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The Effect of Agile Process and Scrum Practices on the Rework and Defect Level of E-services

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Abstract: There is a continuous discussion in the scientific literature if the Agile process and Scrum practices effect better project results, or the results of the e-service improvement project rely mainly on the competence of a project team. The purpose of this study was to determine the effect of the Agile process, Scrum practices and team competence on the rework and defect level (DL) after a release of an e-service. The survey was conducted in 101 different organizations. The statistical analysis of the linear regression, two-way interaction and three-way interaction was performed in order to answer the question under analysis. The statistical analysis of the collected data revealed that the increasing intensity of the application of the Agile process results in a statistically significant decrease of DL. The examination of the statistical models has shown that the team competence does not have a direct effect on DL, but it acts as a moderator of the Agile process. In line with the acceleration of the team competence, the Agile process triggers a stronger decrease in DL. The analysis of the statistical models in terms of the intensity of the application of Scrum practices did not show any statistically significant differences in DL.

Keywords: *Agile, Scrum, e-service, team competence, improvement.*

Introduction

The ongoing manifestation of electronic services, a new innovation brought about by the progress in technological environment, is visible not only in the fields of business and public management, but is also actively examined by researchers. As with the quality of services, the quality of electronic services is also a crucial issue of quality management. Although the quality of electronic services has already been addressed by many authors (Agrawal et al, 2014), in recent years it has received a lot of attention and attempts have been made to generalise the characteristics and criteria for the quality of electronic services. On the other hand, researchers often claim that the research, especially empirical, is still scarce and poses many ambiguous issues in the field of management. Many authors point out that the research into the quality of e-services still poses many questions what to do next and how to effectively improve the quality of e-services.

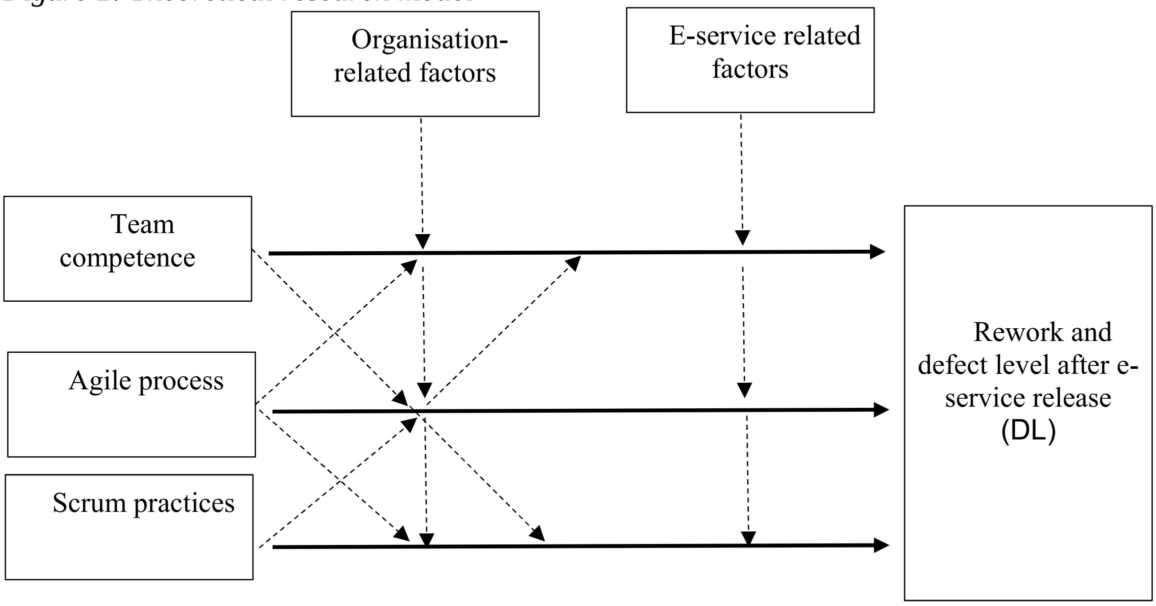
One of the most advanced methodologies targeted at e-systems improvement is Agile methodology. However, there is a constant debate as to whether Agile requires a competent team. In addition, attempts are made to answer questions who or what effects good project results, a team or good practices and principles. This is an important issue because there are claims that specific practice is not important when working with “good people”. This suggests that perhaps the success of Agile methods can be attributed to

groups of “good people”, but not to practices and principles. On the other hand, the participants have stated that Agile methods are valuable (Lindvall et al., 2002).
The purpose of this research was to determine the effect of the Agile process, Scrum practices and team competence on the rework and defect level (DL) after the release of an e-service.

Agile process, Scrum practices and team competence effect on DL research

In order to answer the research question, a theoretical research model was compiled (Figure 1). The research model identifies the potential interactions of the factors under analysis. Taking into account that a conceptual question is raised on what effects DL - either the Agile process, Scrum practices or team competence, therefore, the study examines all the possible interactions.

Figure 1: Theoretical research model



(Source: created by the author)

The direct effect of the factors on DL is represented by solid arrows, the indirect effect - by dotted dash arrows. Since the study involved the evaluation of different e-service projects from different organizations, the organisation-related factors and service related-factors are used by the model as as moderating factors. The key factors related to an organisation or a service, evaluated in the study as moderators are presented in Table 1.

Table 1: The key factors related to an organisation or a service.

Group of factors	Key factors
Organisation-related factors	1. Number of employees of the organisation 2. Strategic orientation to e-services
E-service-related factors	1. Number of members of the e-service improvement team 2. Complexity of e-service improvement

(Source: created by the author)

The main factors related to organisations and services were selected based on the analysis of scientific literature and are described below.

The influence of the number of employees on the performance of processes

The influence of the number of employees on the performance of processes is a matter of scientific discussion. Scientific research findings show rather contradictory outcomes. For example, Looy et al. (2017): "As far as an organisation's size is concerned, data shows that smaller organisations can also achieve higher results of business process management (BPM). Yet, there is also contrary evidence that SMEs are not actively following the BPM, they do not need BPM or are even unable to adapt BPM due to their limited resources".

It is important to emphasise that when examining the influence of the number of employees on process management, analysed authors classify small enterprises up to 100, medium-sized - from 101 to 250 employees. E-service organisations typically have fewer employees. Therefore, it is important to evaluate the effect of the organisation's staff on the e-services DL. In order to avoid the effect of the differences in the classification of the size of organisations, the nominal number of employees should be measured.

Strategic orientation to e-services

The organisations under analysis vary according to the strategic orientation to e-services. The study assessed whether e-service provision is the main activity of the organisation, whether the provision of e-services is an important part of the activity and what form of service provision is used. The classification of the strategic orientation according to the criteria examined in the study is presented in Table 2.

Table 2: The classification of the strategic orientation according to the criteria examined in the study.

Strategic orientation group	Orientation to e-services		Traditional business orientation	
Direction/criterion of strategic orientation	*Orientation to net e-services*	*Orientation to e-Services supplemented with traditional services*	*Orientation to traditional services supplemented by e-Service*	*Orientation to e-services as supporting services*
Provision of e-services is the main activity	+	+	-	-
Provision of e-services is an important part of the activity	+	+	+	-
Services provided only in e-form	+	-	-	-

(Source: created by the author)

After classifying the organisations according to the criteria of strategic orientation to e-services, 2 strategic orientation groups and 4 strategic orientation directions were singled out and deployed in the study in searching for moderating relationships on DL.

Complexity of the improvement of e-services

The factor of the complexity of improvement consists of two factors: the frequency of improvement and the complexity of the e-service. In terms of DL, both factors are important - how often the e-service is being improved and how much the improved e-service is sophisticated. Therefore, the study uses a multiplication of these factors. The frequency of improvement is evaluated on the Likert scale from 1 to 5 points, where 1 is very rarely improved, 5 is regularly improved.

The complexity of the e-service is assessed according to 7 criteria that are adapted for the study under model I6 (Btoush et al, 2008). The models of the classification of e-services developed for the e-government solution, so the criteria for this study have been modified to suit business e-solutions. The study assessed the following criteria of the e-service complexity: Level of service digitization, Automation level, Level of personalization, Internationality, Multichannel, Multiplatform, Integration with other systems. The mean evaluation was calculated o the basis of these criteria. The classification of complexity stages is presented in Table 3.

Table 3: The classification of complexity stages.

Complexity of Improvement	***Very Low***	***Low***	***Median***	***High***	***Very High***
Evaluation	1-5	5-10	10-15	15-20	20-25

(Source: created by the author)

In order to better understand the evaluation outcomes of the complexity of improvement and to interpret the results of the statistical analysis, the complexity improvement was classified to the stages shown on table 3.

The influence of team members on the effectiveness of processes

The number of team members is highlighted by many scholars as an important factor influencing the effectiveness of the process. The findings obtained by Blackburn et al. (1996) are consistent with the traditional view that larger teams reduce productivity due to inperformance caused by communication with many people. Brooks (1975) argued that the need for communication should increase proportionally to the size of the team. The correlation between the largest team size and code line productivity is weakly negative. For example, there is a high negative correlation with team size in testing: companies that have to do a lot of testing are less productive. They spend on average more time for searching, identifying and correcting errors. It is important to test the effect of team members on DL for the reasons mentioned above.

Team competence

There are claims that specific practice is not important when working with “good people” (authors named those who are competent i.e.: Possess real-world experience in the technology domain; Have built similar systems in the past; Possess good people &

communication skills). This suggests that perhaps the success of Agile methods can be attributed to groups of "good people", but not to practices and principles. On the other hand, the participants have stated that Agile methods are valuable (Lindvall et al., 2002).
The participants of the study had to evaluate the competence of the e-service improvement team according to the Likert scale from 1 to 5, where 1 is very low and 5 is very high. The study uses a generalised assessment of competence, since it seeks to answer the conceptual questions on the factors effecting DL.

