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Agile Project Management in Product Development Projects

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Abstract

Despite the growing popularity of agile project management in the field of IT projects, it has not yet been established in other types of projects (engineering, research & development, organisation of events), presumably because of many reasons: the frequent changes are too expensive, the partial deliverables may not be marketed or used, individuals participate in several projects at the same time, etc. We could argue that the approach will never be widely used. However, we cannot say that certain agile practices cannot be utilized for projects that are still carried out in the traditional way. Therefore, we analysed the product development projects in five manufacturing companies. We wanted first to determine whether they already use any of the agile techniques, and further on - using regression analysis - we determined the actual contribution of individual agile techniques to the project's success. The aim of this paper is to demonstrate the applicability of agile project management in the context of product development. We would also like to stimulate professional discussion and researches of agile management of other types of projects, and to encourage the introduction of agile techniques wherever proven to contribute to the success of the projects.

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1. Introduction

Agile approaches to the management of software development projects (hereinafter IT projects) have developed significantly since the Agile manifesto was published in 2001. According to many, especially the manifesto's authors, due to the recognised response to changes agility will become even more important, while Bennekum and Van Hunt (in Bowles Jackson, 2012) even argue that agile thinking is crucial for success in the 21st century!

In an interview with Bowles Jackson, the manifesto's authors also stated that the agile approach is useful for all types of projects and beyond. Asked directly whether agility can be applied outside of IT projects, Hunt further argues that the agile approach has little to do with software; instead, it is all about recognising and applying feedback. Van Bennekum adds that agile is holistic and applicable everywhere in business or life – he uses it as a concept wherever he is and for whatever he does. The third co-author, Highsmith, believes it is necessary to use agile practices and principles in every project that faces uncertainty.

However, the practice has not yet confirmed their foresight and efforts. We checked research studies that have examined the agile approach in the last decade and found that up to 2009 almost all of them focused solely on IT projects; in that year, one article explored the agile approach in product development projects (Berger & Beynon-Davies, 2009). A year later, Doherty researched agility projects in the field of e-learning (Doherty, 2010), while in 2011 Gonzalez examined the agile approach with regard to the establishment and management of intellectual property. In sum, of thirty-three articles only three did not discuss IT projects.

On the other hand, experienced project managers could claim that many *popular agile practices* existed in traditional projects even before the Agile manifesto. When reading the literature by supporters of the agile approach, the agile manifesto and the principles of software development, we could be so somewhat surprised by the criticism of traditional project management – as if the authors had never worked in real teams, as if managers never planned projects together with team members (and vice versa – as if team members never collaborated with managers on project planning), as if managers were not team leaders but estranged administrators, and as if teams never regularly collaborated with the client or end users (Stare, 2013).

Despite doubting that the agile approach will be widely used in the future, presumably because the partial deliverables may not be marketed or used, the frequent late changes are too expensive, multi-project environment where individuals participate in several projects at the same time, etc., we believe that certain agile practices can be utilised for projects that are still carried out in the traditional manner. That is the reason why we made a pilot research on product development projects in five Slovenian enterprises. Our goal was the implementation of a detailed study on a larger sample in the event of encouraging findings in the pilot research.

In this paper we present the results of the research. Our purpose is to stimulate professional discussion and researches that will confirm (or disprove) the presented assumptions and, of course, to implement the agile approach wherever it will truly contribute to a project's success.

2. The agile way of implementing projects

2.1. Agility and the agile approach

Despite titling our paper "Agile project management…" we think that the use of that term is not quite appropriate. Science defines management as a process of planning, organising, leading and controlling; however, when studying the characteristics of the agile approach it would be difficult to find the type of differences that would justify management being named "agile". We also checked the used terms in the literature. In 35 articles published in the last ten years, the highest number of authors (11) write about **agile methods** (of programming, of project management), while only 5 use the term agile project management. Otherwise, authors often discuss agile software development, an agile approach, agile projects and teams, and rarely agile processes, factors, standards and companies. We also found five books that discuss agile methods, although only Wysocki (2009) writes about agile project management, while others do not mention this term:

- Rothman (2007) mostly uses agile project lifecycle, and also mentions the agile project, approach, development, and agile practices and techniques;

- Forsberg et al. (2005) mostly talk about agile methods, processes and practices and agile development;
- Brandon (2006) refers to agile methods, processes, and agile programming; while
- Thomsett (2002), whose book deals with radical/extreme project management, mentions agile development and process.

