Agile values and their implementation in practice

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***Abstract* — Today agile approaches are often used for the development of digital products. Since their development in the 90s, Agile Methodologies, such as Scrum and Extreme Programming, have evolved. Team collaboration is strongly influenced by the values and principles of the Agile Manifesto. The values and principles described in the Agile Manifesto support the optimization of the development process. In this article, the current operation is analyzed in Agile Product Development Processes. Both, the cooperation in the project team and the understanding of the roles and tasks will be analyzed. The results are set in relation to the best practices of Agile Methodologies. A quantitative questionnaire related to best practices in Agile Product Development was developed. The study was carried out with 175 interdisciplinary participants from the IT industry. For the evaluation of the results, 93 participants were included who have expertise in the subject area Agile Methodologies. On one hand, it is shown that the collaborative development of product-related ideas brings benefits. On the other hand, it is investigated which effect a good understanding of the product has on decisions made during the implementation. Furthermore, the skillset of product managers, the use of pair programming, and the advantages of cross-functional teams are analyzed.**

***Keywords* — Agile development, agile values, scrum, cross functional teams, human needs**

I. Introduction

Agile Methodologies are commonly used in our time [1]. Compared to traditional process models (e.g., waterfall model [2]) they promise benefits such as on-time delivery and customer satisfaction [3]. This is based on the assumption that the scope of the product to be developed is not yet fully defined at the beginning of the process and a response to changes is more important than following a fixed plan [4]. Therefore, in the application of agile approaches, there is no initial specification that describes all requirements up to the smallest detail. Requirements are often documented in form of User Stories [5] or Persona Stories [6] [7]. Those will be developed iteratively during the development process. With increasing progress in the development process, the scope of the product becomes clearer. For this purpose, the product, based on a defined vision, is developed iteratively at the beginning [8] [6] [9]. Such a flexible approach has the advantage that the knowledge, which is gained by the project members during the development process of the product, may influence the product development in a positive way. Thus, a product can be developed to meet the expectations of users and other stakeholders.

In literature, many case studies describe how agile approaches can be optimized for practical use [10]. Here, on one hand useful tools and on the other hand the integration of different approaches from other domains are described. In particular, the combination of Human Computer Interaction and Agile Methodologies shows a variety of the best available practices [11] [12] [13]. These kinds of hybrid approaches are often used for development of products in the field of Interactive Multimedia (e.g. eLearning tools [36], consumer products, digital services). As user interaction plays an important role for these products, user participation during development is necessary in order to develop products with a good user experience. In practice these hybrid approaches are often based on recommendations of the authors and are not validated experimentally. Further empirical research is therefore appropriate as, inter alia, used for Silva da Silva et al. [10].

This article focuses on the cooperation in an agile team as well as the understanding of roles and responsibilities. To this end, best practices were reviewed with a questionnaire study. The main contribution of this article is to give optimization for agile approaches based on validated theses. The contents are aimed at both agile practitioners who are interested in quantitative statements about theses - based on their daily work, as well as to the management that wants to adopt Agile Methodologies and faces the challenge of creating existing conditions.

First, a brief overview of the emergence of agile values and principles is given. Following that, the research objectives and the methodology used for the analysis are described. Subsequently, the study and its implementation are discussed. Finally, the results and their conclusions for agile product development processes are debated.

II. Agile software development

Already in the mid-80s, it has been shown that a sequential approach to product development is not well suited due to the lack of flexibility [14]. Thus, in addition to the traditional process models, such as the waterfall model [2], new process models have been developed. For one thing, these are iterative process models such as Rational Unified Process [15], for the other it is about Agile Methodologies such as Scrum [16], Extreme Programming [17] and Feature-Driven Development [18]. Even, some initiatives are bringing together classical methodologies or tendency with agile principles, like approach presented in [19] or in [20]. In particular, agile approaches bring a high level of flexibility, which has not been there previously, and are suitable for the development of complex products [21]. Their application becomes widely spread nowadays, with Scrum playing an important role [1].

In 2001, the *Agile Alliance* [4] created the *Manifesto for Agile Software Development*. The *Agile Manifesto* includes values and principles that help to optimize the software development process. Most of the principles even play an important role in today´s agile community [22].

The values and principles provide no rules, but rather describe the attitude of the Agile Methodologies that should be used. They follow the aim that communication among those involved in the project and reactions to changes are in the foreground. In particular, the relations between the people involved in the process are underlined as very

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important *("Individuals and interactions over Processes and Tools"* [4]).