Agile process

For the evaluation and measurement of the Agile process, the following model (based on the Agile methodology) is used and it is presented in Table 4 The numbering of the activities is conditional, because the model is dynamic, and the activities can rotate at different speeds and cycles and at any stage the input of the corresponding activity can be generated. Agile process activities measured in the study:

1. Shortlist of improvement ideas
2. Evaluation and selection of improvement ideas
3. Preparation of product backlog
4. Setting up customer priorities
5. Determination of preliminary work volumes
6. Sprint backlog
7. Determining the quality criteria for sprint
8. Determining exact volumes of work to be performed
9. Identification of non-conformities
10. Testing
11. Evaluation of actions
12. Gathering feedback
13. Summarizing and taking notes of the lessons learned
14. Evaluating the effectiveness of the improvement process
15. Improvement of the process

The study deployed the division of the Agile process into 15 interrelated activities, the occurrence of these activities in the organization was evaluated by the participants of the survey. The process studies typically use the following scale to measure the prevalence of activities in an organisation: not implemented, rarely, sometimes, often, systematically. For example, this scale was used by Salo in 2008 to explore the use of the Agile methods for software development. The same frequency scale was also used in this study. The Agile process intensity is calculated based on the mean values of the assessment of the activities.

Scrum practices

Salo (2008) identified and evaluated the use of scrum practices: sprint planning meetings, sprints, sprint backlogs, sprint review, daily scrum meetings, product backlogs. These practices are considered to be fundamental Scrum methodologies for assessing whether an organisation uses scrum techniques.

Similar scrum practices were distinguished by Torrecilla-Salinas and others (2015) and Mahalakshmi, Sundararajan 2013, only singled out sprint retrospective and sprint review meetings, which Salo (2008) classified as sprint review.

Basic Scrum Practices (compiled by the author according to Mahalakshmi, Sundararajan 2013, Salo 2008, Torrecilla-Salinas, et al. 2015)

The key Scrum practices outlined in Table 5 were evaluated in the study using the same assessment scale as it was used to evaluate the Agile process.

4: The key Scrum practices.

Basic Scrum Practices	References
A. Product backlogs	Mahalakshmi, Sundararajan 2013, Salo 2008, Torrecilla-Salinas et al. (2015)
B. Sprint planning meetings	Mahalakshmi, Sundararajan 2013, Salo 2008, Torrecilla-Salinas et al. (2015)
C. Sprint backlogs	Mahalakshmi, Sundararajan 2013, Salo 2008, Torrecilla-Salinas et al. (2015)
D. Sprint	Mahalakshmi, Sundararajan 2013, Salo 2008, Torrecilla-Salinas et al. (2015)
E. Daily Scrum meetings	Mahalakshmi, Sundararajan 2013, Salo 2008, Torrecilla-Salinas et al. (2015)
F. Sprint Review meetings	Mahalakshmi, Sundararajan 2013, Torrecil- la-Salinas et al. (2015)
G. Scrum retrospective meetings	Mahalakshmi, Sundararajan 2013, Torrecil- la-Salinas et al. (2015)

(Source: created by the author based on Mahalakshmi, Sundararajan 2013, Salo 2008, Torrecilla-Salinas, et al. 2015)

After assessing the intensity of the application of each Scrum practice, the mean value of the assessment of all Scrum practices was calculated.

Empirical research and discussion of the research results

The purpose of the empirical research was to provide answers to the questions about the influence of team competence on DL, the impact of the applied Agile process on DL and the impact of individual SCRUM practices on DL. To achieve this purpose, the author developed a research tool, an online questionnaire that was completed by respondents from companies who underwent a targeted selection. The author selected the research criteria that are important for the quality of e-services:

- → Complexity of e-service;
- → Frequency of e-service improvement;
- → Number of employees in the organization;
- → Team size;
- → Competence of team
- → Improvement of e-services in accordance with the Agile Scrum methodology;
- → Process quality (Rework and defect level DL %).

The above-mentioned criteria were distinguished by the author on the basis of the findings obtained by a qualitative study of the Agile and Lean software development indicators, carried out by Kupiainen et al. in 2015, who examined over 120 different indicators used. Taking Kupiainen et al. study of 2015 into account, the author selected the key indicators on the basis of the number of their references and also based on their individual relevance. The reliability of the selection of key indicators that best indicate the performance of the process was assured by selecting key indicators, the indicators that were referred to more than 3 times have been selected, and their significance factor has been determined twice or more. Also, the performance criterion is attributed on the basis of the theoretical model constructed by the author aiming to select only the criteria for the performance of the process, since the performance of the service does not ally in this study. This analysis showed that the level of defects and reworks after the release of the e-service is the most appropriate indicator for assessing the quality of improving the process of e-services.

At least one or two questions were formulated for the examination of each criterion involved in the research instrument. The questions were constructed using a range of ranking, relative, interval and percentage scales. The total survey consisted of 17 questions and each respondent took 30-45 minutes to answer the survey questionnaire. The respondents' target sample comprised 101 e-service product owners or managers one of each company. The respondents were purposefully selected according to the lists of Lithuanian dotcoms and lists of e-service development companies, accessible on the portal Webconsulting, according to the statistical data indicating the e-services portal visits of 2017.

The empirical study (questionnaire survey) was conducted in 101 different organisations and aimed to evaluate the differences observed in e-service projects.

The analysis of the empirical research data aimed to answer the following questions: 1. What is the effect of team competence on DL? 2. How does applying the Agile management process effect DL? 3. What is the effect of key SCRUM practices on DL?

In the first place, the statistical analysis examined the direct relationships of the team competence and the factors of the Agile process and Scrum practices with DL. The linear regression analysis did not reveal statistically significant relationships between the team competences, Agile process, Scrum practices, and DL. The findings of the regression analysis may have been influenced by the fact that the study has evaluated various projects of e-services provided by the organisations of different sizes, diverse strategic orientations to e-services and the complexity of the development of different e-services.

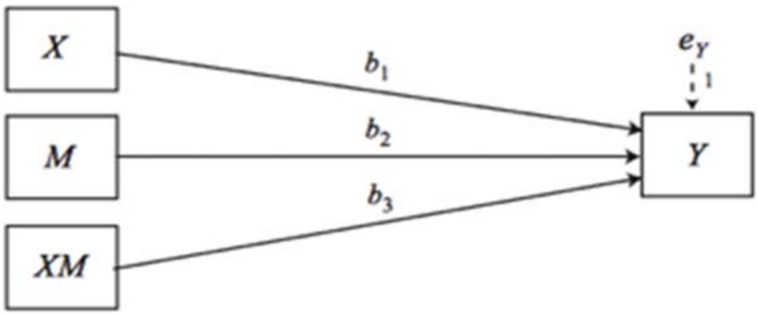
Therefore, it was important to assess how the team competence, Agile process and Scrum practices influence DL and how they are related to particular moderating factors. The IBM SPSS programme was used to carry out the Andrew F. Hayes PROCESS moderation analysis.

On the basis of the conceptual model of the moderation study, the effect of the moderating factor (M) on the relationship between X and Y was evaluated. If the change in the value of M changes the effect of X on Y, such modification gives rise to a moderating effect, which is called the interaction effect in the statistic. The statistical model is shown in Figure 2.

As presented in Figure 2, the statistical model allows us to calculate both, a direct relationship of the principal factor X, the moderating factor M with DL, as well as the interaction of factors X * M with DL. Moderating relationships found if, depending on moderator values, statistically significant differences in regression coefficients are determined. The statistical model equation is described as $y=a+b1*X+b2*M+b3*X*M$ (*Hayes, 2013)*. After determining a moderating connection, it is important to estimate a relative moderator's effect. The lower and upper differences of the M values from the centre (mean value) M=0 are calculated. This allows us to evaluate the effect of X on Y according to three relative M values: low, mean and high.

There were three statistically significant moderators identified in our study: strategic orientation, complexity of improvement and team competence. The factors under examination were not moderated either by the number of the organisation's staff members or by the number of the e-service improvement teams.

Figure 2: Statistical moderator testing model.



(Source: Hayes, 2013, p.4)

An analysis of the effect of moderators has found that the organisational factor strategic orientation moderates the effect of the Agile process intensity on DL. The table 5 presented above shows the only statistically significant relationship of the strategic orientation with the Agile process intensity factor R2-chng=.0488, p=.0173 (an effect on DL). It is also seen that the relative statistically significant effect has been determined only in directions 1 and 2 of the strategic orientation, which are assigned to the 1st strategic group - the activity focused on e-services. The largest effect of the Agile process intensity on DL (-8.28) was observed in the 1st direction of strategic orientation. The statistically significant negative effect found means that the Agile process reduces DL.

Table 5: Moderator Strategic orientation statistical data.

Factor (X)	**Statistical model** R2 p	**Inter-action statistics (X*M)** R2-chng p	**Moderator:** ***Strategic orientation*** **(M)**			
			E-service orientation		**Traditional business orientation**	
			E-service effect p	**E-service+ Traditional** Effect p	**Tradition-al + E-service** Effect p	**E-supporting service** Effect p
Team competence	-	.0051 .4628	-	-	-	-
Intensity of Agile process	**.23 .00**	**.0488 .0173**	**-8.2778 0.0012**	**-5.2757 0.0011**	-1.7732 0.2106	1.7293 0.4702
Application of Scrum practices	-	.0083 .3459	**-**	**-**	-	-

After assessing the moderating influence of the complexity of the improvement of the service's factor, a relationship was found between the Agile process intensity and DL (R2-chng.0567, p.0153). Other examined factors did not reveal statistically significant effects on DL. A relative effect of the Agile effect on DL according to the levels of complexity of improvement is shown in Table 6.

Table 6: Moderator Complexity of improvement statistical data.

Factor (X)	Statistical model R2 p	Interaction statistics (X*M) R2-chng p		Moderator: *Complexity of improvement* (M) Low Effect p	Mean Effect p	High Effect p
Team competence	**-**	.0119	.2911	**-**	**-**	**-**
Intensity of Agile process	**.136 <.01**	**.0567**	**.0153**	-3.6227 0.068	**-7.2247 0.0005**	**-10.1109 0.0003**
Application of Scrum practices	-	.0117	.2926			

Table 6 shows that in case the level of complexity of improvement is low, there is no statistically significant relationship between Agile and DL, although the value of p (.068) is very close to the threshold of statistical significance. When the complexity of improvement increases, the effect of the Agile process on DL becomes statistically significant and the effect is increasingly growing.

The moderation of team competence in terms of the effect of the Agile process on DL has been determined, while the moderation of team competence on the effect of Scrum practices on DL has not been determined (p=.26).