After considering a variety of sources, we found that:

- the term and the concept derive from agile methods for developing information systems (the first already emerged in the 1980s) and are mainly used for IT projects;
- method emphasises the concurrent execution of the traditionally successive tasks of a project (a 'fountain' instead of a 'waterfall'), and the constant coordination of participants. In this sense, agile methods are comparable to concurrent engineering, which also emerged in the 1980s;
- the essence of the approach involves constant updating of the execution, and detailed planning of smaller cycles (iterations) to implement a project according to the current results, lessons learned, new ideas etc.; and
- the focus on the user is very important and the project team therefore usually involves a representative of end users who regularly checks the partial results of the project (to ensure greater suitability of the final product with regard to the wishes and demands of the users).

The method's essence therefore lies in the fact that a project's objectives (project scope, configuration, and the deadline) are defined in less detail at the start of the project, and a project execution schedule is also prepared roughly – the project is divided into equal iterations with assigned parts of the project scope to be created. In the beginning a team undertakes the most important functions, while leaving the least important ones for the end. Less important demands can later be omitted on the basis of the results of already finished iterations, the client's changed wishes/requests, the performers' proposals, or the changes in the environment. A detailed specification of the iterations' products and precise scheduling of the iterations (the way of implementing, tasks, hours of work, performers etc.) is created at the beginning of each iteration, taking into account the current results, new insights, the client's new wishes or the ideas of developers as well as changes to original assumptions and requirements. The execution plan for the iteration is made by the project team (and not the project manager).

Gibbs (2006) mentions that the pioneers of the agile approach and iterative software development followed the example of Toyota's lean production, and their purpose was to eliminate much of the overhead and "ceremony" common to waterfall-based lifecycles. Development iterations lasted two to four weeks then, and nowadays their duration has not changed – Rothman (2007) states that they last from one to four weeks. The testing of intermediate results is so prompt (and not at the end, as with traditional software development) and, after each iteration, the team also obtains feedback on client satisfaction. Wysocki (2009) adds that the iteration can be repeated if the client is not satisfied with the results.

It is important to recognise that the agile approach first of all focuses on the execution phase of a project and does not define the whole project life cycle, which in principle remains the same (initiation, planning, execution and closing), except that the last part of the initiation (definition of specifications) and part of the planning are moved to the execution phase. The approach primarily affects the accuracy of planning – it is certainly necessary to define a rough schedule for entire project at the beginning of the project, while individual iterations are planned in more detail in the execution phase (e.g. tactics, tasks, hours of work, performers etc.).

Extreme project management is an upgrade of agile one (offering a higher level of agility). According to Thomsett (2002), the latter is more flexible and is based on the dynamic requirements, shorter development cycles, virtual teams, changing technologies and joint participation of all stakeholders of the project. He emphasises that the relation between a client (user) and the contractor (project team) is based on a partnership! Wysocki (2009) indicates that the differences in the approaches result from the level of familiarity with the solution at the beginning of the project. The main differences are the detail of planning, the greater role of risk management, and more collaboration with the client. The author defines the use of individual approaches as follows:

- traditional – solution and requirements are clearly defined, large changes in scope are not expected, the projects are routine and repeatable, using a proven template;

- agile – the solution and requirements are partially known, there is a possibility of additional features that the team does not know of yet, a wide range of changes in the project's scope are expected (usually development or organisational projects); and
- extreme – the objectives and requirements are unclear (usually research and development projects).