Another important principle is named self-organizing teams [4]. The teams are supported by the organization - in which they operate - for the time of the execution of their tasks. It is not prescribed how they implement their tasks [16]. Their environment places confidence in the teams to own the skills to implement their tasks in a self-organized way [4]. This type of work can lead to a greater satisfaction among those people who are involved. Satisfaction and positive experiences can be the fulfillment of *psychological needs* [23]. Hassenzahl et al. [24] describe that the fulfillment of psychological needs (e.g., *competence, relatedness, popularity, stimulation, security*) lead to a state of *well-being*. In the self-organized work, the need for autonomy and competence is satisfied and thus the state of well-being occurs.

In the context of Agile Methodologies, specific methods are often used. *Pair programming* is a best practice that has its origins in the agile software development [17]. In pair programming, two developers work together on the same task. Williams et al. [25] describe that the results produced with pair programming have better quality and time to market is reduced. Furthermore, they noted that the developers had more fun working together on the problem-solving process. This can be attributed to the fact that the developers feel safer by the 4-eyes principle during the execution of their tasks. The collaborative development of the solution gives the developers a sense of security. In this way, the human desire for security is fulfilled, and reaches the state of well-being. However, the use of pair programming should always be seen in the context of people working with it. In some cases, pair programming can be perceived as extremely inefficient, very exhausting, and as a waste of time [26].

III. Study

In the following the research objectives, the study design and the implementation are discussed.

A. Research objectives and methodology

The aim of this study is to examine current ways of working in product development using agile approaches from trenches. Both, the cooperation in the project team and the understanding of the roles and tasks need to be analyzed. First theses are prepared for this project, which are then verified by a questionnaire study. The theses have been formulated on the basis of assumptions that are often encountered in practice.

The following six hypotheses are investigated[1]:

(1) The collaborative development of product-related ideas has the advantage that the team develops a better understanding of the product.

(2) A good understanding of the product helps the developers to make better decisions during implementation.

(3) The product manager should have the ability to create a rudimentary concept of the product, which is then elaborated in more detail.

(4) The concept of pair programming can also be transferred to the creation of a design concept.

(5) The concept of pair programming can also be transferred to the implementation of quality assurance measures.

(6) In project teams composed of members with different professional backgrounds, team members learn more than in teams composed of members from the same field.

In the original study, further theses have been examined. The complete questionnaire can be found in Schön [27].

[1] The original questions were written in German (see Appendix A).

B. Construction of the questionnaire

In the design of the questionnaire appropriate guidelines have been used for the design of good online questionnaires [28] [29]. It is important to keep the amount of items small, because the response rate is higher for short questionnaires compared to long questionnaires. In addition, long questionnaires usually have a higher dropout rate for episode [30]. The questionnaire was written in German and is divided into three sections: introduction, body and conclusion. The preface contains the instruction objective of the survey, privacy, duration, contact information, and some questions about the differentiation of the target group. The main section includes items formulated to verify the propositions. The final part consists of open questions and a final page, by thanking the participants and contact information for questions and suggestions.

In a pretest of the questionnaire, it was tested and revised in five iterations by various test persons of the target group. For this purpose, qualitative interviews were carried out with these people. Those were asked to answer the questionnaire. Thus, the idea of the test persons could be collected for analysis; the method *Think Aloud* [31] has been applied. Based on the pretest, the average time to answer the questions was set up to 10-15 min. The willingness to complete a questionnaire with this period is relatively high, compared temporally to elaborate ones [32].

C. Implementation of the study

To carry out the study, an online survey with the survey tool *Limesurvey*[2] was placed. The online survey was conducted during the period 2014-03-18 – 2014-04-08 (duration of three weeks). The target group of the survey has been selected from the IT industry with expertise in the subject area Agile Methodologies. Participants were recruited through personal networks, entries in thematically relevant groups in social media networks, and in forums of the university network *oncampus*[3]. The study has been carried out within an interdisciplinary group of participants. This has the advantage that the theses are evaluated from different perspectives. Information regarding the professional experience of the participants is shown in Table 1. In addition, Table 2 shows the company type of the participants.

Overall, the questionnaire was been filled out 175 times. Of these, 129 questionnaires were completed (dropout rate = 26.28%). 98% of those stopped after the questions of the introductory part. This leads to the assumption that these participants did not feel addressed as a target group.

