Where Is Scrum in the Current Agile World?

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Abstract: A variety of methodologies in software processes exist nowadays with the Agile software development having gained significant ground since the introduction of the Agile manifesto in 2001. Scrum is a representative Agile development method employed in the software industry. Since trends come and go, it is vital to see where they stand in the real world. In order to gain an insight into how Scrum is viewed nowadays, we have conducted an online study on the current state of the adoption of Scrum. The study targeted in demonstrating where the success or failure success factors of Scrum lie and in viewing Scrum properties in comparison to heavyweight approaches. This paper presents the results of the study that constitute an instructive view into the above aspects of Scrum development.

1 INTRODUCTION

As organizations become global new software paradigms derive with some being embraced from the software community and others still lacking wider acceptance. The era of the dominance of the waterfall model may have come to an end. The most widely adopted processes that have gained a strong momentum in the last years can be found in Agile development (Highsmith and Cockburn, 2001). Agile methodologies have been adopted by many industry leaders worldwide including Yahoo, Microsoft, Oracle and IBM. Agile principles can be found in different development approaches including Extreme Programming (XP), Scrum, Feature Driven Development (FDD), Crystal methods and Adaptive Software Development (ASD) with some approaches having wider acceptance than others.

This paper presents a summary of the results of a field study conducted on the adoption of Scrum as an Agile methodology in the software industry (Scwaber and Beedle, 2002). The initial motivation for conducting the survey derived from the global spread of adaptive software development and our personal experience in a Scrum industrial environment. Although many Agile-related surveys have been conducted, since the introduction of Agile in the industry (the first one dates back to 2003), the reality in the software industry is constantly evolving. In contrast to existing studies the main objectives of the survey we conducted were to:

- Demonstrate where Scrum adoption lies today globally in terms of quantities.
- Discover the success or failure rate of both Scrum- and Agile-driven projects.
- Perform a comparison among the results of using Scrum- or Agile-based techniques and of following traditional development approaches.

The participants of the study were informed that some questions would concern only Scrum, although a part with generic Agile questions was also present, since some Agile principles are common in all Agile methods. Those with experience with more than one Agile methodologies were asked to base their answers on Scrum. The majority of participants indicated Scrum as the employed Agile methodology (76.9% of the participants), which makes the results obtained more applicable on this specific case of Scrum.

The rest of the paper is structured as follows. Section 2 is referring to related surveys. Section 3 describes the survey methodology followed, whereas section 4 presents the main survey results. Section 5 is dedicated to a summary and a general discussion of the survey results with section 6 pointing out the limitations of the study. Finally, section 7 concludes the paper.

2 RELATED SURVEYS

Various surveys have been conducted by

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organizations on Agile development or software processes in general after the appearance of the Agile manifesto in 2001. We are referring here to global surveys and not cases applicable in specific countries, which can also be found in the literature.

One of the earliest surveys on Agile was conducted by the Australian Shine Technologies in 2003 (Shine technologies, 2003). With the majority of the 131 survey participants referring to adoption of XP and around 8% adopting Scrum, 49% stated that Agile reduced development costs, 93% that productivity was better, 83% that business satisfaction was better and 88% that the quality of the software improved. Although a rather early survey, when Agile experience had not been not gained yet, the results from the Agile use are generally in accordance with the outcome of our survey. However, back in 2003 XP was more popular than Scrum that is gaining ground nowadays.

The survey of Digital Focus of 2006 was based on responses from 136 executives across 128 organizations and showcased the main advantages and disadvantages of adaptive software processes. A survey of 2008 that focused again on Agile adoption indicated the benefits and problems of adopting Agile techniques (Vijayasarathy and Turk, 2008). The increased productivity, the job satisfaction, the improved predictability of costs and quality and the knowledge transfer were the main benefits observed, whereas the lack of Agile knowledge and the individual resistance were seen as the main challenges. This earlier survey approaches Agile from the perspective of individual's view within the team focusing on knowledge and data exchange opposed to the survey presented in this work. A survey on Agile adoption and success or failure project results was performed by Version One in 2010 (VersionOne survey, 2010). Among the main failure reasons the lack of experience with agile methods and the company culture were indicated by the participants as the most common cases.

One of the most recent survey was published in 2012 (Kurapati et al., 2012). However, it has different goals from the survey presented in this work. It concentrates on the adoption of Agile methods and on the applicability degree of the Agile principles. From this survey it is interesting to see that the majority of employees and customers are satisfied with the adoption of Agile practices.