2.2. Agile methods and techniques, and novelties the agility brings to project management

The additional study of the literature and The Principles of Agile Software Development (www.agilemanifesto.org) showed that the main differences of the traditional and agile approach can be classified in four groups: requirements & specifications (the level of detail at the beginning of the project), project scheduling (iterations and a rough schedule at the planning phase), team work (self-organised teams, daily meetings), and the client's collaboration (the representative of the client is a regular team member). Below we present groups of factors in more detail.

Requirements/specifications
- are prepared jointly by the client and the project team (*www.agilemanifesto.org*),
- are roughly defined at the start of the project, while more detailed only at the beginning of the iterations (Brandon, 2006),
- include an assessment of the importance of the functions (Gibbs, 2006),
- can be changed and supplemented during the whole project, on the proposal of the client or the members of the team (Meade & Sarkis, 1999),
- the least important features are already eliminated at the project planning phase, or later, at the iteration planning (Gibbs, 2006).

Project schedule
- the project is divided into short iterations, that usually last no more than eight weeks (Beck and Fowler in Thomsett, 2002; Rothman, 2007),
- the project is roughly scheduled at the beginning, while the detailed schedule of the iteration is prepared by the team at the start of the iteration (Boehm & Turner, 2005),
- the self-organised team determines the execution tactics, tasks and performers (Meade & Sarkis, 1999; Lindstrom & Jeffries, 2004; Boehm & Turner, 2005),
- the test procedures are developed before the development of the solutions (Brandon, 2006).

Role of the team and team work
- the team is responsible for the success of the product in the market, and not only for the effective execution of the project (Forsberg et al., 2005),
- constructive confrontation is a regular way of searching for new ideas and for problem-solving (Forsberg et al., 2005),
- team members work in pairs (Lindstrom & Jeffries, 2004; Brandon, 2006; Rothman, 2007),
- the team meets every day to discuss work results, ideas, problems and to define daily tasks (Rothman, 2007),
- team members regularly discuss their own mistakes and learn from them,
- after each iteration the team discuss the adequacy of the assessments required, the methods and techniques, work mistakes, and possible improvements in the future (Boehm & Turner, 2005).

Client collaboration - representative of the client:
- is available 24/7 for further information (Meade & Sarkis, 1999), one is a regular team member and actively participates every day (Brandon, 2006),
- participates in the development of the test procedures (Lindstrom & Jeffries, 2004; Gibbs, 2006),
- regularly tests the intermediate results and reports to the team on inadequacies and errors (Brandon, 2006),

- proposes changes and participates in their evaluation (additional work and cost, added value).

In addition to the listed agile techniques/practices we have studied the latest research papers to find out how much individual techniques/practices improve the project's performance and success. However, the studied papers primarily present the general aspects of the agile approach, the way teams, managers and clients collaborate, plan and execute projects. We have found few papers with subjective opinions of project stakeholders that usually exposed a positive influence of the agile approach on the project's success (Conforto & Amaral, 2008; Nănău, 2008; Batra, 2009; McAvoy & Butler, 2009; Subramanian at al., 2009); however, only a few researched and presented the statistical impact of agile techniques on project performance and success (using the regression analysis; Lee & Xia, 2010).

Ceschi et al. (2005) exposed good experiences of project managers with agile planning (agile managers were more satisfied with the project plan than "plan-based" traditional managers), while agile companies were also more satisfied with their client relationships than plan-based companies. It was very interesting to find that agile without a structure can cause chaos, particularly in large complex distributed projects where planning, control, and coordination are critical (Batra at al., 2010). Structure without agility can lead to rigidity, particularly when a project involves a great deal of learning, discovery, and changes.