The results of 129 completed questionnaires were filtered for analysis in order to obtain the answers of the participants who have already had practical experience with agile approaches. For the evaluation of the results, the participants were included who have already used an agile approach (N = 93). The key aspects of the participants - in the last two years - were wide-ranging and covered the following subject areas[4]: project management (39), software architecture (30), quality assurance (26), back-end development (25), front-end development (23), user experience design (19), infrastructure (7), technical sales (7) and operations (6).

TABLE I
PROFESSIONAL EXPERIENCE (N=93)

Experience	Answers
Young Professional (less than 1 year)	3.23%
Professional (between 1-8 years)	47.31%
Senior (more than 8 years)	49.46%

[2] www.limesurvey.org
[3] www.oncampus.de
[4] Participants had the opportunity to make multiple choices

TABLE II
TYPE OF COMPANY (N=93)

Company type	Answers
Service provider	64.52%
Product manufacturer	25.81%
Freelancer	7.53%
Other	2.15%

IV. Results

To capture the personal opinion 5-point Likert items were used. There are the following gradations *totally agree, tend to agree, neutral, disagree, and totally disagree*. In one question, the participants also had the opportunity to make no statement at all.

The survey results that are considered for the evaluation come from the participants who have already used an agile approach and who have worked with Scrum (N=93) in the last two years. Two questions on *pair programming* have been shown only to those participants who have confirmed that they have a notion of *pair programming*. As a result there is a smaller sample of these items (N=81).

A. Presentation of results

For clarity, the results are first presented in tabular form (Table 3). For this purpose, the two positive responses (*totally agree, tend to agree*) are counted as the sum of the theses. Subsequently, each item will be considered in detail.

In the following figures (Figure 1 – 5), the results (see Table 3) of the questionnaire are shown in detail.

TABLE III
OVERVIEW OF THE STATEMENTS

Item	Theses	Agree-ment	Number of Participants
1	The collaborative development of product-related ideas has the advantage that the team develops a better understanding of the product.	91%	N=93
2	A good understanding of the product helps the developers to make better decisions during implementation.	94%	N=93
3	The product manager should have the ability to create a rudimentary concept of the product, which is then elaborated in more detail.	86%	N=93
4	The concept of pair programming can also be transferred to the creation of a design concept.	76%	N=81
5	The concept of pair programming can also be transferred to the implementation of quality assurance measures.	70%	N=81
6	In project teams composed of members with different professional backgrounds, team members learn more than in teams composed of members from the same field.	80%	N=93

Collaborative development (Item 1)

The collaborative development of product-related ideas has the advantage that the team develops a better understanding of the product.

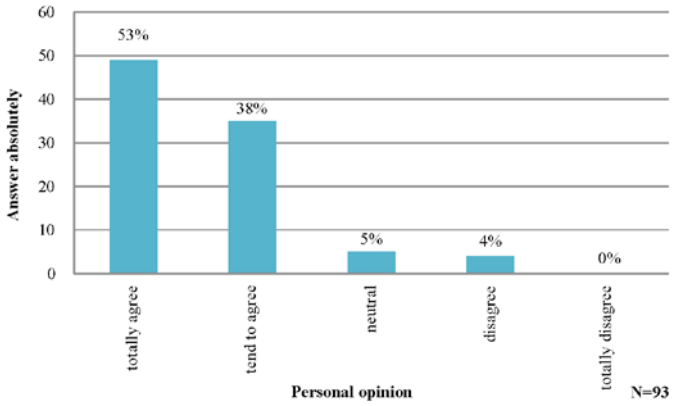

Figure 1: Collaborative development

91% of the sample N=93 agreed to this statement. The high agreement makes clear that it is considered useful in practice to involve the team in the ideation process.

Good understanding (Item 2)

A good understanding of the product helps the developers to make better decisions during implementation.

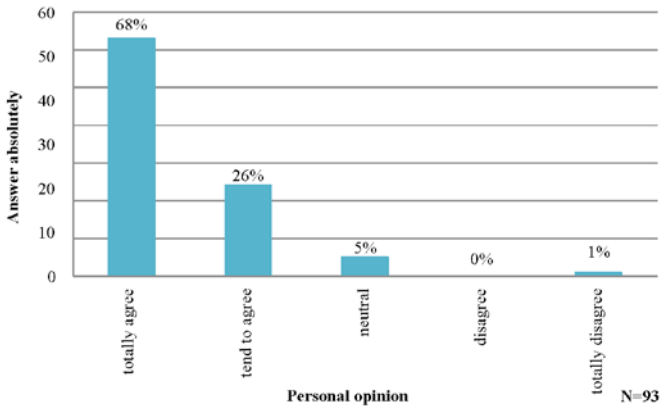

Figure 2: Understanding the product helps during implementation

This item received the highest popularity by the participants. 94% of the sample (N=93) agreed with this statement. Therefore, the developers can develop a good understanding of the product, it is important to include them in the ideation process (see Figure 1). In addition, visual artifacts, such as e.g. a sketch support the communication process and contribute to a better understanding [33].

