

# Impact of the Applied Project Management Methodology on the Perceived Level of Creativity

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*Abstract: The phenomenon of creativity has been studied by many authors and there have been numerous research studies conducted about how to induce it. In software development project contexts, especially when comparing agile and waterfall methodologies, this topic seems to be unexplored. The authors aimed to fill this research gap by conducting a survey based on quantitative research that involved 61 project managers or employees. The perceived creativity in project activities is operationalized through the degree of innovation content and extraction in the project, as well as through factors that relate to the exploitation of creativity as the way how it is learned and recognised. The use of the agile development approach was characterized by agile practices such as the use of stand-ups, sprint plannings and user stories. The results of the research suggest that the chosen software development approach has an impact on the perceived use of creativity, whereas learning is significant in cases where the stand-up tool of agile project management is used.*

*Keywords: project; project management; creativity; learning; agile software development*

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# 1 Introduction

Many researchers highlighted that projects, despite being “*temporary endeavours undertaken to create a unique product, service, or result*” [1] deliver significant added value and help achieve strategic goals [2] [3], as they are “*vehicles for strategy implementation*” [4]. Researchers also highlighted that an appropriate translation of strategy to project level, and project governance are also important for realizing competitive advantage [5] [6] [7] [8]. However, Shenhar & Dvir [9] identified that, projects should be considered from two other angles; being a temporary organization and a unique task. In this way, project managers should focus on three aspects, such as managing the unique task, managing the temporary organization, and delivering the beneficial change [10]. This triple aspect further increased both the complexity and the importance of the role of the project manager, which was highlighted by numerous authors [3]. Researchers also revealed that a properly defined and planned project process could have a huge impact on successful project delivery [11] [12] [13] [14] as well as the business case, risk management, organizational characteristics, and senior management support [15] [16] [17] [18] [19] [20]. Görög [3] and Blaskovics [10] identified nine potential factor groups which could influence achieving project success, and based on these, the following categories can be created:

- Environmental factors, i.e. those, which are originated from the surrounding project environment, and have an impact on the project.
- Hard, methodological, i.e. those, which are related to the project process and the relevant tools and techniques
- Soft, i.e. those, which are related to managing the project team, the project manager, and the other stakeholders which bear of importance.

Certain environmental factors such as the macroeconomic environment or the COVID-19 pandemic, or those that originated from a distinct organizational unit (like the project management office and the company-related project management policy) also play a significant role in achieving project success, or in some cases, influencing circumstances [21]. Numerous researchers highlighted that soft and methodological elements could be at least as important as the aforementioned ones [10] [22] [23]. It has also been highlighted that a motivated and competent project manager and project team could have a high if not the highest impact on project success. An appropriate project task delegation system and a challenging yet supportive environment could increase the performance of the project team members. Goleman [24] points out that emotional intelligence, including empathy, could increase the effectiveness and efficiency of project management. Blaskovics [10] further reinforced this statement, since a stakeholder-centric attitude, which considered the appropriate management of stakeholders as a key project management task, could generate the highest potential for project success. Görög [3] also argued for the importance of the project manager and stated that the lack of

a competent project manager cannot be compensated, while other factors could be somehow substituted by a resource-abundant environment. Creativity, especially on project level, has also been highlighted to be a key factor in achieving project success [25] [26] [27] [28].

Based on the above-mentioned research findings, the focus of our research study is to explore the perceived level of creativity by the project team members. Since numerous authors found differences between the level of motivation and work efficiency in different project management methodologies (especially between agile and waterfall), the authors will analyse the perceived level of creativity in terms of waterfall and agile project management methodology, to understand whether project members experience a higher level of creativity in an agile rather than in a waterfall project.

## 2 Literature Review

### 2.1 Creativity and Innovation

Creativity as a construct has been widely researched in psychology over the past decades, but it has been difficult to define and measure it due to its complex and multidimensional nature. Definitions of creativity usually include at least one of four perspectives: cognitive processes involved in producing creative work, characteristics of creative individuals, end products or outcomes of creative work, and the environmental factors conducive to creativity. Measuring creativity is usually based on these main categories of creativity definitions [29].