Lee & Xia (2010) empirically examined the rather narrow area of the agile approach - the relationships among the software team response extensiveness and the team response efficiency, team autonomy and team diversity, and the software development performance (on-time completion, on-budget completion, and software functionality). The survey showed that response extensiveness and response efficiency impact software development performance differently (response efficiency positively affects all of the on-time completion, on-budget completion, and software functionality, whereas response extensiveness positively affects only software functionality). Team autonomy has a positive effect on response efficiency and a negative effect on response extensiveness, and that team diversity has a positive effect on response extensiveness. The authors also discovered that standardized processes, methodologies, and tools help manage changes, time, and cost. Stare (2010) also discovered the strong impact of standardised change management processes on time and cost in combination with risk management.

The only known research on agile product development was made by Berger & Beynon-Davies (2009). They demonstrated a number of problems with the application of iterative development principles, particularly surrounding the conduct of stakeholder involvement within joint design. In general, stakeholders were initially passive in their involvement and, although formally empowered, proved reluctant to make decisions outside of their expected positions. Communication within design sessions was also restricted rather than open. Such difficulties impacted upon the project's trajectory causing delays in meeting key project deadlines.

3. Empirical research

3.1. Research method

Since the findings of the study of literature did not contribute to the validation of our assumptions, we developed a model (Fig. 1) and tested it against a pilot empirical quantitative research involving 21 product development projects in five Slovenian enterprises. The sample of respondents was not large, however, the main purpose of this research was to examine whether any embryo of agile product development in Slovenian enterprises existed. In the case of the encouraging findings a wider empirical quantitative research would be implemented.

The results were collected in the Web questionnaire, and two types of analysis were implemented. First, we examined what agile practices were already being enforced in enterprises, and to what extent. And second, with a multivariate analysis using the SPSS software we examined the impact of different practices on efficient project implementation and project success. We analysed the acquired data with a multivariate analysis - with the correlation analysis we verified whether the existence of particular variables reduced (or increased) effective project execution (project performance) and on project success. By calculating a linear regression of individual

variables we wanted to find the degree to which they impact, however, the correlation analysis showed so few correlations between variables that the regression analyse would be worthless.

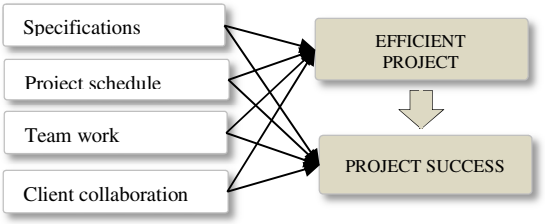

Fig. 1. The research model

To identify the impact of agile practices on project performance, we defined four efficiency indicators: project delay, cost surplus, work hours, and product functions. We used the ratio (%) between the baseline and the actual indicators (indicated at the end of the project) and these became the first group of dependent variables in the subsequent analysis. The respondents had to estimate the average final deviations of the projects (findings are shown in table 1).

Tab. 1: Project performance indicators of the examined projects

	Time	Cost	Work	Functions
Number of projects indicating a surplus	11 (50%)	8 (36%)	13 (59%)	4 (18%)
Average deviation	29%	14%	30%	15%
Number of projects with a surplus over 50%	2 (9%)	0	2 (9%)	2 (9%)

One of the characteristics of development projects is that they could be executed inefficiently (with delays and over budget), however, the developed product could still be successful in the market. That is why we also wanted to identify the impact of agile practices on a project's success, which we measured using three indicators: 1) client satisfaction, 2) the success of the product on the market, and by the 3) overall financial success. We used a four-level Likert scale - respondents had to estimate the level of success indicators from less satisfactory (1) to exemplary (4). The percentage of projects with single levels of success is shown on Fig.2.