Table 7 shows that in case when the level of teamcompetence is low, the Agile process intensity does not effect DL (p. 45). At mean and high levels of competence, the relationship between the Agile process intensity and DL is statistically significant and increases with the accelerating level of competence.

Table 7: Moderator Team competence statistical data.

Factor (X)	Statistical model R2 p	Interaction statistics (X*M) R2-chng p		Moderator: *Team competence* (M) Low Effect p	Mean Effect p	High Effect p
Intensity of Agile process	**.083 .0434**	**.0447**	**.036**	-1.4371 0.4501	**-5.4163 0.0065**	**-9.3955 0.0056**
Application of Scrum practices	**-**	.0138	.2555	-	**-**	**-**

Since moderation is the interaction of factors, it is typical that if one of the interaction factors moderates the influence of another factor on the dependent variable, then the interaction occurs when the independent variable (X) and the moderator (M) are switched places. In this study, this is especially true, because we are trying to answer the question what affects the lower DL, the Agile process or the team competence. Therefore, it is important to assess the effect of Agile as a potential moderator, on the extent of the effect made by the team competence on DL.

Table 8: Moderator Intensity of Agile process statistical data.

Factor (X)	**Statistical model** R2 p	**Interaction statistics (X*M)** R2-chng	 p	**Moderator:** ***Intensity of Agile process*** **(M)** **Low** Effect p	 **Mean** Effect p	 **High** Effect p
Team Competence	**.083** **.0434**	**.0447**	**.036**	**5.8129** **0.023**	2.0989 0.2773	-1.0844 0.6662
Application of Scrum practices	**-**	.0138	.2555	-		

The reverse analysis of moderators shows that the team competence effects DL only when the Agile process intensity is relatively low. Nevertheless, the effect is positive, which means that in the cases of low intensity of the Agile process, the growth of DL is effected by the increasingly growing team competence.

The analysis of the moderators revealed that the effect the Agile process intensity on DL is related to the following moderators: team competence, strategic orientation, and complexity of improvement. Furthermore, the study provides the evaluation of the effect of the outlined moderators and presents a more detailed examination of the statistically significant relationships of the effects of the Agile process intensity effecting DL.

The effect of the Agile process intensity on DL according to levels of competence

After performing the statistical analysis of the influence of the intensity of the Agile process on DL according to the levels of competence, the following general model was obtained: F (3.93)=2.82, which is statistically significant p=.0434, and the model explains 8.3% of the relationship found between the Agile process intensity and DL (R2=.083). The value of R2 indicates that the statistical model is not very strong.

The analysis of the predictive factors presented in the statistical model:

- → *Factor 1:* The Agile process intensity (t(93)=-2.51) is a statistically significant factor (p=.014), with an increase of 1 point in the evaluation of the Agile process intensity, DL decreases by 4.39 percentage points (b=-4.39).
- → *Factor 2:* Team competence (b=2.62, t (93)=1.36) is a statistically insignificant factor
- → p=.18. The relationship between team competences and DL has not been found.
- → *Interaction of factors 1 and 2*: b=-3.98, t(93)=-2.13 is statistically significant (p=.036).

Based on the analysis of the predictive factors, the following equation is formed according to the statistical model:

$$Y = \text{constant} - 4.39\ (\text{Agile}) - 3.98\ (\text{Agile*Competence}), \text{ where } Y \text{ is DL.} \quad (1)$$

In order to evaluate the moderating effect of the team competence, an equation is formed where the mean value of the team competence M (competence) = 3.72 is made equal to 0, thus, the following equation is obtained:

$$Y = \text{constant} + 0 - 4.39\ (\text{Agile}) + 0 \quad (2)$$

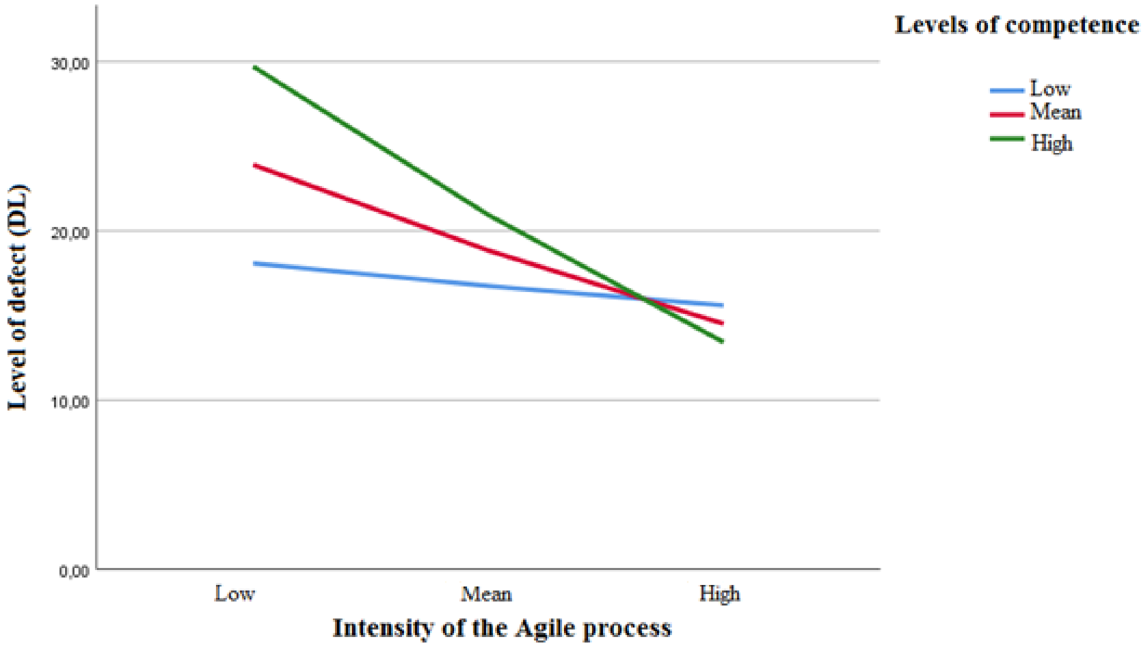
The relationships of the Agile process intensity with DL, obtained according to the levels of competence are as follows:

- → When the competence is relatively low (M-.74) (3-Mean), Agile b=-1.44, t(93)=-.76, p=.45. When team competence is relatively low, there is no association between Agile and DL.
- → When team competence is relatively mean, (M + .26) (4-High), the effect of the intensity of application of the Agile process is statistically significant (b=-5.42 t(93)=-2.78, p<.01). When team competence is relatively mean, each increase in the evaluation of the Agile process intensity by one point results in the decrease of DL by 5.42 percentage points.
- → When the competence is relatively high (M +.1.26) (5-Very high), the effect of the application of the Agile process intensity is statistically significant (b =-9.40 t (93) =- 2.84, p<.01). When the team competence is high, a 1-point increase in the assessment of the Agile process intensity leads to the decrease of DL by 9.4 percentage points.

The differences in the relationships between the Agile process intensity and DL by the competence levels are shown in Figure 3. It is obvious that team competence moderates the relationship between the Agile process intensity and DL, since there are evident differences in the inclination of the straight lines.

As seen in the diagram, the higher the team's level of competence, the higher DL is observed when the intensity of the Agile process is low (DL, respectively, according to the relative levels of competence 18.1%, 23.9% and 31.97%). This may be due to the fact that higher competence provides greater confidence, therefore, improvements in higher complexity are carried out (as evidenced by the relationship of team competence and the complexity of improvement, which, apart from the systematic process, triggers a higher DL. As the Agile process increasingly intensifies, the level of DL decreases with the accelerating levels of competence. Upon reaching the high level of intensity of the Agile process, the lowest DL at all relative levels of competence is reached and the fundamental regularity changes as follows: the higher the level of competence, the lower the overall DL is (15.58%, 14.4% and 13.41%, respectively, according to the relative levels of competence). When the team's level of competence is low, the relationship is statistically insignificant as it is revealed by a practically flat bottom line. This indicates that the high level of team competence without the systematic use of the Agile process does not help in achieving lower DL. Also, when team competence is low, a systematic application of the Agile process does not reduce DL. However, it should be taken into account that the statistical model under consideration does not refer to other important factors, such as the complexity of the improvement with which the team competence is statistically related. Therefore, it is important to evaluate the complex effect of both moderators.

Figure 3: Effect of the Agile process intensity on DL according to levels of competence



Also, the analysis of moderators allows us to determine the point from which the relationship between the Agile process intensity and DL is statistically significant p=.05. This point is found where team competence is assessed by at least 3.5 points, the relationship between the Agile process intensity and DL is statistically significant, T(93) =-1.99, p=.05, b=-3.33. When the competence assessment grows, a negative relationship between the Agile process and DL increases, and the highest Agile process effect on DL (b = -9.40, t (93) = - 2.84, p <.01) is achieved upon the highest assessment of competence (5 - Extremely high).

After performing the statistical analysis, we can see that Agile process intensity has a negative effect on DL when the assessment of team competence is more than mean, and the effect of the Agile process significantly increases with increasingly growing assessment of competence. It should be taken into consideration that this explains only 8.3% of the relationship under analysis.

The effect of the Agile process intensity on DL according to the directions of strategic orientation.

The statistical analysis of the influence of the Agile process intensity on DL according to the strategic orientation resulted in obtaining the following model F(3.93)=9.13, which is statistically significant p=.00 and accounts for 23% of the relationship between the Agile process intensity and DL (R2=.23). An analysis of the predictive factors presented in the statistical model:

- → *Factor 1:* The Agile process intensity (t (93)=- 2.6) is a statistically significant factor (p=.011), an increase in the Agile process intensity assessment by 1 point triggers the DL decrease by 3.4 percentage points (b=-3.4).
- → *Factor 2:* A direction of strategic orientation (b=-5.14, t(93)=-4.42) is a statistically significant factor p=.00. There is a relationship between the direction of strategic orientation and DL.

→ *Interaction of factors 1 and 2:* b=3.34, t(93)=2.42 is statistically significant (p=.017).