A more specialized survey on the degree of adoption of Scrum was announced in Carnegie Melon University in 2011 (Paulk, 2011), but its results or whether it was conducted were ever reported. The questions used in the questionnaire concerned only the adoption of Scrum and were not referring to any comparisons to other approaches.

The most recent and related survey conducted close to the presented study was performed by the Scrum Alliance in the beginning of 2013 with roughly 500 participants from 70 countries (Scrum Alliance, 2013). The Scrum Alliance survey draw useful conclusions on the use of Scrum, but the objectives differ from the main objectives of our survey: this earlier survey had a focus on how the specific principles of Scrum are adopted instead of uncovering advantages and disadvantages and comparing Scrum to traditional approaches. Moreover, the results reflect mainly the point of view of managers of different levels that formed 53% of the participants, whereas in our survey Scrum software engineers and Information Technology (IT) managers were mainly engaged.

3 PREPARATION AND CONDUCT

For the survey management and execution a procedure typical followed for conducting surveys was used (Statistics Canada, 2003):

1) Formulation of the Statement of Objectives: the survey motivation was determined, the objectives were set and the research questions were identified consisting in the following:

RQ1: How popular is Scrum in the industry today?

RQ2: Do engineers like Scrum?

RQ3: Are Scrum and Agile projects successful?

RQ4: Does Scrum or Agile adoption provide better results in software development (compared to traditional approaches)?

2) Selection of a Survey Frame and Determination of the Determination of Sample Design: requests for participation were distributed to employees of various organizations and individual Agile practitioners. The potential participants were selected among Agile practitioners instead of targeting any software engineering company, since we wanted to study opinions on Scrum coming from people with Agile experience even if this experience may have been in the form of a partial Agile adoption. We searched for companies of various sizes with an active role in the software industry, sent e-mail requests to over 200 companies with an Agile profile including personal e-mails to specific employees and requests for distribution within the

organization through Human Resources departments. We also sent notifications to members of Agile-related groups (e.g., Scrum Alliance) exploiting relevant mailing lists and using Online Social Networks with announcements on the Facebook group of Scrum alliance and distribution through LinkedIn.

3) Questionnaire Design: In order to keep the time necessary for the completion of the questionnaire to a minimum, the majority of questions chosen were of closed type leaving space for general comments at the final stage of the survey. This proved useful as we gained useful insights from these comments. The length of the questionnaire was restricted to 35 questions. In order to increase the validity of the results attention was paid on the survey design making sure that we are asking questions that measure what we want to measure referring here to the research questions posed.

4) Data Collection: the web-based survey was open for a period of three months (March-May 2012). All potential participants were informed that approximately 10 minutes would be required to complete the survey.

5) Data Capturing and Coding, Editing and Imputation: the survey management was done through the SurveyMonkey tool.

The remaining steps of *data analysis and dissemination* that were carried out subsequently are presented in this article stressing out the main results of the study in respect to the benefits of Scrum development and its comparison with traditional approaches. The results reflect the 233 complete questionnaires collected out of a total of 335 responses. Since many participants skipped questions on development methodologies, these incomplete questionnaires were neglected.

4 MAIN RESULTS

4.1 Demographics

We obtained answers from more than 126 companies distributed geographically in 44 different countries: 40% of the countries are from North and South America, 35% from Europe, 4% concern companies with a global presence (i.e., presence in more than one continents), 13% originate from the remaining continents (Africa, Asia and Australia), while in 8% of the cases the country is not specified.

The main age group of the participants is between 30 and 40 (41.1%). 28.1% are between the age of 40 and 50, 14.3% between 50 and 60, 12.1% between 18 and 30 and 4.5% above 60. Men mostly responded to the survey (90.5%) opposed to women (9.5%). The education level of the participants is high with 42.5% possessing a masters degree, 38.9% a bachelor or diploma, 8.0% a technical degree, 4.4% a PhD and 2.2% being in possession of other kinds of degree (mostly college degrees).