According to Hennessey and Amabile [30] social and environmental factors play major roles in producing creativity in work. They also assert that there is a strong and positive link between a person's intrinsic motivational orientation and the creativity of the person's performance: people are the most creative when they feel motivated by interest, enjoyment, satisfaction, and the challenge of the work itself. If people are intrinsically motivated, they seek situations that require the use of their creativity and resourcefulness [31].

Amabile [32] expands on the definition of creativity by adding the dimension of innovation in a business context: creativity is the implementation of novel, useful ideas to deliver new products and services. According to her componential model of creativity, three major components of creativity in the workplace – expertise in complex problem solving, creative thinking of new ideas and intrinsic task motivation – are all necessary for being creative in any domain. It also means that the work environment can have an impact on creativity by influencing task motivation, providing learning opportunities, and facilitating creative problem

solving for team members. The theory also states that creativity produced by individuals serves as a primary source for innovation within the organization. Management practices are also necessary to foster innovation and creativity, especially in projects, including clear planning and constructive feedback, good communication between team members, as well as mutual support and commitment.

The existence of a mutual link between flow and creative work was proposed by Csikszentmihalyi who described the mental state of flow as the “*peak of creative insight*” and “*optimal experience*”, when interviewing hundreds of people, such as rock climbers, artists, chess players, and athletes, who had a deep sense of enjoyment and accomplishment in their work that were challenging enough to stretch their abilities and skills. He used the term “*flow*” to describe the common subjective experience reported by his respondents as several of them used the metaphor of a current that carried them along when they enjoyed performing their activities that they found challenging. He considered the experience of flow as a vital element in all activities which makes work more productive, rewarding, and meaningful [33] [34]. Although the concept of flow has remained vague and ambiguous in psychology ever since it was coined by Csikszentmihályi in 1975, the initial studies helped define the phenomenological and intrinsically motivating nature of the flow experience [35].

Creativity along with innovation has been suggested to play an important role in Information Systems Development projects over the past 30 years, and most recently in the agile method movement which advocates that creativity and innovation are needed to solve complex software development problems and to deal with unpredictability inherent in technology projects. The agile environment is particularly conducive to creativity and innovation as it provides a high degree of autonomy, task diversity and swapping of roles, goal clarity, ownership of work, trust and openness [36]. Görög [3] also highlighted that improvisation – which is the manifestation of creativity on project level – is one of the five crucial project management characteristics. Müller and Turner [37] identified in their research – based on the leadership model of Dulewicz & Higgs [38] – that a high-level of creativity (intuitiveness) is required especially in a highly uncertain environment with a considerable impact on organizational performance, but creativity could be important in every type of project.

As optimal experiences most often occur within sequences of challenging activities that are goal-directed and bounded by rules, requiring appropriate skills or highly disciplined mental activity [39], it can be particularly relevant in the context of complex project management which provides a structured framework for goal-oriented and challenging activities that require highly specialized skills and competencies.

## 2.2 Waterfall and Agile Project Management

As numerous authors have highlighted an appropriate planning process is of utmost importance, arguing that a suitable project life cycle should be assigned to projects [11] [40] [41]. The Project Management Institute [11] identified four types of life cycles based on the definition of project result; (i) predictive, (ii) iterative, (iii) incremental, and (iv) adaptive. Although Wysocki [41] also identified four types of project life cycles, these are based on the ambiguity of project result and the implementation method: (i) traditional, (ii) agile, (iii) extreme, (iv) emergent. The commonality in these categorizations is that they define the best-suited life cycle for the project based on the uncertainty regarding the client and environment, the nature of the project result, and the novelty of the methodology that should be used to deliver the project result. However, authors tend to agree that agile could manage more effectively a higher level of uncertainty than the predictive or traditional approaches.

### 2.1.1 Waterfall Project Management

The planning-based methodology, which is either called waterfall, traditional, or predictive, is considered a methodology where the different phases of the project follow one another. Cleland [2] identified five phases; (i) conceptualization, (ii) planning, (iii) execution, and (iv) termination. Verzuh [42] also identified similar phases; (i) definition, (ii) planning, (iii) execution, and (iv) close out. Gido, Clements & Baker [43] came to the same conclusion. All the authors separate the definition of the business case and the business benefit of the project (as conceptualization or definition) and the detailed planning phase. The first defines the potential project result, the general requirements, the time and cost constraints, and the high-level risks of the project. While the second defines the definition of the deliverables, the detailed key elements of the project, the detailed scheduling, and budgeting, the communication and every other element that is needed to deliver the project with the predefined requirements. Görög [3] merges the first two phases as project preparation but defines a separate phase for the external contributor. All of these approaches consider that project phases follow one another – although there could be overlaps between the phases, and there is a need for detailed planning and control of the completion. Researchers highlighted that this type of project planning methodology could be less adaptive to changes, and as a result of this, there is a potential for achieving a lower level of customer satisfaction than expected. At the same time, this frequent and phase-based completion could reduce the commitment of both the project team and the project manager.