Taking into account the analysis of the predictive factors according to the statistical model, the following equation is formed:

Y = constant – 3.4 (Agile) – 5.14 (Strategic orientation) + 3.34 (Agile*Strategic orientation), where Y is DL. (3)

In order to evaluate the moderating effect of the strategic orientation, an equation is formed where the mean value of the strategic orientation M (Strategic orientation)=2.51 is determined and made equal to 0, thus the equation obtained is as follows:

Y = constant + 0 – 3.4 (Agile) + 0 (4)

Thus, we obtain the following Agile process intensity relationships with the DL according to the directions of strategic orientation:

When the direction of strategic orientation is *net e-services* (M-1.47) (direction1), the increase in Agile process intensity by one point leads to a decrease of DL by 8.28 percentage points (b = -8.28, t (93) = -3.33, p <. 0).

→ When the direction of strategic orientation is *e-services supplemented with traditional services* (M-.57) (direction 2), a one-point increase in Agile process intensity assessment results in the decrease of DL by 5.28 percentage points (b = -5.28 t (93) = - 3.38, p <.01.)

→ When the direction of strategic orientation is the *traditional services supplemented with e-services* (M + .48) (direction 3), there is no association between the Agile process intensity evaluation and DL (b=-1.77, t (93) = - 1.26, p=.21)

→ When the direction of strategic orientation is *e-services as supporting services* (M + 1.52) (direction 4), there is no relationship between the Agile process intensity assessment and DL (b = 1.73, t (93) =. 73, p = .47).

The graphical strategic orientation moderator analysis is not possible and would be inappropriate due to the structure of the information provided by the SPSS, as the information required for graphical analysis is presented by SPSS distinguishing only two categories that represent directions 1 and 3 only, and one of which is statistically insignificant.

The statistical analysis shows that the intensity of application of the Agile process influences the decrease of DL in the cases of the strategic orientation directions 1 and 2. The highest effect of the Agile process intensity on the decrease of DL is observed in the first direction of strategic orientation.

The effect of the Agile process intensity on DL according to the levels of complexity improvement

After analysing the effect of the Agile process intensity on DL **according to the levels of the complexity of improvement**, the following general statistical model was obtained: F (3.93) = 4.89, which is statistically significant p<.01, the model explains 13.6 per cent of the relationship between the Agile process intensity and DL (R2=.136). The analysis of the predictive factors presented in the statistical model:

- → *Factor 1:* The Agile process intensity (t(93)=- 3.5) is a statistically significant factor (p<.01), the increase of the Agile process intensity assessment by 1 point triggers the decrease in DL by 6.86 percentage points (b=-6.86).
- → *Factor 2:* Complexity of e-service improvement (t (93) = 2.6) is a statistically significant factor p=.01, the increase of the Agile process intensity evaluation by 1 point results in the increase of DL by 74 percentage points (b =.74). It should be noted that the scale of the complexity improvement assessment is from 1 to 25, i.e. 5 times higher than the other scales because two factors (improvement frequency and e-system complexity) are multiplied. Taking this into consideration, we can see that the effects of the complexity of improvement are significant in increasing DL.
- → *Interaction of factors 1 and 2:* b = -.51, t (93)=-2.47 is statistically significant (p=.02).

Taking into account the analysis of predictive factors according to the statistical model, a dependence equation is formed:

Y = constant – 6.86 (Agile) + .74 (The complexity of improvement) – .51 (Agile*The complexity of improvement), where Y is DL. (5)

In order to evaluate the moderating effect of the complexity of improvement of e-services, an equation is formed where the mean value of the complexity of improvement M (*complexity improvement*) = 14.1 is determined and is equated to 0, thus the following equation is obtained:

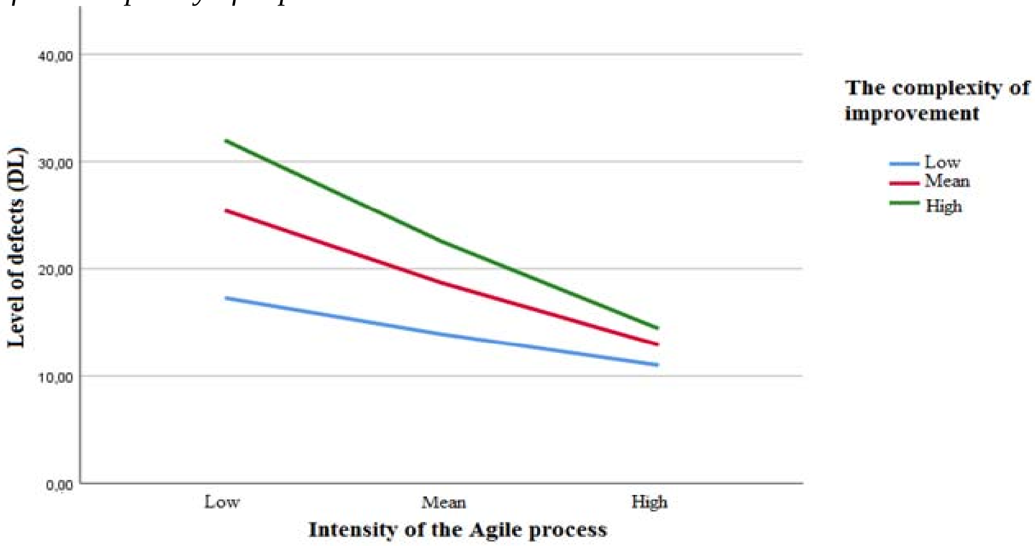
Y = constant + 0 – 6.86 (Agile) + 0 (6)

The relationships between the Agile process intensity and DL according to the levels *of the complexity of improvement* are obtained as follows:

- → When *the complexity of improvement* is relatively low (M-6.4) (7.7-low complexity), the relationship between Agile and DL is not observed (b= -3.62, t(93)= - 1.85). The relationship is statistically insignificant but very close to the threshold of statistical significance p = .068.
- → When *the complexity of improvement* is relatively mean (M.73) (14.83-mean complexity), Agile (t (93) = - 3.6), then the increase of 1 point in the assessment of the Agile process intensity leads to the decrease of DL by 7.22 percentage points (b = -7.22), it is statistically significant (p <.01).
- → When *the complexity of improvement* is relatively high (M 6.45) (20.55 - very high complexity), a one-point increase in the assessment of the Agile process intensity (t (93) = - 3.75) results in the DL decrease by 10.11 percentage points (b = -10.11), it is statistically significant (p <.01).

The differences in the effects of the Agile process intensity on DL according to the complexity of improvement levels are shown in Figure 4. It is clearly seen that the complexity of improvement moderates the effect of the Agile process intensity on DL because there are obvious differences in the inclination of the straight lines: the higher the complexity of improvement level the higher DL is, while the intensity of the Agile process is low (DL is 17.29%, 25.44%, 31.97% respectively, according to the relative levels of the complexity of improvement). With the increasing Agile process intensity, the decrease in the level of DL intensifies as a result of a higher level of the complexity of improvement. Upon reaching a high level of the Agile process intensity, the lowest DL is achieved at all levels of the complexity of improvement (DL is 11%, 12.9% and 14.44%respectively), and, according to the relative levels of the complexity of improvement, the gap between DL significantly decreases (from 7-8% to 1.5-2%).

Figure 4: The effect of the Agile process intensity on DL according to the relative levels of the complexity of improvement



Furthermore, the analysis of moderators enabled us to determine the point from which the relationship between the Agile process intensity and DL is statistically significant, $p=.05$. This point occurs when the complexity of improvement is evaluated by at least 8.1 points, and the relationship between the Agile process intensity and DL is statistically significant, $T(93) = -1.99$, $p=.05$, $b=-3.84$. When the evaluation of the complexity of improvement grows, the negative relationship between the Agile process and DL increases after reaching the highest assessment point of the complexity of improvement (25-Very high), ($b=-12.28$, $t(93)=-3.62$, $p<.01$).

The performed statistical analysis shows that the application of the Agile process effects DL, when the complexity of improvement is slightly higher than the mean evaluation of the low complexity of improvement (8.1 point, low complexity of improvement from 5 to 10 points) and the Agile process effect significantly increases with the increasing complexity of e-service development. It should be noted that this explains 13.6% of the relationship, which shows that the statistical model is not very strong.

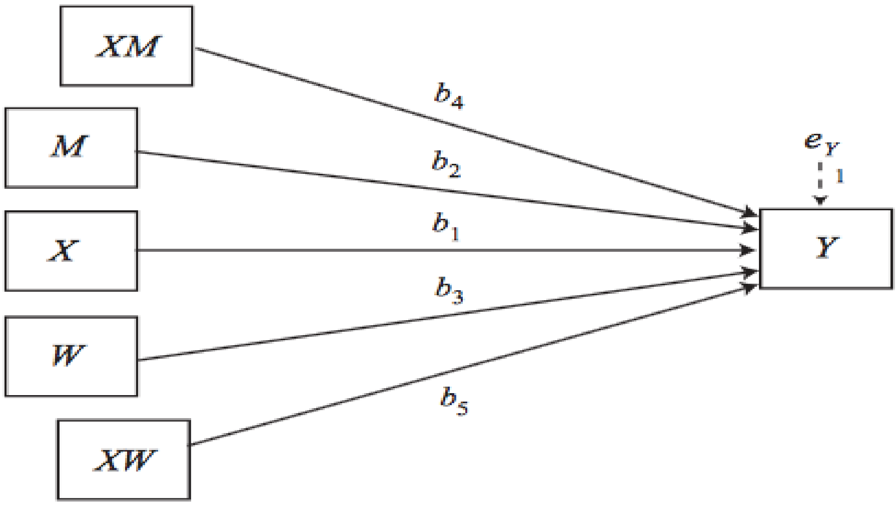
The systematic application of the Agile process effects DL and depends on the organisation's strategic orientation towards e-services, the complexity of the e-services development and the competence of the development teams. The higher the complexity of the development, the more intensively the Agile process is applied and the more reduced DL is observed. When the complexity of the improvement is relatively small (<8.1 points), the effect of the Agile process application intensity on DL becomes statistically insignificant. When an e-service-oriented organisation applies the Agile process more intensively, it reduces DL ($p<.01$). When the activities of organisations are focused on the traditional performance, there is no relationship between the Agile process and DL ($p=.27$). The higher the team competence, the higher the effect of applying the

Agile process on DL is. When the team competence is evaluated as mean and below, the relationship between the Agile process and DL is not found (p=.45).