The results of the survey cover a wide range of practitioners. For instance many indicated themselves as Scrum Masters, who do not have a pure technical role but provide rather guidance and assist in problem solving in the Scrum team. 27% indicate themselves as software engineers, 25.2% as IT managers, 23.0% as project managers and 8.4% as business stakeholders. The remaining 15.5% of the participants are active in other technical roles, such as quality assurance engineers (or testers), data professionals and analysts, whereas 0.9% have an operation or support role. The fact that the majority of participants have a direct involvement in the development process from a technical role (42.5%) or as IT managers (25.2%) is an advantage for the accuracy of the results, since we wanted to reflect the perspective of technical practitioners.

4.2 Organization Profile

The participants are working in enterprises of different sizes: one third is coming from enterprises with over 1000 employees (30.6%), one quarter with 101 to 1000 employees (25.5%), whereas the rest is employed in smaller companies.

Concerning the participants specific experience in teams working with Agile techniques most are quite experienced with their involvement ranging from 3 to over 10 years. The Agile practitioners of the survey employ mostly Scrum. Most were quite experienced with its use: Scrum is either the normal way the organization uses to build software (32.5%), one of the standard ways (27.3%) indicating that it is usually employed in combination with other techniques, the method that has just been adopted for development across the organization (14.7%) or a method that has been piloted without taking any adoption decision yet (10.8%). Some are currently piloting Scrum (9.5%), whereas only 5.2% have not used Scrum. This last result provides a rough estimation on the non-Agile practitioners contacted during the distribution of the questionnaire. Regarding the specific use of Scrum in the organization development projects, Scrum is generally used a lot (61.1% answered that Scrum is used for a percentage around 50% and higher)

showing a tendency of applying Scrum organization wide (Figure 1).

4.3 How Popular Is Scrum

When it comes to development methods there are organizations that opt for heavyweight and others that go for lightweight approaches. Our survey showed that the most popular among heavyweight alternatives is, as expected, the waterfall model (36.5%) followed by the Spiral model (14.4%) and the Unified Process (12.2%), whereas enterprises tend to adopt also hybrid approaches or reject traditional methodologies completely heading directly for adaptive techniques (36.9%).

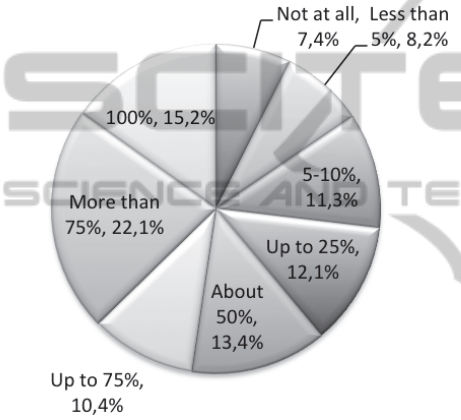

Figure 1: Development work performed with Scrum.

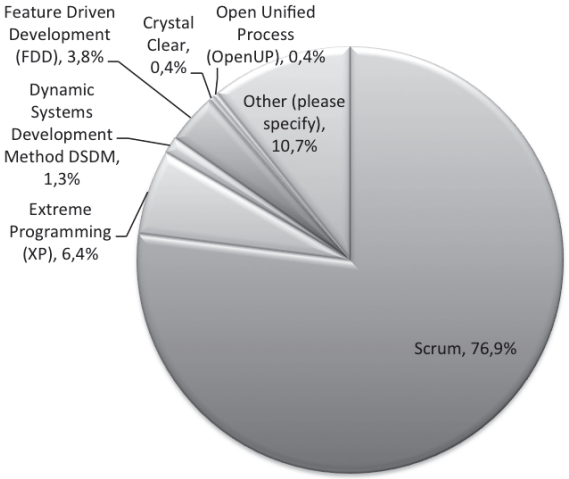

Figure 2: Agile methodologies mostly used.

Among Agile methodologies the big winner is Scrum (76.9% of the participants) followed by Extreme Programming (6.4%) and Feature Driven Development (3.8%), whereas Agile combinations were also indicated (Figure 2). In these combinations increasing importance is given to Kanban that is based on building software production on customer demand with characteristics from Just-In-Time and Lean production (Sugimori et al. 1977).

These results constitute an indication of a tendency moving from XP to Scrum. Nevertheless, we are aware of the fact that the emphasis on Scrum indicated as the driving force of the study may have lead participants who have employed more than one Agile methodologies to give Scrum as an answer.

4.4 Do Engineers like Scrum

Agile focuses on four main principles found in the Agile manifesto: 1) Individuals and interactions over processes and tools, 2) Working software over comprehensive documentation, 3) Customer collaboration over contract negotiation, 4) Responding to change over following a plan.

