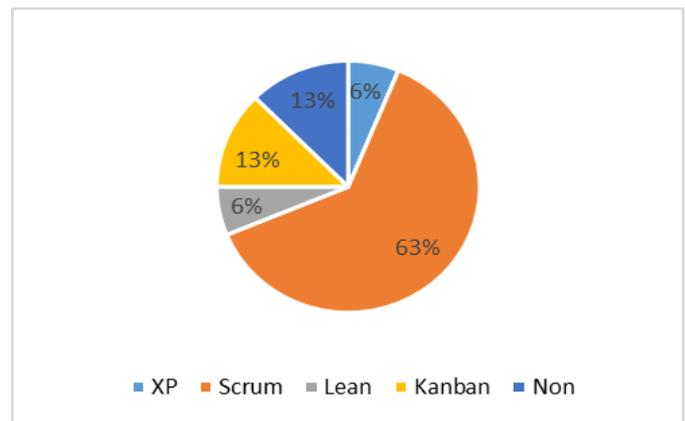


Fig 6. Methodology transition from Waterfall in the past

If we analyze the answers of the respondents about the preferred methodology in the contexts of the size of the organization, the following conclusion can be made. In the first three groups representing smallest company sizes, the majority of the respondents stated that they did not use any particular software development methodology (24%, 41%, and 40% respectively). For organizations that have 1-10 employees, the next most widely applied methodology is FDD, which was

currently used by 17% of the respondents. In organizations with 11-50 and 51-100 employees the next most applied methodology is Scrum (used by 36% and 33% of the respondents respectively). According to these results the fifth hypothesis should be rejected. However, considering that noticeable number of respondents stated they were using some of the agile methodologies and taking into account the trend toward using agile approaches, this hypothesis can easily become true in the near future. In the organizations with over 100 employees, 57% of the respondents stated they used Scrum, while the next most applied methodology - Kanban is used by 29% of the respondents (Table II). However, the responses considering the company size for the big companies should be taken with some reserve because they were represented with smaller number of respondents.

TABLE III. Methodology by company size

Methodology	Company size			
	<i>1-10</i>	<i>11-50</i>	<i>51-100</i>	<i>101-500</i>
Company size				
XP	7%	9%	0%	0%
Scrum	14%	36%	33%	57%
DSDM	3%	0%	0%	0%
FDD	17%	5%	20%	0%
ASD	10%	0%	0%	0%
Crystal	3%	0%	0%	0%
RAD	7%	0%	0%	0%
Lean	3%	0%	0%	0%
Kanban	7%	0%	0%	29%
Waterfall	3%	9%	7%	0%
Non	24%	41%	40%	14%

VI. CONCLUSION

Results from the survey have confirmed most of the presented hypothesis. The results are suggesting that Macedonian companies for software development are not sufficiently familiar with the methods for agile software development, which confirms the first hypothesis. The analysis of the companies that have chosen to implement a project according to certain agile methodology, showed that the principles of agility are mostly followed, which confirms

the second hypothesis. The third hypothesis was confirmed, since a large part of Macedonian companies for software development did not have a system to measure the quality of the product. The research showed that most of the Macedonian software companies that have used traditional waterfall methodology in the past, are currently turning toward using agile methodologies in the implementation of the projects, which confirms the fourth hypothesis. And finally, the fifth hypothesis was not concluded, since most of the micro, small and medium sized companies in Macedonia did not rely their project implementation on agile methodologies.

ACKNOWLEDGMENT

We would like to thank all the anonymous respondents for the feedback that made this paper possible.

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