A complex analysis of the effect of moderators on the Agile process intensity effecting DL

An analysis of individual moderators has found that the relationship between the Agile process intensity and DL is influenced by three moderators: team competence, strategic orientation and complexity of improvement. Since the moderators under examination are closely interrelated, in order to verify and validate the findings, it is important to carry out a complex analysis of the effect of the Agile process intensity on DL and the moderators identified by statistical model shown in figure 5.

Figure 5: The two moderator statistical model.



(Source: Hayes, 2013, p.5)

The relative effect of X is calculated from the equation Y=b1+b4M+b5M, the statistical equation is written as follows Y=a+b1*X+b2*M+b3*W+b4*M+b5* (*Hayes, 2013).*

Complex analysis of the effect of the Agile process intensity on DL according to strategic orientation and complexity of improvement

The research model distinguishes between the two main moderators: strategic orientation and complexity of improvement. Also, the regression analysis has revealed that these moderators are related. Therefore, the complex analysis of these moderators has been performed first. After carrying out a statistical analysis of the effect of the Agile process intensity on DL according to the strategic orientation and the complexity of improvement, the following general model was obtained: F(5. 91)=5.85, which is statistically significant p<.01 and explains 24.33 per cent of the relationship between the Agile process intensity and DL (R2=.2433). It is a much stronger statistical model rather than that obtained from examination of individual moderators. An analysis of the predictive factors presented in the statistical model:

- → *Factor 1:* Agile process intensity (t(91)=- 3.43) is a statistically significant factor (p<.01); when the Agile process intensity assessment increases by 1 point, DL decreases by 6.43 percentage points (b=-6.43).

→ *Factor 2:* Complexity of e-service improvement ($t(91)=1.57$) is a statistically insignificant factor $p=.12$, ($b=.44$).

→ *Interaction of factors 1 and 2:* $b=-.46$, $t(91)=-2.2$, is statistically significant ($p=.03$).

→ *Factor 3:* the direction of strategic orientation to e-services ($t(91)=-3.54$) is a statistically significant factor $p<.01$, ($b=-8.69$).

→ *Interaction of factors 1 and 3:* $b=2.58$, $t(91)=.90$ is statistically insignificant ($p=.37$).

According to the statistical model and on the basis of the analysis of predictive factors, the following equation is formed:

$$Y = \text{constant} - 6.43\ (\text{Agile}) - .46\ (\text{Agile*The complexity of improvement}) - \\ - 8.69\ (\text{Agile*Strategic orientation group}), \text{ where Y is DL.} \quad (7)$$

In order to evaluate the moderating effect of the complexity of improvement of e-services and strategic orientation, the equation is formed where the mean value of the complexity of improvement M (*the complexity of improvement*)=14.1 and the mean value of the strategic orientation group M (*strategic orientation*)=1.6 is made equal to 0:

$$Y = \text{constant} - 6.43\ (\text{Agile}) + 0 + 0 \quad (8)$$

Accordingly, we obtain the following relationships between the Agile process intensity and DL according to the levels of the complexity of improvement and the strategic orientation group as seen in Table 9.

As we can see from the complex analysis of moderators, the essential differences in the Agile effect on DL emerge between the different relative levels of the complexity of improvement. When the complexity of improvement is relatively low, there is no relationship between the intensity of the Agile process and DL. Although it is important to mention that the effect observed in the strategic orientation group targeted at e-services is very close to the statistically significant threshold. The differences in the effect are also observed depending on the group of strategic orientation when the relative complexity of improvement is the same.

Figure 6 shows the differences between the effects of the Agile process intensity on DL according to the levels of the complexity of improvement by distinguishing the effect according to the strategic orientation groups. The complexity of improvement moderates the effect of the Agile process intensity on DL because there are obvious differences in the inclination of the straight lines. Figure 6 demonstrates that the higher the level of the complexity of improvement, the higher is DL when the intensity of the Agile process is low (25.47%, 31.26%, 35.89% respectively). The increasing intensity of the Agile process triggers the decrease in the level of DL, the higher the complexity of improvement level, the more intensive decline is observed. After reaching a high level of the Agile process intensity, at all levels of the complexity of improvement, the lowest DL level is achieved, and the gap between DL practically disappears (16.80%, 16.89% and 16.97% respectively).

Table 9: Conditional effect of Agile process on DL at values of moderators (M).

Relative evaluation of the complexity of improvement (M)	Strategic orientation group (M)	Effect on DL	Effect on DL by percentage	p
Low (7.7 points)	E-services	-5.0	-19.63	.064
Low (7.7 points)	Traditional services	-2.42	-16.45	.25
Mean (14.8 points)	E-services	**-8.28**	**-26.49**	**.0006**
Mean (14.8 points)	Traditional services	**-5.7**	**-27.82**	**.021**
High (2.55 points)	E-services	**-10.92**	**-30.43**	**.0001**
High (2.55 points)	Traditional services	**-8.33**	**-33.15**	**.0112**

When the organisation's activities focus on traditional services, the same trend as in an e-service-oriented organisation is observed, only the general DL is lower (about 5-10 percentage points depending on the intensity of application of the Agile process). When the intensity of the Agile process is low (14.71%, 20.49%, 25.13% respectively), the increasing Agile process intensity correlates with decreasing level of DL, the higher the complexity of improvement level, the more expressed reduction is found. After reaching a high level of the Agile process intensity, the lowest DL is achieved at all levels of the complexity of improvement, and the gap between DL also practically disappears (10.51%, 10.60%, 10.68% respectively).

Figure 6: The effect of the Agile process intensity on DL according to the levels of the complexity of improvement in organization oriented to e-services

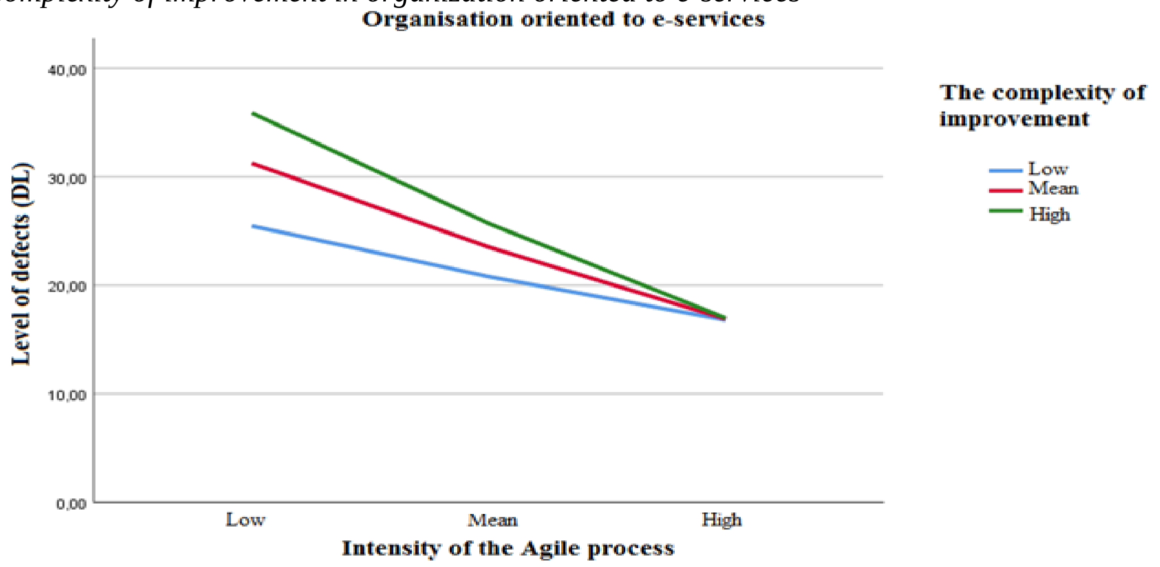
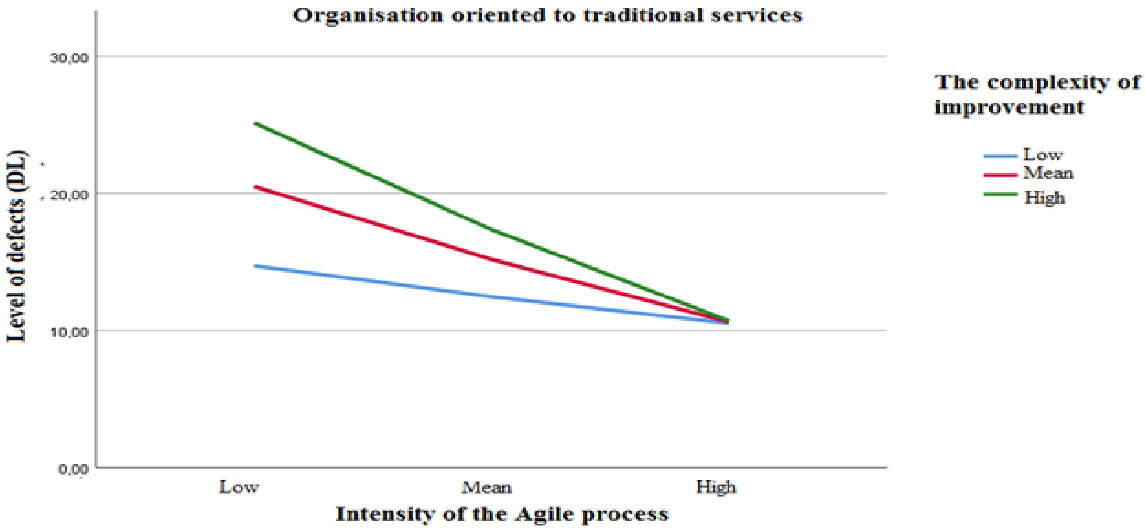


Figure 7: The effect of the Agile process intensity on DL according to the relative levels of the complexity of improvement in organization oriented to tradition services



Significant differences in DL between the different strategic orientations of organisations are likely to arise due to differences in scale of improvement. By evaluating the effect of the Agile process intensity in percentage between different groups of strategic orientation, the differences practically disappear and the Agile effect is 2.5 percentage points higher even in the traditional services-oriented organisation with a relatively high level of the complexity of improvement. Therefore, it can be argued that organisations oriented to e-services tend to have a larger DL, but the intensity of application of the Agile process effects DL of the organisations of both groups.