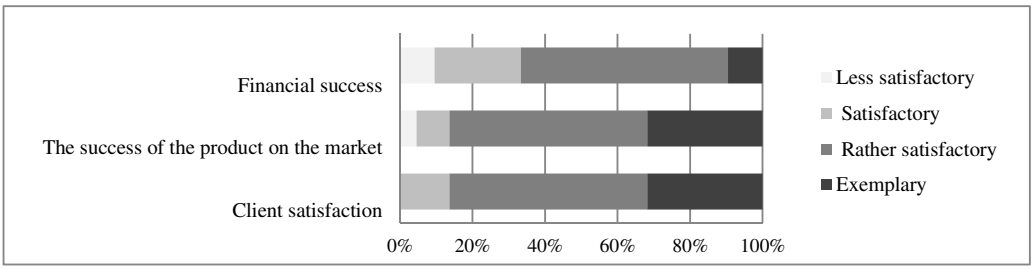

Fig. 2. The projects' success indicators

3.2. Results and discussion

We first examined the method of preparation of the **requirements/specifications** and the level of detail at the start of the project. 81% of the projects' specifications were prepared jointly by the client and the project team (Fig. 3), 86% included an assessment of the importance of the functions, while 62% of the project teams considered to eliminate the least important functions.

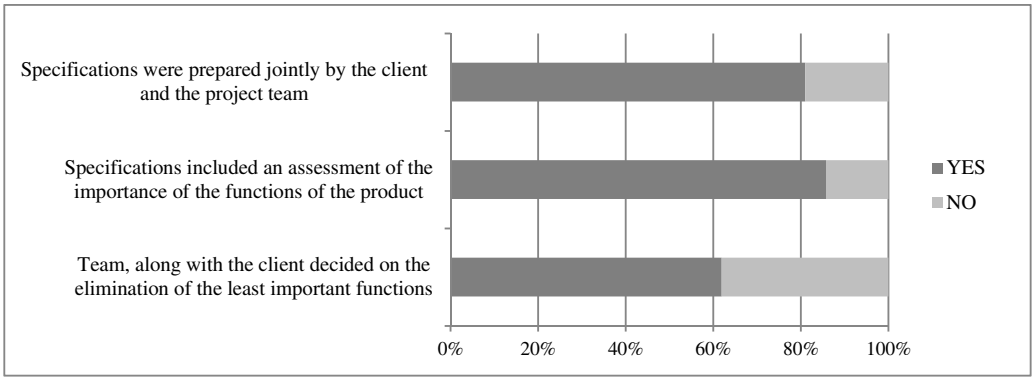

Fig. 3. Preparation/definition of specifications

In addition, we asked the respondents to state to what level the product specifications were defined at the beginning of the projects: 29% of the projects had already precisely defined whole product functionality at the start, 33% of them had roughly defined product functionality at the start, while only the most important functions were defined in detail, yet 38% of projects had defined only the most important functions, while the rest were set out in detail later.

We then analysed the impact of the specification defining with a correlation analysis - we verified whether the existence of particular variables reduces (or increases) the effective project implementation and project success. The correlation showed that the *definition of the functions' importance* leads to reductions in project delays (Pearson Correlation C 0.727, Sig. 0.000), and costs (C 0.510, Sig. 0.031), while *the elimination of the least important functions* increases the overall financial success of the projects (C 0.602, Sig. 0.005). Other factors did not prove influential.