### 2.1.2 The Beginnings of the Agile Mindset

To the authors' understanding, the earliest source on the subject is an article by Nonaka and Takeuchi [44] on the nature of effective innovative product

development projects. Their paper describes an approach to adapting to changing circumstances, a rapid yet flexible development, which these authors call "scrum". Scrum is the resumption of play after an interruption when one has to adapt to the play of the opponent as well as to the other own team. Nonaka and Takeuchi [44] do not use the word "agile", but the problem they studied is precisely the one that led to the development of the agile approach. Product development teams were expected to deliver results in a reasonable time, within changing expectations [44].

### 2.1.3 The agile Approach in Software Development

Many authors consider the "Agile manifesto", which was issued by methodological experts in the field of software development [45], as the first crucial milestone of the agile movement. However, criticism against the planning-based approach arose earlier [46] [47].

Software development has its specific risks. The socio-technical nature of information technology systems makes learning cycles almost inevitable. The failure rate of software development projects is high, as it is indicated by the Standish Group reports [14]. Around the same time when the Agile Manifesto was published, a number of new software development methods based on iterative and incremental approaches emerged. According to "*The Annual State of Agile*" report, a survey that is conducted in the United States, Scrum is the most popular method [48]. The advantage of this method could be earlier completion, and higher customer satisfaction [49].

Scrum is the most widely known agile development method, and in accordance with the aim of this research and the popularity of the method, the authors describe agile software development primarily in terms of the Scrum method. In the Scrum development process, there are procedures and roles.

In Scrum terminology, an iterative development cycle is called a sprint, and the software functionality to be implemented during a given sprint is called the "*sprint backlog*". These functionalities are often expressed in terms of user stories or cadences. Scrum assumes that the scope of all the products to be built during the sprint is known in broad terms, hence the term product backlog [49].

Scrum assumes smaller development teams (5-8 people). It distinguishes between two roles; the "*product owner*", meaning a user who can essentially define the functionality expected from the software to be developed; and the "*scrum master*", who is responsible for understanding and enforcing the rules of Scrum. The remaining members of the development team are simply called developers.

Having settled down the sprint backlog, the development work can be started. Each day during a sprint a workshop called "*daily scrum*" should be celebrated that is used to plan the work in the next 24 hours. At the end of the sprint, a "*sprint review*" takes place where the completed and unfinished parts are reviewed; the reasons and possible consequences are examined. At this point, the state of implementation of

the overall product can also be reviewed. A “*sprint retrospective*” can also be used to assess the actions taken to improve the development team and methodology. This can then be used to plan the next sprint, often defining functionality that can be used immediately upon successful completion of the sprint.

#### 2.1.4 The Appearance of Agile Project Management

Over the years, several works have been published that approach the topic of agile project management from a software development perspective [50] [45] [51] [52]. The common feature of these works is that they fit their specific proposals to a specific life cycle model of software development. The agile label has proved so successful that there are now independent certification schemes for individual project managers created by the market. The content of these certifications, however, is still linked to the world of software development.

From 2000, publications appeared that discuss the concept of agile project management in general. Wysocki [41] discusses project management in general, with agile project management as one possible approach. Wysocki recognised that, although by definition a project is a unique endeavour, there is a significant difference between the uniqueness (or riskiness) of each type of project. The construction of a typical family house is usually substantially different from an innovative product development project. Wysocki sees the way to deal with these differences as an appropriate dose of “*flexibility*” and “*adaptive capacity*”. In this terminology, “*agile project management*” is needed when the goal is clear but the way to achieve it is not. For such cases, Wysocki proposes a phasing of the project life cycle that is iterative and incremental [41].