Complex analysis of the effect of the Agile process intensity on DL according to the complexity of improvement and team competence

In order to provide a complex assessment of the effect of the Agile process intensity on DL, it is also important to evaluate a complex moderating effect of the complexity of improvement and team competence. The regression analysis revealed that these moderators are related. After carrying out the statistical analysis of the effect of the intensity of the Agile process on DL according to the complexity of improvement and team competence, the following general model was obtained: F(5.91)=3.15, which is statistically significant p=.01 and explains 14.74 per cent of the relationship between the Agile process intensity and DL (R2=.1474).

The analysis of the predictive factors presented in the statistical model:

→ *Factor 1:* The Agile process intensity (t(91)=-3.60) is a statistically significant factor (p<.01); the increase in the assessment of the Agile process application intensity by 1 point shows a decrease of DL by 7.55 percentage points (b=-7.55).

→ *Factor 2:* Complexity of the improvement of e-services (t(91)=2.33) is a statistically significant factor p=.02. A 1-point increase in the assessment of the complexity of improvement accelerates DL by 68 percentage points (b=.68). It should be noted that the scale of the assessment of the complexity of improvement ranges from 1 to 25, i.e. is 5 times higher than other scales because two factors (improvement frequency and e-system complexity) are multiplied.

→ *Interaction of factors 1 and 2:* b=-.40, t(91)=-1.37 is statistically insignificant (p=.176).

→ Factor 3: team competence (t(91)=.97) is a statistically insignificant factor p=.34, (b=1.85).

→ *Interaction of factors 1 and 3:* b=-1.40, t(91)=-.54 is statistically insignificant (p=.59).

According to the statistical model and based on the analysis of the predictive factors, the following equation is formed:

Y = constant – 7.55 (Agile) + .68 (The complexity of improvement), where Y is DL. (9)

In order to evaluate the moderating effect of the complexity of the improvement of e-services and the team competence, an equation is formed where the mean value of the complexity of improvement M (*complexity of improvement*) =14.1 and the mean value of the team competence M (*strategic orientation*) = 3.72 are made equal to 0, thus, the following equation is obtained:

Y = constant – 7.55 (Agile) + 0 + 0 (10)

Accordingly, we obtain the following relationships between the Agile process intensity and DL based on the relative levels of *complexity of improvement* and *team competence* (Table 10).

The complex analysis of moderators reveals that the essential differences in the Agile effect on DL occur on the different relative levels of the complexity of improvement. When the complexity of improvement is relatively low, there is no relationship between the Agile process intensity and DL. Although it is important to emphasise that at relatively low and mean levels of competence, the effect is sufficiently close to the statistically significant threshold. Depending on the relative level of competence of the team, the differences in the effect are also observed when the relative assessment of the complexity of improvement is uniform. When the competence assessment is higher, the negative effect of the Agile process intensity on DL increases.

Table 10: Conditional effect of Agile process on DL at values of moderators (M).

Complexity of improvement (M) (Relative assessment)	**Team competence (M) (Relative assessment)**	**Effect on DL**	**Effect on DL by per cent**	**p**
Low (7.7 points)	Low (3 points)	-3.93	-23	.072
Low (7.7 points)	Mean (4 points)	-5.33	-27	.069
Low (7.7 points)	High (5 points)	-6.73	-30	.189
Mean (14.8 points)	Low (3 points)	**-6.80**	**-28**	**.026**

Mean (14.8 points)	Mean (4 points)	**-8.20**	**-31**	**.0004**
Mean (14.8 points)	High (5 points)	**-9.60**	**-32**	**.0132**
High (2.55 points)	Low (3 points)	**-9.11**	**-31**	**.04**
High (2.55 points)	Mean (4 points)	**-10.51**	**-32**	**.0005**
High (2.55 points)	High (5 points)	**-11.91**	**-34**	**.0008**

Figure 8 shows the differences in the effects of the Agile process intensity on DL by the level of the complexity of improvement and by distinguishing the effects according to the relative assessment of the team competence. It is obvious that the higher the level of the complexity of improvement, the higher DL when the Agile process intensity is low (16.74%, 23.87%, 29.58% respectively). While the Agile process intensity increases, the level of DL decreases; the higher the complexity of improvement level, the lower DL is. After reaching a high level of the Agile process intensity, the lowest DL is achieved at all levels of the complexity of improvement, and the gap between DL significantly decreases (9.93%, 12.07% and 13.79%respectively).

When the team competence is relatively mean, the same trend is observed as in the case of a relatively low team competence, only the general DL is higher (by about 3 percentage points). While the Agile process intensity is low (19.71%, 26.84%, 32.55%respectively), the increase in the Agile process intensity correlates with the decrease of the level of DL, the higher the complexity of improvement level, the lower DL is. Upon reaching a high level of the Agile process intensity, the lowest DL is achieved at all levels of the complexity of improvement, and the gap between DL also significantly decreases (10.48%, 12.62%,14.34% respectively). The difference between relatively low and mean competences practically disappears (differs by only 0.5 percentage points).

Figure 8: The effect of the Agile process intensity on DL according to the relative levels of the complexity of improvement when team competence is relative low

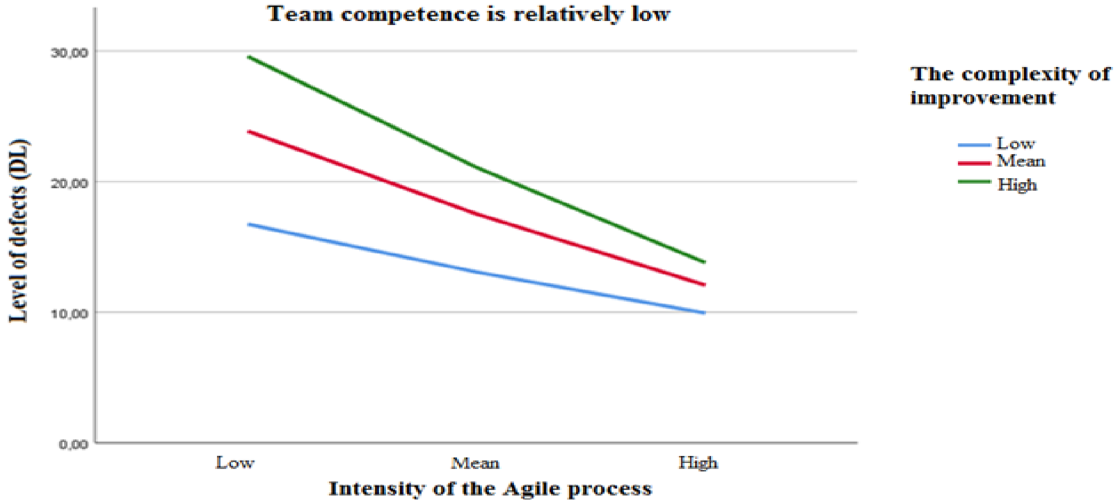
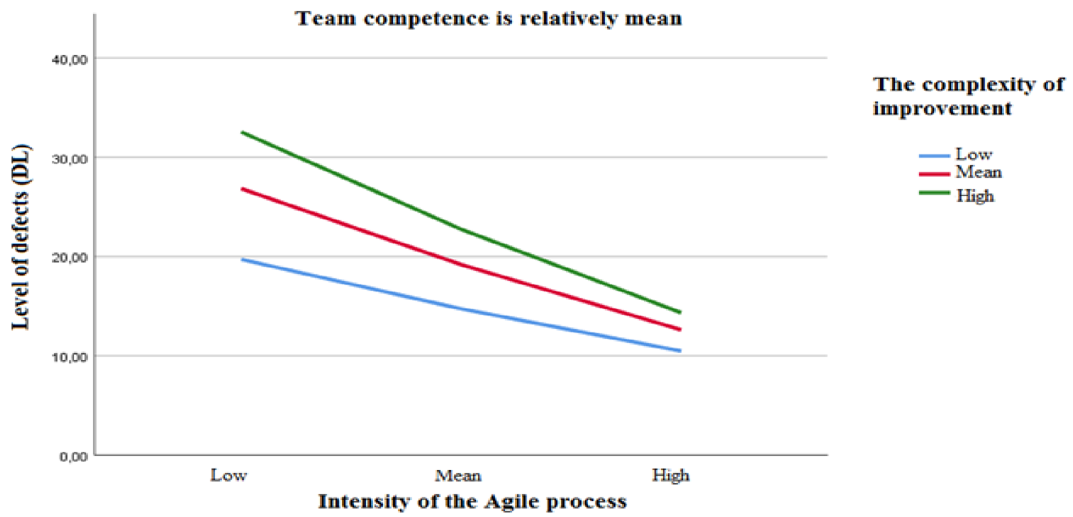
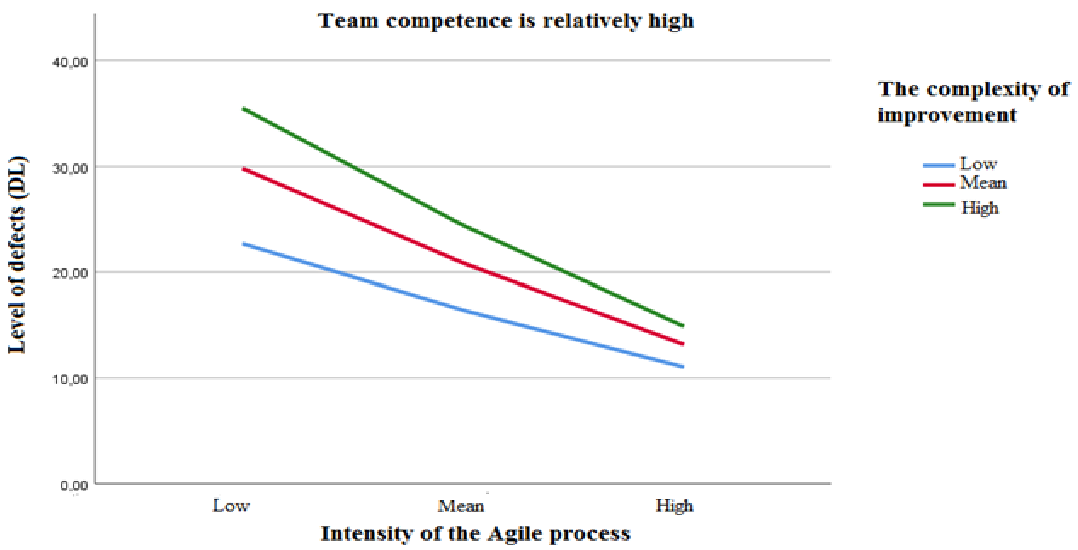


Figure 9: The effect of the Agile process intensity on DL according to the relative levels of the complexity of improvement when team competence is relative mean



When the team competence is relatively high, the same tendency is observed as in the cases of relatively low and mean team competences, only the general DL is lower (about 3 percentage points). When the intensity of the Agile process is low (22.68%, 29.81%, 35.53% respectively), the higher the intensity of the Agile process, the lower the level of DL is, the decrease in DL is higher when the complexity of improvement level is higher. Upon reaching the high level of the Agile process intensity, the lowest DL point is achieved at all levels of the complexity of improvement, and the gap between DL also decreases significantly (11.0%2, 13.17%, 14.89% respectively).