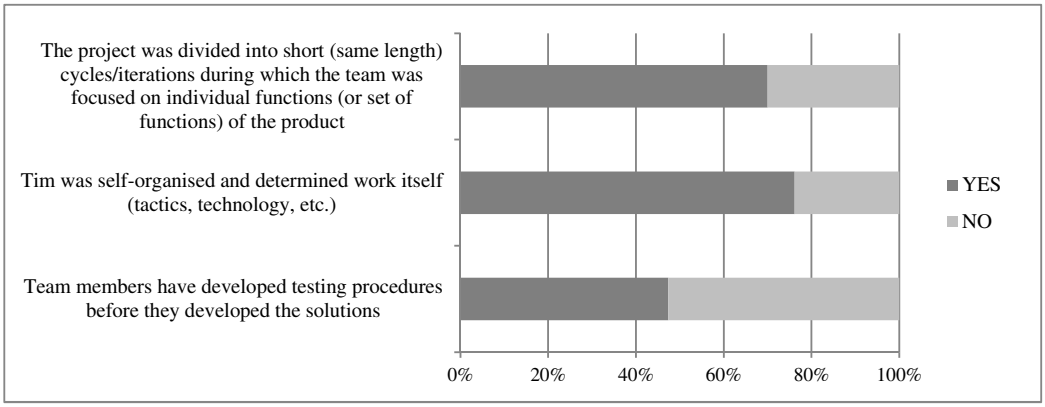

Fig. 4. Projects' scheduling

As mentioned at the beginning of the chapter, the survey sample was small, which certainly affected the quality of the regression analysis. However, research clearly showed that in the majority of the studied development projects the specifications were defined in the agile way, yet to prove that it actually brings benefits, we would have to examine a larger sample of projects.

The next examined area was **project scheduling**. 70% of projects were divided into short (same length) iterations/phases during which the teams were focused on individual functions or a set of functions of the product (Fig. 4). Three quarters (76%) of the teams determined the way of the project's execution (tactics, technology, tasks, etc.) by themselves, while almost half of them (47%) developed testing procedures before they developed the solutions (product functions). However, only 19% of the projects were not scheduled at the beginning of the project – they were only divided into iterations/phases, while those were in more detail scheduled only at the beginning of their execution. The majority, 71% were scheduled at the beginning of the project and regularly updated during the execution, on the basis of the results and the changes, while 19% of the projects were fully and accurately scheduled at the beginning and did not change much during the execution phase.

The correlation analysis showed only one prominent factor of efficient execution – when *self-organised teams determined the way of a project's execution*, the final product's functionality deviates less from the required (C 0.451, Sig. 0.046), while we found no influence of examined factors on the project's success.

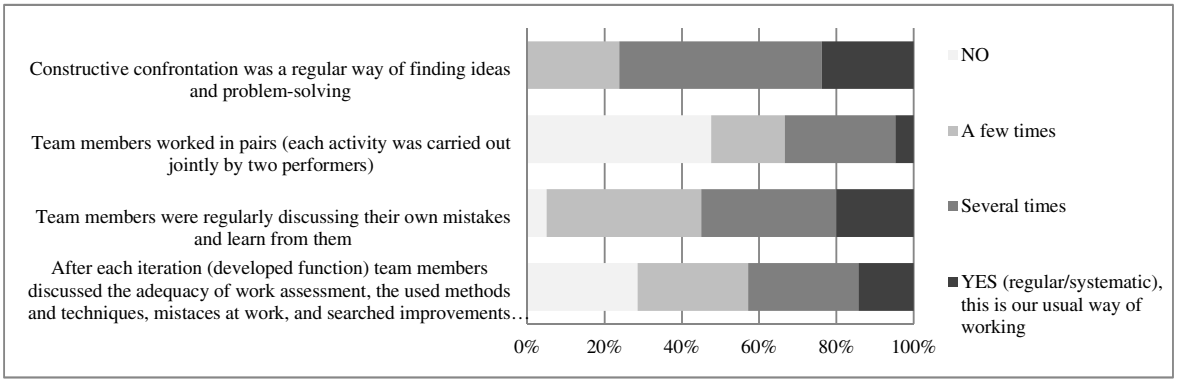

Fig. 5. The role of the team and team work

The third examined group of agile practices was **team role and team work** (Fig. 5). We found that almost two thirds (62%) of the teams were not only responsible for the efficient project execution but also for the success of the product in the market. In half of the projects the teams had often to work agile, however, only less than a quarter of the teams were constructively confronting on a regular basis, searching for new ideas and for problem-solving (24%), regularly discussing their own mistakes and learning from them (20%), and after each iteration discussing the adequacy of the assessments required, the methods and techniques, work mistakes, and possible improvements in the future (14%). In only 5% of projects team members regularly worked in pairs (while 29% worked often). We also asked respondents to state the frequency of team meetings; however, only one project team met several times a day, no one daily, yet 16 (76%) met weekly. Probably because of less systematic approaches we did not find the impact of the team role/work factors on the efficient execution and success of the project.