A similar approach is taken by Chin [53], who justifies the introduction of the concept of agile project management, inter alia, on the basis of the different uncertainty of projects. Like Wysocki [41], Chin [53] also examines the question of the applicability of the agile approach, i.e. he approaches the issue from a contingency perspective.

There are a number of reasons for using an agile project management approach. The main drivers of the adoption of agile are the hazy (unclear) definition of and the frequent changes to project deliverables, and the incremental approach of delivery [54].

In accordance with the purposes of this paper, we will distinguish only two project approaches (life cycles) of software development; agile and waterfall. We characterized the agile life cycle mainly by the use of sprints (as a planning tool) and daily stand-ups (as work organization).

### 3 Methodology

The ultimate aim of the research is to identify whether there is a connection between the applied project life cycle and creativity. Thus, our research question is:

- Is there a higher level of perceived creativity in the case of using agile project management methodology compared to waterfall?

In accordance with Görög [3], Csíkszentmihályi [33], and Müller and Turner [37], we decomposed perceived creativity into two main factors: (i) innovation content of the project, and (ii) challenging level of the project task, considering them as factors, which could catalyze creativity. However, based on Goleman [24], Horváth [55], and Hennessey and Amabile [30], the output side should also be analyzed which could be decomposed into two categories; (i) learning from the project, (ii) appreciation for the project work.

For identifying the project approach as agile, a dual approach was used. On one hand, it was asked directly from the participants, whether the project was more agile or predictive, and on the other hand, we asked them whether they use certain tools and techniques, which are characteristic of the agile approach, such as (i) existence of stand-ups, (ii) existence of sprints or cadences, (iii) participation in sprint (or cadence) planning, and (iv) use of user stories in planning.

Based on these, and in accordance with the research question, the following hypotheses were formulated:

- H1: The perceived innovation content in projects using agile project management methodology is higher than those that use waterfall project management methodology.
- H2: The perceived challenge level of the tasks in projects using agile project management methodology is higher than those that use waterfall project management methodology.
- H3: People learnt more in projects using agile project management methodology than those that use waterfall project management methodology.
- H4: The perceived appreciation in projects using agile project management methodology is higher than in those that use waterfall project management methodology.

In order to answer the research question, and accept or reject the hypotheses, exploratory research was conducted, which consisted of two phases. The first was the library research, and in the course of this phase, the nature of the project, elements of creativity, and the project life cycles were analysed. As a result of this, we accepted the findings of Amabile [32], and Csíkszentmihályi [33], and we measured creativity in terms of innovation content and challenge, and based on Goleman [24], and Hennessey and Amabile [30], the “*rewarding*” side based on



learning and appreciation. The special tools and techniques of agile project management methodology were also revealed and encapsulated in the model. In the second phase, during the field research, a questionnaire was filled out by project managers and project team members, in a leading IT company. The research model is shown in the following figure:

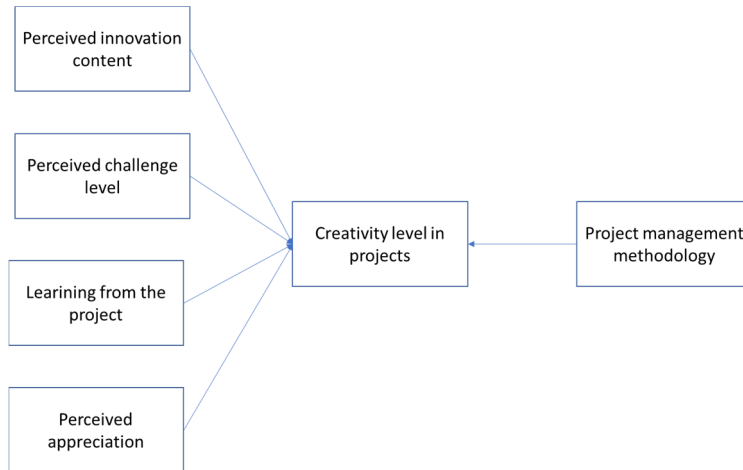


Figure 1  
Research model

*Source: authors' own editing*

In accordance with the aim and nature of the research, a questionnaire-based survey was conducted, which took place between June and July 2022, at a software development company which was selected based on such selection criterion as being one of the leading software developers in Hungary, which guarantees high, medium, and low innovation-content projects, and uses both agile, and waterfall approach for project delivery. Besides basic, demographic questions the questionnaire collected data regarding the general working environment (like current job position, task delegation, etc.), and more project-specific questions (like the aforementioned factors of creativity) from their last project. We argue that team members remember their last project the most, and only closed projects have the potential to have a complete overview.