The principle that is valued most by practitioners is #4, while many are intrigued by #1 and #2 (Figure 3). Indeed adaptation to change is one of the main characteristics of Agile (Leau, Loo et al., 2012). However, there are also elements that people dislike in Agile as the lack of project structure given as the most typical answer (38.2%), the low documentation (35.2%), although some see it also as an advantage, the low planning (16.6%) and the less management control (10.1%).

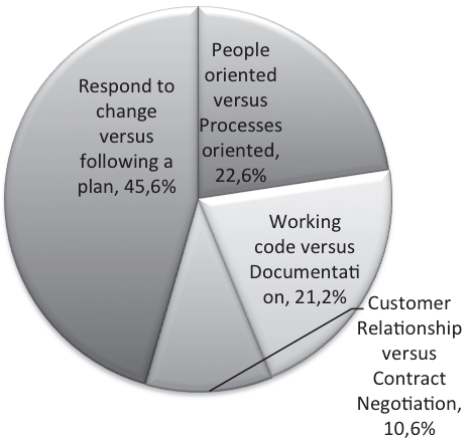

Figure 3: Appealing Agile aspects compared to heavyweight methodologies.

The Scrum Master is one of the main players in Scrum. Many participants indicated themselves as Scrum Masters. We wanted to see how people see the Scrum Master: most find the role useful (73.7%) or useful to some extend (19.2%), whereas some

find it redundant (4.2%) or not useful (2.8%). It might be that the role cannot be fully perceived by players involved in the Scrum development process that are not, however, part of the development team that is in constant contact with the Scrum Master.

Investigating how practitioners see Scrum in general most appear satisfied, whereas a small percentage is not sure or does not find Scrum suitable for their needs (Table 1). Roughly 1 out of 10 is either not satisfied or has not made up his/her mind yet.

Table 1: Overall satisfaction with Scrum.

Project measure	Higher
Very pleased with Scrum	38.0
Scrum exceeds my expectations	10.9
Scrum is adequate for my needs	38.0
Disappointing outcome	3.1
Not at all pleased with Scrum	3.9
I don't know yet	2.6
Not applicable	3.5

4.5 Success in Scrum or Agile Projects

Agile adoption is not always easy and seamless. Drawbacks are usually found in the need for constant customer participation, the difficulty to scale in large projects and the need for Agile training (Petersen and Wohlin, 2009). The lack of skilled people who can follow Scrum is one important reason for failure (Figure 4). Indeed motivated people are needed, since Agile requires discipline in order to be successful.

Project size also poses a problem. As project size grows, so does the need for people participation, which introduces more complexity in communication activities. Other participants see the lack of customer collaboration as a major problem. Moreover, customers may find it hard to comply with Agile principles that state the importance of active customer participation. Other problems noted in the study are the lack of top management support and the project team size, which is not ideal in all cases.

Regardless of the problems that may be observed during the project execution, the results of the final product are of significant importance. Project success is usually identical with on-time product delivery within the assigned budget, but different criteria may also be important in specific projects. In order to study project success without considering how success is specifically defined for each organization, we tried to detect the percentage of projects that were considered successful. Agile projects are generally successful with 54% of the participants indicating an overall success rate over 81% for their projects (Figure 5).

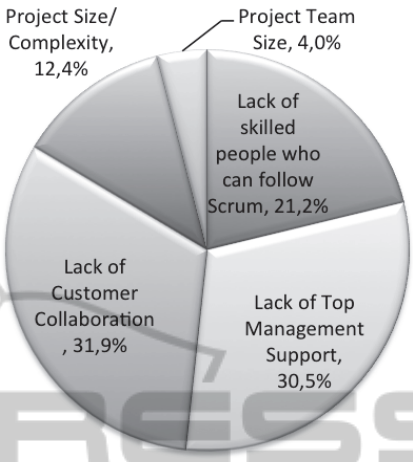

Figure 4: Most common problems while practicing Agile methodologies.