The last examined group was the **client collaboration** (Fig. 6). Its examination showed the lowest level of the agile approach in projects. Representatives of users/clients were regular team members only in two projects, while only on one project he/she participated on a daily basis (but only once a day). On half of the projects they participated weekly, on 15% of the projects monthly, while on 30% even more rarely. On two thirds (67%) of the projects, representatives of the users/clients proposed and evaluated (cost, value added) changes together with the team, but this was also usual in the traditional projects. 24% of the client representatives participated in the development of the test procedures, while 38% regularly tested the intermediate results and reported to the team on the inadequacies and errors.

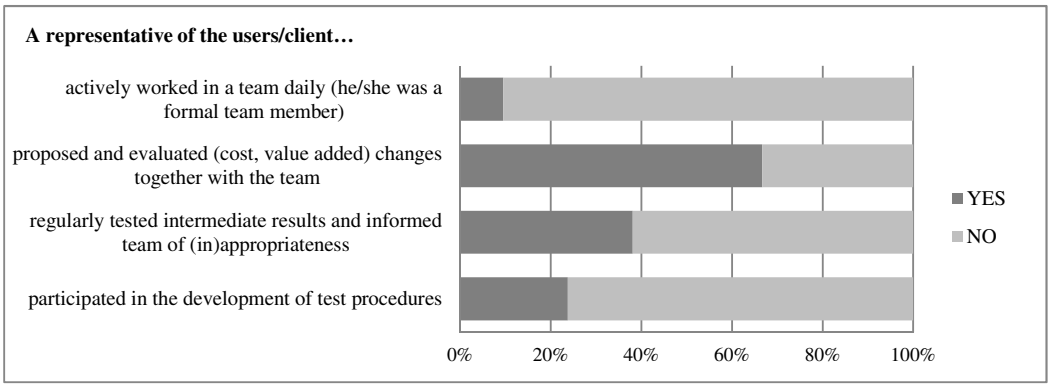

Fig. 6. Client collaboration

Again we have not found the impact of the client collaboration factors on the efficient execution; however, the *regularly tests of the intermediate results* by the client proved to increase the overall financial success of the projects (C 0.589, Sig. 0.006). Other factors did not prove influential.

4. Conclusion

Agile approaches to the management of software development projects have developed significantly since the Agile manifesto was published in 2001. The manifesto's authors stated that the agile approach brings many benefits to both the client and to the project team, and that the approach would be useful for all types of projects, however, the practice has not yet confirmed their foresight and efforts. Despite our doubts that the agile approach will be widely used in the future, we believe that certain agile practices can be utilised for product development projects that will be basically still carried out in the traditional way.

The main differences of the traditional and agile approach can be classified in four groups: requirements & specifications (the level of detail at the beginning of the project), project scheduling (iterations and a rough schedule at the planning phase), team work (self-organised teams, daily meetings), and the client collaboration (the representative of the client is a regular team member).

The past researches primarily exposed the general aspects of the agile approach, the way teams, managers and clients collaborate, plan and execute projects, while only a few examined the influence of individual agile practices on project performance and success. Since those findings did not contribute to the validation of our assumptions, we made a pilot research on product development projects in five Slovenian enterprises. The empirical quantitative research involved 21 product development projects. The sample of the respondents was not large, however the main purpose of the research was to examine whether any embryo of agile product development in Slovenian enterprises exists.

The research showed that many agile practices existed in the examined projects; however, we cannot talk about the systematic agile approach to the development of new products, but about partial approaches that have been established by the individual teams/managers on the basis of best practices from past projects. Unfortunately, the multivariate analysis of the agile practices influence on the project performance and success did not bring much useful information, presumably due to the small sample. However, we have encountered some sufficiently encouraging findings that convince us it makes sense to carry out a detailed study on a larger sample.

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