The most important questions (what were used in the analysis), and their types are summarized in Table 1.

The base for the analysis was twofold. On the one hand, we checked the free text and option set questions whether the responses were suitable for analysis (like working in a project environment, or giving a complete answer for every question), and then we compared the creativity factors to the methodology itself, and the questions checking the agile approach.

Table 1  
Questions and their types

Question	Type
How innovative was your last project?	Ordinal (1-7 Likert-scale)
How challenging was your task in your last project?	Ordinal (1-7 Likert-scale)
How much have you learnt from your last project?	Ordinal (1-7 Likert-scale)
How was your work appreciated during the project by others?	Ordinal (1-7 Likert-scale)
Do you think your project has agile or waterfall/predictive characteristics?	Nominal (more like agile, more like predictive/waterfall, don't know)
Did you have daily stand-ups?	Nominal (no, seldom, frequently, every day or multiple times a day)
Did you have sprints (or cadences) in your project?	Nominal (no, sometimes, yes)
Did you participate in sprint (or cadence) planning?	Nominal (no, sometimes, yes, we didn't have sprints)
Did you use user stories in your project estimations?	Nominal (never, seldom, often, always)

*Source: authors' own editing*

The population in the research was the employees working on projects. The planning and the sampling were done with the help of a key project manager in the company. In the end, we received 59 unique answers we could work with. 176 people started the questionnaire, but only 61 respondents provided answers to the questions defined in Table 1, the other respondents gave only mainly their demographic and/or company-related data. However, two responses should have been taken out because they answered 'don't know' for the project management methodology they used, and as a result of this, they were not suitable for analysis. Altogether 59 respondents' answers were analyzed, out of which 5 were women and 54 were men. Most of them, 30 respondents, had a BA/college degree, 19 had university or MA, 5 had Ph.D., and 5 people's highest education is high school. The average age was 37,5 years (ranging from 22 to 64, with a median of 35 years), while 13.7 years was the average work experience (ranging from 1 to 40 with a median of 12 years). They work in the current position for 3.5 years on average (ranging from 0 to 14 with a median of 3 years), and in a managerial role for 3.2 on average (ranging from 0 to 19). However, these demographic data were not used in the analysis since we were focusing on the project management methodology (where 12 people worked in a waterfall environment, and 47 in agile). This was the only factor we considered for categorizing the sample.

The number of responses can be considered low<sup>1</sup>, and the answers were measured on an ordinal scale, thus non-parametric tests were applied [56]. During the analysis, we used the following methodologies:

- Comparing two groups, the Mann-Whitney test was used<sup>2</sup>.
- Comparing more than two groups, Kruskal–Wallis test was used<sup>3</sup>.
- For post hoc tests, the Mann-Whitney test was used with Bonferroni correction.

The significance level was analysed on 5%.

The aim of the research was to answer the aforementioned research question and find out whether there could be a difference in the level of perceived creativity in case of agile and waterfall project management methodology. Based on the results of this research, the authors acknowledge that the sample should be further expanded both horizontally and vertically to formulate more general conclusions.

## 4 Research Findings

During the analysis, we focused on the four creativity factors and the project management methodology related questions, such as which methodology they used in their project, and whether there were any daily stand-ups, sprints or cadences, participation in sprint or cadence planning, and use of user stories. The basic description of the first four questions based on the project management methodology is summarized in the following table:

Table 2  
Median and mean rank of the factors based on the project management methodology

Factors	Methodology	N	Median (7-point-Lickert-scale)	Mean rank <sup>4</sup>
<b>Innovation content of the project</b>	Waterfall	12	2.5	20.33
	Agile	47	4	32.47
<b>Challenge level of tasks</b>	Waterfall	12	3.5	21.25

<sup>1</sup> but according to Pesämaa et al. [57], suitable for analysis with certain conditions

<sup>2</sup> nonparametric alternative to independent samples t-test

<sup>3</sup> nonparametric alternative to one-way ANOVA

<sup>4</sup> Calculated after transforming the original data into ranks for the Mann-Whitney test