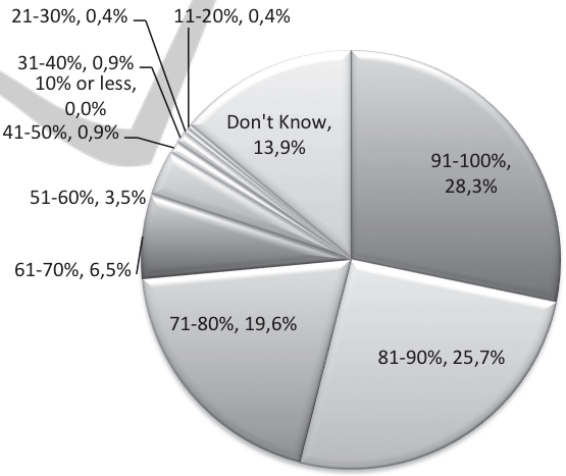

Figure 5: Overall success rate of Agile projects.

4.6 Comparison with Traditional Approaches

In comparison to traditional approaches adaptive methodologies are generally considered to perform better in terms of increase in productivity, quality improvement, cost reduce, maintainable and extensible code, collaboration and customer satisfaction. In our study the majority of participants indicated a more or less significant increase in productivity, much higher or somewhat higher quality of the product, much lower or somewhat lower development cost and much higher or

somewhat higher stakeholder satisfaction (Table 2). The rest of the participants did not provide any answer, which may indicate that they did not have access to this kind of information from their position.

The only point, where Scrum methodologies may be problematic was from the perspective of cost, which appeared slightly increased in many cases (26%). This is justifiable for organizations that adopted Scrum for the first time, since any change comes with time and costs needed for the transition, training activities and the general learning curve. All these aspects increase the costs and may also affect the development procedure.

The increase in quality and productivity was also observed in the adoption of Scrum in Primavera (Schatz and Abdelsha, 2005): it resulted in an increase of 30% in quality in terms of number of customer defects compared to the traditional software process and an improvement in time to market with the product delivered in 10 months instead of the original plan of 14 months. Similar improvements were indicated by Yahoo (Benefield, 2008), Amazon (Atlas, 2009) and Microsoft (Williams, Brown et al., 2011) where the impressive productivity increase of 250% was observed (measured by the number of lines produced in each Scrum Sprint).

Many of the above experience reports indicated the importance of the organization culture for the successful adoption of Scrum. The adoption constitutes a big challenge for companies that are rather traditional than Agile-oriented. Unsuccessful Scrum adoption cases are also to be found proving that Scrum is not a priori successful in any environment and that traditional development approaches may be more appropriate (Hajjdiab, Taleb and Ali, 2012).

Table 2: Scrum comparison with traditional approaches.

Project measure	Higher	No change	Lower	No answer
Productivity	87.5%	6,8%	5.5%	0.18%
Quality	84,3%	13,1%	2.5%	0.3%
Development cost	26%	25.4%	48.5%	0.1%
Stakeholder satisfaction	85.4%	9,5%	5.15%	0%

5 DISCUSSION

The participants' answers in the survey were indicative of the current state of Scrum and Agile compared to traditional approaches, whereas the opinions or experience on Agile development expressed by many participants through dedicated comments were useful for drawing further conclusions on software engineering practice. As a final note to the study results the main Scrum characteristics in comparison to traditional techniques – considering only the proportion of the participants that indicated themselves as Scrum practitioners – can be found in the following points:

- *Respond to Change Rather than Following a Plan*: 47.1% of the Scrum practitioners believe that this is the main asset of Scrum. Scrum can assist in rapid re-organization, allowing sudden project changes without introducing significant losses in time and cost management. Flexibility is in general important and should form part of the software development process (Gao and Yong-hua, 2012).
- *People-centric and Not Process-centric*: the most significant advantage of Scrum for 22.4% of the participants.
- *Emphasis on Code Writing Instead of Documentation*: this is the most important aspect for 21.3% of the participants. Generally it can be in some cases is observed that many software engineers are not very keen on the process of writing documentation to accompany their source code.
- *Increase in Team Productivity* was observed for 87.5% of the participants. Productivity is a vital aspect of development for the organization also from the managerial perspective.
- *Product Quality*: the software quality was increased for 84.3% of the cases.
- *Decrease in Project Cost*: this is considered true for 48.5% of the participants, although cost increase was also observed in many cases (26%).
- *Stakeholder Satisfaction*: an increased customer satisfaction is considered true for 85.4% of the participants.