Skills of the product managers (Item 3)

The product manager should have the ability to create a rudimentary concept of the product, which is then elaborated in more detail.

With this item we have examined the skillset of the product managers. 86% agreed to the sample N=93. In the selection of the person for the role of the product manager, it should be ensured that this person is able to develop a rudimentary concept of the product.

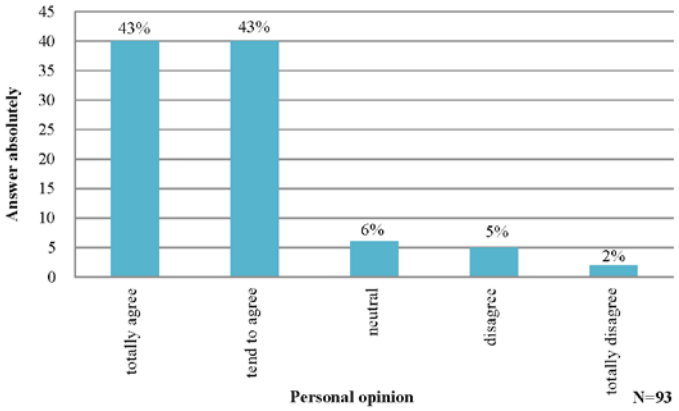

Figure 3: Skillset of product managers

Pair Concepting und Pair Testing (Item 4, 5)

Item 4 and Item 5 are displayed only to those participants who have confirmed that they have a notion of pair programming. This results in a sample of N=81. 76% of the participants agreed to item 4, and 70% agreed to item 5. The concept of pair programming can therefore not only be used in programming, but can also optimize the operation in other domains, such as in the conceptual design (Item 4) or quality assurance (Item 5).

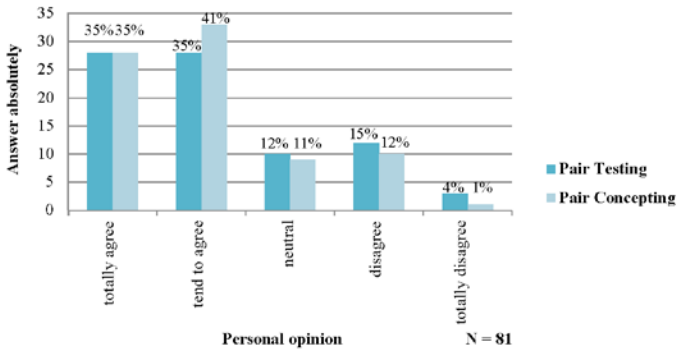

Figure 4: Pair Concepting and Testing

Since the concept of pair programming is closely linked to programming and which has not yet been established in the fields of design and testing, the agreement probably does not refer to its own experience but also reflects the willingness, the concept promising in these two domains to use.

Cross functional teams (Item 6)

In project teams composed of members with different professional backgrounds, team members learn more than in teams composed of members from the same field.

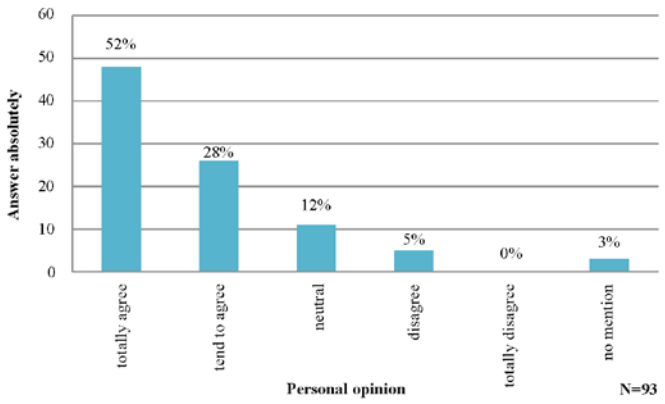

Figure 5: Cross functional teams

In addition to the 5-point Likert scale, participants had the opportunity to make no mention of this statement, it was used by 3 participants (3%). 80% of the sample, N=93 agreed to this statement.