Factors	Methodology	N	Median (7-point-Lickert-scale)	Mean rank <sup>4</sup>
Learning from the project	Agile	47	5	32.23
	Waterfall	12	3.5	21.13
	Agile	47	5	32.27
Appreciation for the project work	Waterfall	12	5	22.75
	Agile	47	5	31.85

Source: authors' own research, 2022, N=59, main descriptive statistics

Based on the Mann-Whitney test, it can be concluded, when people worked with waterfall project management methodology, they gave significantly lower values (on 5%) in each creativity category, than in the case of those, who worked with agile project management methodology, as seen in Table 3:

Table 3  
Perceived level of creativity factors based on the project management methodology

Results					
Factors/Methodology		N	Sum of Ranks	Z	P (one-tailed)
Q2.5 How innovative was your last project? (1 – not at all, 7- completely)	Waterfall	12	244	2.24	0.013
	Agile	47	1526		
Q2.6 How challenging was your task in your last project? (1 – not at all, 7 – completely)	Waterfall	12	255	2.03	0.021
	Agile	47	1515		
Q2.7 How much have you learnt from your last project? (1 – nothing, 7 – outstanding learning experience)	Waterfall	12	253,5	2.04	0.020
	Agile	47	1516,5		
Q2.8 How was your work appreciated during the project by others? (1 – not at all, 7 – outstanding appreciation)	Waterfall	12	273	1.70	0.045
	Agile	47	1497		

Source: authors' own research, 2022, N=59, results of Mann-Whitney test

We can see from table 3 that both the perceived innovation content, the perceived challenge level, the amount of learning from the project, and the appreciation received are significantly higher in agile projects. Therefore, we conclude that **all of the four hypotheses can be accepted on 5% significance level.**

In order to have a complete overview of the impact of agile project management methodology on the perceived level of creativity, we also analysed the most well-known agile project management tools and techniques to understand whether in those cases, where agile techniques are applied, the creativity factors are significantly higher than without these techniques. We analysed them with Kruskal–Wallis (K-W) test, and, in case of significant results, we also used Mann-Whitney tests with Bonferroni correction as post hoc tests

The authors analysed the answers regarding the daily stand-ups. Three kinds of answers were given: there were *no daily stand-ups* in the respondent's project, there were *frequently*, and *every day or multiple times a day*. We found on a 5% significance level that, the values received for the following factors in terms of the three aforementioned categories do not differ; innovation content (K-W H:5.187;  $df=2$ ;  $p=0.075$ ), challenge level of the tasks (K-W H:4.875;  $df=2$ ;  $p=0.087$ ), and appreciation (K-W H:3.258;  $df=2$ ;  $p=0.196$ ), but do differ in learning amount (K-W H:8.348;  $df=2$ ;  $p=0.015$ ). If we further analyse visually this latter factor (see Figure 2), we can conclude that the frequency of the daily stand-ups is less important because there is no visual difference between the *frequently*, and *every day or multiple times a day* answers, while the *doesn't have stand-ups* and the latter two categories have, as shown in Figure 2:

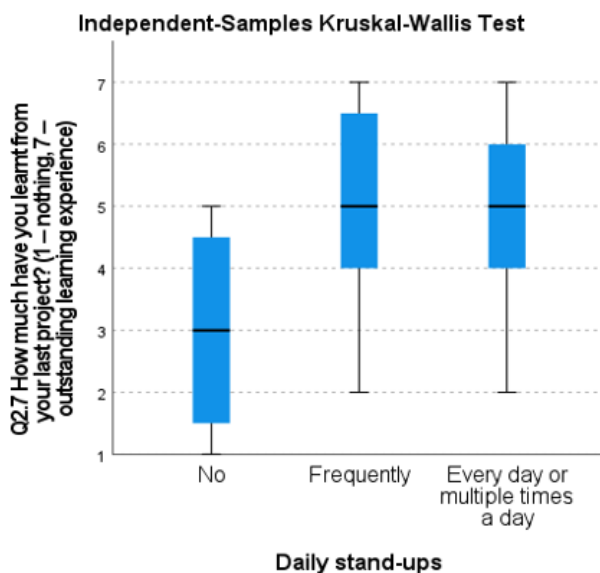


Figure 2

Boxplot diagram showing the distribution of the learning amount in terms of the different daily stand-up categories