Figure 10: The effect of the Agile process intensity on DL according to the relative levels of the complexity of improvement when team competence is relative high



When the team competence is relatively high, the effect of the Agile process intensity increases both in absolute value and in percentage terms. Upon a relatively higher competence and a relatively low Agile process intensity, DL is higher (the difference between the groups is about 3 percentage points for each level of competence). In the case of a relatively high Agile process intensity, a decrease is observed in the differences in DL between the levels of competence (the difference between the groups is about 0.5 percentage points for each level of competence).

Complex analysis of the effect of the Agile process intensity on DL according to the strategic orientation group and team competence

In order to comprehensively assess the effect of the Agile process intensity on DL, it is also important to assess the complex moderating effect of strategic orientation and team competence. The statistical analysis was carried out into the effect of the Agile process intensity on DL according to the strategic orientation and team competence, and the following general model was obtained: F(5.91)=5.43, which is statistically significant p <.01 and explains 22.97% of the relationship between the Agile process intensity and DL (R2=.2297).

The analysis of the predictive factors presented in the statistical model:

- → *Factor 1:* The Agile process intensity (t(91)=-3.21) is a statistically significant factor (p<.01), when the assessment in the Agile processapplication intensity increases by 1 point, DL decreases by 5.3 percentage points (b=-5.3).
- → *Factor 2:* strategic orientation (t(91)=- 4.07) is a statistically significant factor p<.01 (b=.
- → *Interaction of factors 1 and 2:* b=3.24, t (91)=1.13, statistically insignificant (p=.26).
- → *Factor 3:* team competence (t(91)= 1.31) isa statistically insignificant factor p=.19, (b=2.34).
- → *Interaction of factors 1 and 3:* b=-3.57, t(91) = -1.93 is statistically insignificant (p=.0565), but very close to the threshold of statistical significance.

According to the statistical model and based on the analysis of predictive factors, the following equation is formed:

$$Y = \text{constant} - 5.3\ (\text{Agile}) - 9.66\ (\text{Strategic orientation}), \text{ where } Y \text{ is DL.} \tag{11}$$

In order to assess the moderating effect of strategic orientation and team competence, the equation is formed where the mean value of the strategic orientation M (*the complexity of improvement*)=1.6 and the mean value of the team competence M (strategic orientation)=3.72 are determined and made equal to 0, thus the following equation is obtained:

$$Y = \text{constant} - 7.55\ (\text{Agile}) + 0 + 0 \tag{12}$$

Accordingly, we obtain the following relationships between the Agile process intensity and DL according to the strategic orientation group and the relative level of team competence (Table 11):

Table 11: Conditional effect of Agile process on DL at values of moderators (M).

Strategic orientation group(M)	**Team competence (M) (relative evaluation)**	**Effect on DL**	**Effect on DL by per cent**	**p**

E-services	Low (3 points)	-4.55	-17.11	.093
E-services	Mean (4 points)	-8.12	-25.54	.0006
E-services	High (5 points)	-11.69	-31.60	.0004
Traditional services	Low (3 points)	-1.32	-9.21	.50
Traditional services	Mean (4 points)	-4.88	-24.98	.04
Traditional services	High (5 points)	-8.45	-34.16	.0265

A complex analysis of moderators shows that the essential differences in the effects of the Agile effect on DL are observed where the relative evaluation of team competence differs. When team competence is relatively low, there is no relationship between the intensity of the Agile process and DL. The differences in the effect also depend on the relative level of team competence when the strategic orientation group is the same. When the team competence evaluation is higher, the negative effect of the Agile process intensity on DL increases.

Figure 11 shows the differences in the effect of the Agile process intensity according to the relative team competence evaluation outcomes in the e-services oriented-organisations. It is obvious that when the Agile process intensity is low, the higher the team competence level, the higher DL is (26.60%, 31.80%, 37%respectively). As the Agile process intensifies, the level of DL decreases in line with the growing the level of team competence. Upon reaching a high level of the Agile process intensity, the regularity of DL changes at all team competence levels, i.e. the higher the competence, the lower DL is (18.70%, 17.71%, 16.74% respectively). It is clearly seen from the intersecting straight lines.

When the organisation's activities focus on traditional services, the same trend as in the case of an e-service-oriented organisationis ovserved, only the general DL is larger (about 12 percentage points). When the intensity of the Agile process is low (14.11%, 19.54%, 24.74% respectively, according to the relative levels of competence), the increasingly growing Agile process decreases DL to the extent corresponding to the growth of a relative evaluation of team competence. Upon reaching a relatively high level of the Agile process intensity, the lowest DL point is reached at all the relative levels of team competence and the regularity also changes (12.1%, 11.07% and 10.09% respectively). The difference between the strategic orientation groups remains statistically significant (about 6 percentage points).

Figure 11: The effect of the Agile process intensity on DL according to the team competence when organization is e-services oriented

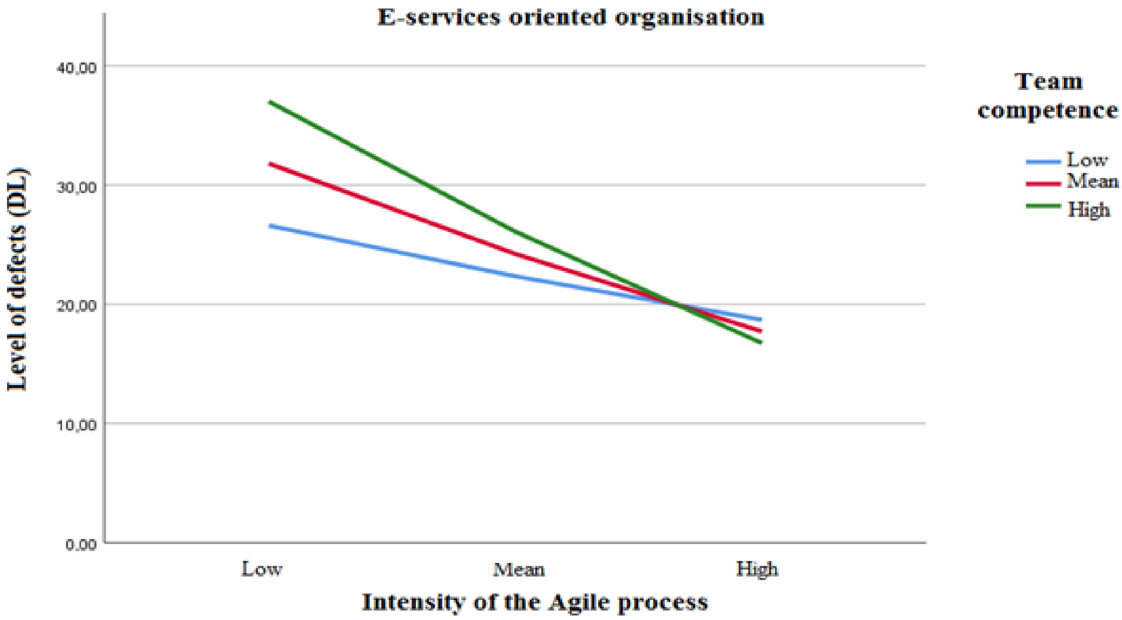
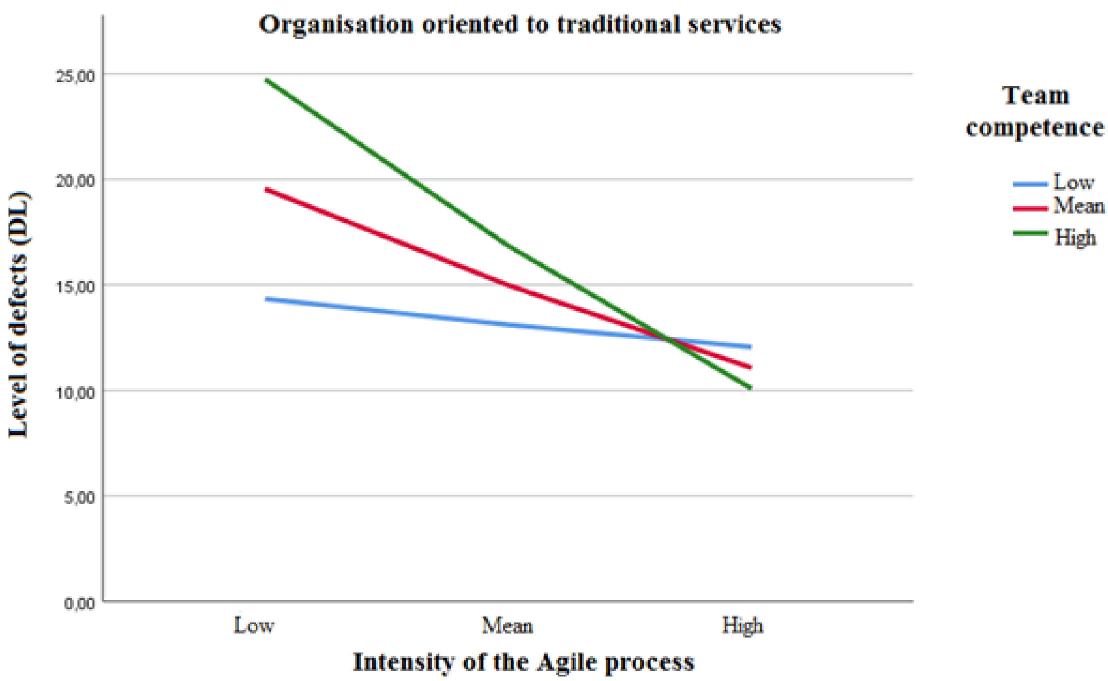


Figure 12: The effect of the Agile process intensity on DL according to the team competence when organization is tradition services oriented



With a relatively higher team competence, the effect of the Agile process intensity grows both in absolute value and in percentage terms. With a relatively higher competence and a relatively low Agile process intensity, DL is higher (the difference between the groups is about 3 percentage points for each level of competence). With a relatively high Agile process intensity, DL of the team with a higher level of competence becomes lower compared to that observed in the teams of lower competence.