B. Conclusion for agile product development processes

The survey clearly supports all of the six theses. The results thus confirm the assumptions that are made in practice. In addition, they provide important insights for Agile Product Development Processes. It has been shown that the collaborative development of product-related ideas contribute to a better understanding of the product (see, Item 1). For Agile Development Processes this entails that a collaborative ideation process should take place as early as possible in the development process. Here, it is advantageous to include developers, because a good understanding of the product helps them to make better decisions during implementation (see, Item 2). Furthermore, the results show that the product manager should have the ability to create a rudimentary concept of the product (see Figure 3). This finding is very significant for the selection of a suitable candidate (in Scrum product owner) who takes over the role of the product manager. In practice, the product owner is often supported by a product ownership team [34] in carrying out one`s tasks. The team may consist, for example of a business analyst, a user experience designer, and a lead developer. These collaboratively develop in an iterative product discovery requirements (see Figure 6). The product discovery is used to define the strategic direction of the product and to evaluate different ideas [35].

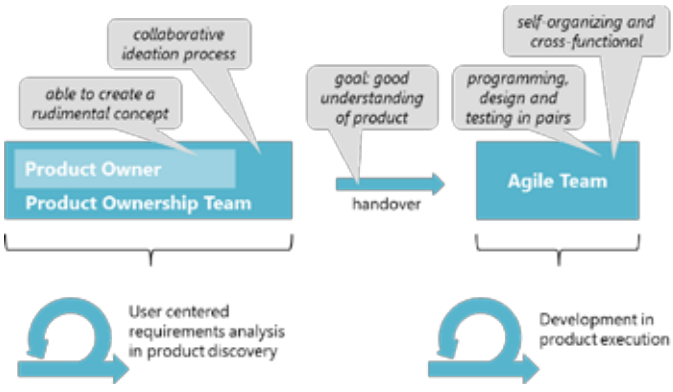

Figure 6: Implications for an Agile Product Development Process

The method pair programming shows that best practices of Agile Product Development promote cooperation in the agile team. The results of the survey show that the concept of pair programming is also seen on the creation of a design concept and the implementation of

quality assurance measures as appropriate (see Item 4, Item 5). Thus, the advantages of the method can be used across domains. Furthermore, cross-functional teams have the advantage that the team members learn more from each other than in purely functional teams (see Figure 6).

V. Conclusion

In this article, the current operation has been studied in agile product development processes. For this purpose, an empirical study was conducted. By means of the analysis of collaboration in the agile team of the understanding of roles and responsibilities has occurred. With the results, existing best practices of agile product development could be confirmed. In addition, qualitative optimization for agile product development processes could be derived. The optimization applies in particular for middle-sized projects, where the user interface plays an important role. Apart from that, the size of the company is irrelevant. Another significant point is that scaling agile is not considered in the aim of this study. The aim of this study was to analyze the collaborative work on team level.

The use of process models and methods should be evaluated with focus on the people affected. Compared to traditional approaches, agile approaches base the values and principles of the Agile Manifesto. If the people concerned do not practice these, the success in the implementation of these approaches fail.

The relationship between agile values with regard to the fulfillment of psychological needs can be further investigated in future studies. For this purpose, best practices such as pair programming can be used. In addition, the study has been carried out in the German-speaking area. It is also possible to conduct an international study, because of the wide spreaded use of agile approaches.

Appendix A

In the following the original German questions are listed:

(1) Die gemeinsame Entwicklung von produktbezogenen Ideen hat den Vorteil, dass das Team ein besseres Verständnis vom Produkt entwickelt.

(2) Ein gutes Verständnis vom Produkt hilft den Entwicklern dabei, bessere Entscheidungen während der Implementierung zu treffen.

(3) Der Produktverantwortliche sollte die Fähigkeit besitzen ein rudimentäres Konzept vom Produkt zu erstellen, welches anschließend detaillierter ausgearbeitet wird.

(4) Das Konzept vom Pair Programming lässt sich ebenfalls auf das Erstellen eines Design-Konzeptes übertragen.

(5) Das Konzept vom Pair Programming lässt sich ebenfalls auf die Durchführung von qualitätssichernden Maßnahmen übertragen.

(6) In Projektteams, die sich aus Mitgliedern mit unterschiedlichem fachlichem Hintergrund zusammensetzen, lernen die Teammitglieder mehr voneinander als in Teams, die aus Mitgliedern derselben Fachrichtung bestehen.

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