Source: authors' own editing

This is partially reinforced by the post hoc test, the pairwise comparisons of the evaluation of the three groups. Between those who don't have daily stand-ups and who frequently have, the difference is not significant ( $Z = -2.204$ ;  $p(\text{with Bonferroni correction}) = 0.083$ )<sup>5</sup>. Between those who don't have, and those who have every day or multiple times a day, the difference is significant ( $Z = -2.852$ ;  $p(\text{with Bonferroni correction}) = 0.013$ ). Between those who frequently have, and every day or multiple times a day have, the difference is not significant ( $Z = 0.01$ ;  $p(\text{with Bonferroni correction}) = \sim 1$ ).

We also analysed the other three agile tools and techniques (existence of stand-ups, existence of sprints or cadences, participation in sprint or cadence planning, using user stories), but on 5% significance level, there was no difference in the creativity factors. This means that the scores for the innovation content, challenge level, and appreciation were not significantly different based on the existence of sprint or cadence planning, participation in sprint or cadence planning, and using user stories. This is encapsulated in the following table:

Table 4  
Kruskal-Wallis test on creativity factors in terms of the other three agile tools and techniques

	<b>Innovation content of the project</b>	<b>Challenge level of tasks</b>	<b>Learning from the project</b>	<b>Appreciation for the project work</b>
<b>Existence of sprints</b>				
<b>K-W H (df=2)</b>	1.380	0.532	2.807	0.788
<b>p</b>	0.502	0.767	0.246	0.674
<b>Sprint planning participation</b>				
<b>K-W H (df=2)</b>	1.396	0.427	2.834	1.609
<b>p</b>	0.498	0.808	0.242	0.447
<b>Use of user stories</b>				
<b>K-W H (df=3)</b>	2.541	1.908	1.803	3.725
<b>p</b>	0.468	0.592	0.781	0.293

Source: authors' own research, 2022,  $N=59$ , Kruskal-Wallis test

## Conclusions

Creativity on project level is regarded as an important factor, which could contribute to project success in a considerable manner (see, e.g. Schulz *et al.* 2015). Researchers highlighted that both the input and output sides of creativity should be analysed in order to have a comprehensive picture of it. Thus, based on Görög [3], Csíkszentmihályi [33], Müller and Turner [37], Goleman [24], Horváth [55], and Hennessey and Amabile [30] we decomposed creativity into i) perceived innovation content of the project, ii) challenge level of the tasks, iii) learning from the project,

<sup>5</sup> Note that, the number of respondents in each group was fairly low ( $n_1=n_2=8$ ).

and iv) perceived appreciation. We analyzed them in terms of the project management methodology to understand whether the agile project environment could generate a higher level of creativity than the waterfall environment. We analyzed in the course of an explanatory manner and formulated four hypotheses focusing on whether the creativity elements have a higher manifestation in an agile environment than in a waterfall. We have selected one leading software development company, and we analysed the received answers with the Mann-Whitney and Kruskal-Wallis tests on 5% significance level. The findings are summarized in Figure 2.

The current research (considering its limitations) highlighted that, for the given sample, agile project management methodology does generate a higher level of creativity. Therefore, we can conclude that:

- The perceived innovation content is higher in case of agile project management methodology than in waterfall methodology (H1 is accepted based on the result of Mann-Whitney test on 5% sign. lvl.).
- The perceived challenge level of the tasks in case of agile project management methodology is higher than in waterfall methodology (H2 is accepted based on the result of Mann-Whitney test on 5% sign. lvl.).
- People learn more in case of agile project management methodology than in waterfall methodology (H3 is accepted based on the result of Mann-Whitney test 5% on sign. lvl.).
- The perceived appreciation in case of agile project management methodology is higher in waterfall methodology (H4 is accepted based on the result of Mann-Whitney test on 5% sign. lvl.).
- In those projects, where there were daily stand-ups every day, people learn more than in those projects, where there weren't any (tested with Kruskal-Wallis test and Mann-Whitney post-hoc test on 5% sign. lvl.).

Thus agile project management methodology – considering the limitations of the research – generates a higher level of creativity than a waterfall project management methodology.

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