A general observation of the study is that the efficiency from the adoption of Agile and Scrum depends heavily on the nature of the software product and the organization culture that can assist in the transition from waterfall to Agile. Most participants are employing Scrum and come usually from organizational environments that do not hesitate to try new technologies. 62.4% of the participants indicated that their organization does not hesitate to adopt new technologies, 30.3% that it is more conservative, since it follows the approach only when the technology is proven, and 7.3% that it prefers more traditional approaches. It was observed

that those who are open to new technologies follow in most cases Agile techniques (62.4%), whereas the adopters of traditional approaches followed in most cases the waterfall development model (91.7%). This observation supports the fact that Agile development is usually embraced by innovative people (Moore, 2002).

Regarding the dedicated comments of the participants the most useful outcome was the wide adoption of Kanban or the combination of Kanban with Scrum, namely Scrumban. This hybrid method is indicative of the future trends in software process evolution. Kanban has advantages from which software organizations can profit and some have successfully performed the transition from the pure Scrum to the hybrid Scrumban.

In terms of initial research questions introduced the survey has assisted in drawing the following conclusions:

Popularity - RQ1: Our study showed that Scrum is gaining ground in comparison to other Agile approaches and especially Extreme Programming.

Approval - RQ2: In principle engineers like Scrum. Of course the answer depends also on the personality, the organization and its effect on the execution of the daily activities of the engineer. Another issue is specific roles as the Scrum Master introduced in Scrum that is not present in other lifecycle models. Is the Scrum master a manager or can a manager become a Scrum master? The answer is no. Indeed as one participant indicated for Scrum: "*You need a team that is open minded with a strong scrum master who does not over-manage*." The way roles are viewed depends again on the daily interactions of the engineer with interpersonal relationships playing a significant role. Moreover, the culture also comes to play.

Success - RQ3: Through the study we were able to discover the success or failure rate of and Scrum- and Agile-driven projects and most projects appear successful for the organization.

Improvement - RQ4: Generally Agile adoption provides better results than traditional methods. Agile assists in the quality and productivity increase, but this cannot be usually identified in the short term, i.e., in a pilot Agile adoption. The problematic part is the initial cost required for investing time on learning Scrum and getting used to Agile processes integrating them in coding activities. Some organizations undertake educational activities to minimize this cost; for instance IBM has introduced an Agile night school program (West, 2010) to make Agile transition faster.

6 THREATS TO VALIDITY

In terms of threats to validity encountered in case study research (Yin, 2008) the main issues of our study were detected in relation to *external validity*; related specifically to what extent we can generalize our findings. The communication on the emphasis on Scrum to the participants may have affected the outcome giving less accuracy to the obtained results for general Agile: participants may have responded based only on Scrum even if they also adopted other Agile techniques (e.g., XP, Dynamic Systems Development Method / DSDM, FDD). The number of incomplete questionnaires poses an additional threat (233 questionnaires were complete out of the 335 that were partially answered). This was an observed disadvantage of the procedure selected for the collection, since the survey would allow participants to skip some questions. The high number of incomplete questionnaires is attributed to either the lack of adoption of Agile methodologies from the specific participant or the inadequacy of the participant's organization as a representative case for the survey goals. Lastly, we did not perform any analysis on the participants' distribution among the companies, i.e., if there was a higher participation rate of employees inside specific companies.

Despite these remarks, the *conclusions validity* is not largely affected. The number of responses and comments we gathered can be considered representative of the current state on the use of Scrum assisting in showing the impact of Scrum among Agile practitioners. Regarding reliability validity related with whether the study can be replicated we have made the study results available online on the website of the first author.

Construct validity refers to whether the explanation provided for the results is indeed the correct one. In our study one threat is linked with whether we are asking the correct questions (in terms of Research Questions). In order to increase the validity attention was paid on the survey design making sure that we are asking questions that measure what we want to measure.

7 CONCLUSIONS

In this paper the process and the results of a field study on the effectiveness of Agile methodologies with an emphasis on the Scrum practice was presented. The results indicate a significant increase in the adoption of Scrum in comparison to other Agile methodologies with many successful project

executions: 8 out of 10 Scrum projects are successful according to half of the participants. The survey participants valued the main characteristics of Agile processes that generally assist in achieving increased productivity and producing software systems of higher quality.

The adoption of Scrum seems indeed to be wide and many books and articles are centred around its use. Nevertheless, continuous studies are necessary to follow its adoption progress and the emerging variants, especially its combination with other production methods, such as Kanban. Hybrid Agile methods and their effectiveness under different environments are an interesting field of study in software processes.

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