Conclusions

This research was aimed at addressing a crucial theme in the field of quality management – the improvement of the quality of electronic services. The scholars have presented a wide range of discussions on characteristics and criteria of the quality of electronic services, but it has not been made clear what determines the effectiveness of the improvement process - the team competence or the performance of the methods used in the improvement process.

This study presents the interaction of the effectiveness of the improvement process with the DLafter the introduction of quality improvement. Apart from the team competences, this study has examined the application of the advanced Agile process management and Scrum practices in today's modern process of improving electronic services and evaluated the effect of these practices on the DL. The research was carried out in Lithuania based on the methodology developed by the author. The survey was conducted in 101 different organisations, evaluating the differences of one e-service project from another. The statistical analysis of linear regression, two-way interaction and three-way interaction was performed in an attempt to answer the research question.

The findings of the study revealed as follows:

1. **The complexity of quality improvement** increases DL, while the Agile process is a key factor of the study in terms of its effect on the decreasing DL when e-services are subject to improvement. When the complexity of the improvement is relatively very low or low, no statistically significant relationship between the intensity of application of the Agile process and DL is observed. Nevertheless, it is noteworthy that the decreasing effect of the Agile process intensity on DL still remains and in many cases p value is very close to a statistically significant threshold.
2. **The company's strategic focus** on providing e-services is related to DL, however this factor is not decisive. The effect of the Agile process intensity is also similar and depends more on the complexity of improvement than the strategic orientation.
3. **The number of employees of the organisation and the number of members of the e-service improvement team** do not impact the relationship between the factors under analysis and DL.
4. **Team competence** is important in e-service improvement, which, together with the systematic application of the Agile process, gives the highest effect on the DL reduction. Although the study did not reveal a direct relationship between team competence and DL, many of the models under examination revealed that in cases where the team competence is relatively low, there is no relationship between Agile and DL; however, the complex evaluation of the moderators of team competence and complexity of improvement in terms of the Agile effect on DL has revealed that there is no association except for the cases where the complexity

of improvement is low regardless of the relative level of team competence. In all the examined cases, the team competence strengthens the effect of the Agile process intensity on DL. When the intensity of the Agile process is low, DL increases as team competence increases.

5. All the models under analyses showed that the **Agile process intensity** significantly reduces DL. Complex analyses revealed what if the complexity of improvement is low, the reducing effect of the Agile process is not statistically significant but as mentioned above very close to a statistically significant p value (when team competence is relatively as follows: low- p value is .072, effect on DL is -3.93 (-23%), mean - p value is .069, effect on DL is -5.33 (-27%), high- p value is .189, effect on DL is -6.73 (-30%)). Emphasis should be laid on the fact that the difference in the effect on DL between the levels of team competence by percentage is higher compared to other relative levels of complexity of improvement. From these data we can predict the following: when the complexity of improvement is low (it means that the improvement of e-service is infrequent and the complexity of e-service is not high) the competence of a team may be more important to trigger an effect on DL in such a cases and the effect of Agile process intensity is still important but slightly less if the complexity of improvement is higher. The complex analyses revealed that in all the other cases the examined intensity of the Agile process reduces DL at a statistically significant level.
6. The **intensity of the application of Scrum practices** according to the statistical models under analysis did not show any statistically significant effects on DL.

Overall, team competence has emerged as a moderating factor that enhances the effect of the Agile process on DL. However, the key factor to lowering DL through the improvement of e-services is a systematic use of the iterative process of improvement. Only when we systematically manage the process of improving e-services, a higher competence of the team allows us to reach DL, which is even lower. It does not depend on the size of a company or a team. Scrum practices are not relevant in terms of diminishing DL. The results of the study confirm the principles of the process approach, dominant in the field of quality management - in order to ensure higher quality, it is essential to systematically manage the processes in any size of a company and a team.

References

Agrawal, V., Tripathi, V., Setet, N., (2014). A Conceptual Frame work on Review of E-Service. Quality in Banking Industry World Academy of Science, Engineering and Technology. International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering Vol: 8, No: 12, pp.3935–3939.

Arshad, N., Ahmad, F. and Janom, N., (2007). Empirical study on electronic service quality. *Public Sector ICT Management Review,* Vol. 2 No. 1, pp.29–37.

Blackburn, J. D., Scudder, G. D., Wassenhove, L. N., (1996). Improving Speed and Productivity of Software Development: A Global Survey of Software Developers, TRANSACTIONS ON SOFTWARE ENGINEERING, VOL. 22, NO. 12, pp 875-885.

Brooks, F. P., Jr., (1975). *The Mythical Man-Month, Essays on Software Engineering*. Reading, MA: Addison-Wesley.

Btoush, M. H., Siddiqi, J., Grimsley, M., Akhgar, B., Alqatawna, J., C., (2008). Comparative Review of e-service Maturity Models: 6I Model. *Proceedings of the 2008 International Conference on E-Learning, E-Business, Enterprise Information Systems, and E-Government*, *EEE 2008*, July 14-17, 2008, Las Vegas, Nevada, USA, pp.3–8.

Bullock, R. K., (2006). *Theory of Effectiveness Measurement.* Doctoral thesis. Faculty Graduate School of Engineering and Management Air Force Institute of Technology Air University ADA456717.

Dingsøyra, T., Nerurc, S., VenuGopal Balijepally, V., Moea, N. B., (2012). A decade of agile methodologies: Towards explaining agile software development. *The Journal of Systems and Software,* 85, pp.1213– 1221.

Edvardsson, B., (1996). Making service-quality improvement work. Managing Service *Quality: An International Journal*, Vol. 6 Issue 1, pp.49–52.

Fassnacht, M., Koese, I., (2006). Quality of Electronic Services: Conceptualizing and Testing a Hierarchical Model. *Journal of Service Research*, JSR9.1, pp.19–37.

Field, J. M., Heim, G. R. and Sinha, K. K., (2004), Managing Quality in the E-Service System: Development and Application of a Process Model. *Production and Operations Management,* 13, pp.291–306. doi:10.1111/j.1937-5956.2004.tb00219.x

Gershon, M., (2010). Choosing Which Process Improvement Methodology to Implement. *Journal of Applied Business & Economics*, Vol. 10 Issue 5, pp. 61–69.

Harvey, G., Wensing, M., (2003). Methods for evaluation of small scale quality improvement projects. *Qual Saf Health Care,* 12, pp.210–214.

Hayes, A. F., (2013). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach.* New York: Guilford Press. ISBN 978-1-60918-230-4.

Kumbhar, V. M., (2012). Conceptualization of e-services quality and e-satisfaction: a review of literature. *Management research and practice,* Vol. 4 Issue 4, pp.12–18.

Kupiainen, E., Mäntylä M., Itkonen J., (2015). Using metrics in Agile and Lean Software Development – A systematic literature review of industrial studies. Information and Software Technology, 62 (2015), pp.143–163.

Li, H., Suomi, R., (2009). A proposed scale for measuring e-service quality. *International Journal of U- and E-Service, Science and Technology*, Vol. 2 No. 1, pp.1–10.

Lindvall, M., Basili, V., Boehm, B., Costa1, P., Dangle1, K., Shull, F., Tesoriero, R., Williams, L., Zelkowitz, M., (2002). Empirical Findings in Agile Methods. *Proceedings of Extreme Programming and Agile Methods – XP/Agile Universe*, pp.197–207. http://users.uom.gr/~achat/articles/agile.pdf

Looy, V., Bergh, A. & V., Bus J., (2017). The Effect of Organization Size and Sector on Adopting Business Process Management, Business & Information Systems Engineering, Vol. 60 Number 6, pp.479-491.

Mahalakshmi, M., Sundararajan, M., (2013). *Traditional SDLC Vs Scrum Methodology – A Comparative Study.*

O'Cass, J. C. A., (2011). Developing a framework for understanding e-service quality, its antecedents, consequences, and mediators. *Managing Service Quality: An International Journal*, Vol. 21 Issue 3. pp.264–286.
Riedl, C., Leimeister, J. M. and Krcmar, H., (2011). Why e-Service Development is Different: A Literature Review. *E-Service Journal,* Vol. 8, No. 1, Services 2.0.1: Advanced Thinking on the Nature of IT Services (Fall 2011), pp.2–22. DOI: 10.2979/eservicej.8.1.2.
Salo O., Abrahamsson P., (2008). Agile methods in European embedded software development organisations: a survey on the actual use and usefulness of Extreme Programming and Scrum, IET Software, vol. 2, no. 1, pp. 58-64, February 2008.
Sharma, S., Sarkar D. & Gupta, D., (2012). Agile Processes and Methodologies: A Conceptual Study. *International Journal on Computer Science and Engineering,* 4, 5, pp.892–989.
Torrecilla-Salinas, C. J., Sedeño, J., Escalona, M. J., Mejías, M., (2015). *Estimating, planning and managing Agile Web development projects under a value-based perspective*.
Zemblyte, J., (2015). The Instrument for Evaluating E-Service Quality. *20th International Scientific Conference Economics and Management - 2015 (ICEM-2015). Procedia - Social and Behavioral Sciences,* 213, pp.801–806.